



Minto Mine

Water Licence QZ14-031

Quartz Mining Licence QML-0001

2018 Annual Report

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Minto Mine

March 2019

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Appendix D – Seepage Monitoring Program Laboratory Results

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Appendix I – 2018 AMP Groundwater SRK Memo

Appendix J – MDMER Effluent Monitoring and Environmental Effects Monitoring Water Quality 2018 Submissions

Appendix K – Minto Creek Sediment, Periphyton and Benthic Invertebrate Community Assessment 2018 Update

Appendix L – Minto Creek Fish Monitoring Program Review and Recommendations

Appendix M – Waste Rock Verification Program Results

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Appendix O – Wildlife and Hazing Tracking Report

Appendix P – 2018 Update Minto Mine Constructed Wetland Treatment Research Program

Appendix Q - 2018 Annual Socio-Economic Monitoring Report

List of Acronyms

Acronym	Definition
ABA	Acid-Base Accounting
AMP	Adaptive Management Plan
AP	Acid Potential
CWTS	Constructed Wetland Treatment System
DSTSF	Dry Stack Tailings Storage Facility
EEM	Environmental Effects Monitoring
EMSRP	Environmental Monitoring, Surveillance and Reporting Plan
GCL	Geosynthetic Clay Liner
GPS	Global Positioning System
HDPE	High Density Polyethylene
LTF	Land Treatment Facility
MCDS	Minto Creek Detention Structure
Minto	Minto Explorations Ltd.
MDMER	Metal Mining Effluent Regulations
MPTMF	Main Pit Tailings Management Facility
MVF	Mill Valley Fill
MVFE	Mill Valley Fill Extension
MWD	Main Waste Dump
NP	Neutralizing Potential
NPR	Neutralizing Potential Ratio
QA/QC	Quality Assurance and Quality Control

QML	Quartz Mining Licence QZ-0001
ROD	Reclamation Overburden Dump
SAT	Waste material destined for subaqueous long term storage
SECP	Sediment and Erosion Control Plan
SDD	South Diversion Ditch
SMP	Seepage Monitoring Plan
SOP	Standard Operating Procedure
SWD	Southwest Dump
TDD	Tailings Diversion Ditch
TDS	Total dissolved solids
TSS	Total suspended solids
UG	Underground
UTM	Universal Transverse Mercator
WGS 84	World Geodetic System 1984
WSP	Water Storage Pond
WUL	Water Use Licence QZ14-031
YWB	Yukon Water Board

List of Units

Unit	Definition
BCM	Bank cubic meter
BTU	British Thermal Unit
dmt	Dry metric tonnes
g/t	Gram per tonne
kg	kilogram
L	Litre
m	meter
m ²	Square meter
m ³	Cubic meter
mg/m ²	Milligrams per square meter
Mlb	Million pounds
Mt	Million tonnes
oz	ounce
V	Volt

1 Introduction

This Annual Report has been prepared by Minto Explorations Ltd. (Minto) for the 2018 calendar year, as required by Type A Water Use Licence (WUL) QZ14-031-01 and Quartz Mining Licence (QML) QML-0001. Specific requirements for the Annual Report, as outlined in the respective licences, are summarized in Table 1-1.

This report provides a summary of activities at Minto Mine for the reporting year, including production summaries, construction activities, environmental monitoring studies, physical stability monitoring, water management, and progressive reclamation.

An aerial photo taken in August 2017, with updated site infrastructure labeled, is presented in Figure 1-1.

Table 1-1: Reporting Requirements as per WUL and QML (2018)

Licence	Section	Clause	Requirement	Annual Report Section
WUL QZ14-031				
WUL QZ14-031	16		Summary of the review of the <i>Spill Contingency Plan</i> including any changes needed.	2.5.4 App. B
WUL QZ14-031	18		Summary list of all spills for 2018.	2.5.3
WUL QZ14-031	25		The Licensee shall submit Annual Reports to the Board no later than March 31 of the year following the reporting period. The reporting period is January 1 to December 31 of each year.	All
WUL QZ14-031	26	a	Summary of all data collected as per the EMSRP, including analysis and interpretation by a qualified party and a discussion of any variances from baseline conditions, from previous years' data, and from expected performance.	5-8, 11-14
		b	Summary of actions as per the Operations Adaptive Management Plan, including analysis and interpretation by a qualified party and a discussion of any variances from baseline conditions, from previous years' data, and from expected performance.	10 App I
		c	A record of any major maintenance carried out on any physical works.	2.2
		d	Detailed data on the volume of water used during the year including water withdrawal from each water source, water routed around and through the site as part of the water conveyance system, water diverted around the site, water routed for storage in the pits, water deposited with mine wastes in waste storage facilities, water routed to the Water Storage Pond, water routed to the treatment plant and water discharged to Minto Creek.	8

Licence	Section	Clause	Requirement	Annual Report Section
WUL QZ14-031		e	Detailed data on tailings deposition in each of the tailings management facilities, including volume and tonnage of tailings slurry deposited, cumulative volume of tailings solids stored in the pits, tailings solids surface elevation and pit water elevation.	2.3.4
		f	Details of updates to the Water Balance and Water Quality Model.	8.2.4 App. E
		g	Results and interpretations of the QA/QC Program.	5.1.2
		h	Any other reports that are required to be submitted as part of the Annual Report by this Licence.	See Below
WUL QZ14-031	70		The Licensee shall monitor, sample, and report on the maintenance and performance of the Mill Water Pond, in accordance with the procedures that are detailed in the Physical Monitoring Program, and include in the Annual Report	9
WUL QZ14-031	86		The Licensee shall include data relating to the Surface Water Surveillance Program in the Monthly and Annual Reports.	5.3
WUL QZ14-031	89		The results of these studies and programs in clauses 87 and 88 shall be submitted to the Board as part of the Annual Report along with and any additional studies or revisions to studies required under the MDMER.	11
WUL QZ14-031	93		The results of the seepage program shall be compared to the source terms used in the Water Balance and Water Quality Model Report and summarized in the Annual Report.	7 App. E
WUL QZ14-031	95		The Licensee shall implement the updated Geochemical Monitoring Program, including the Waste Rock Verification Program, and the results from this program are to be included in the Annual Report.	13 App. M, App. N
WUL QZ14-031	97	h	Reporting of all data obtained using physical monitoring instrumentation as a part of the Physical Monitoring Program in Monthly and Annual Reports.	9
WUL QZ14-031	98		The Physical Monitoring Program shall be updated annually to reflect the installation of new instrumentation, replacement of damaged instrumentation, and changes in monitoring methods and procedures. The updated Physical Monitoring Program shall be provided as part of the Annual Report, along with a summary table outlining revisions to the plan from previous versions.	App. G
WUL QZ14-031	99	b	The Licensee shall submit these Geotechnical Engineer's Inspection and Data Reviews as part of the Annual Report.	9

Licence	Section	Clause	Requirement	Annual Report Section
WUL QZ14-031	100	f	For each operating year, the following information shall be provided as part of the Annual Report for the Physical Monitoring Program: i. interpretation of physical monitoring data, and summary of the stability, integrity and status of all the inspected structures, works, and installations inspected by the Professional Engineer; ii. a list of each of the Professional Engineer's recommendations for remedial action; iii. an explanation of how and when each recommendation was addressed, including supporting documentation, and iv. a list of outstanding recommendations (including previous inspection reports) and associated approach and timelines to address them.	9.2 9.2 Table 9-2 Table 9-2
WUL QZ14-031	102		The Licensee shall review and evaluate the Aquatic Environmental Monitoring Program design every three (3) years and submit the findings to the Board, along with any recommendations for further refinements, as part of the Annual Report, starting in 2016.	11.4
WUL QZ14-031	104		Results and interpretations of the QA/QC program shall be provided in the Annual Report.	5.1.2
WUL QZ14-031	108	a	The Licensee shall submit an updated Water Balance and Water Quality Model as part of the Annual Report. The updated models shall include without limitation all model assumptions.	App. E
		b	Updated site data collected as per the EMSRP including: i. water quality results and water levels from all groundwater monitoring wells; ii. the most current climatic, environmental and operational conditions and data; iii. surface water quality and quantity data; iv. seepage monitoring quality and quantity data, and v. geochemical source terms from tailings and waste rock.	6 12 5.3 7 App. E
		c	A comparison of the updated geochemistry for Phase V/VI tailings and waste rock with that of previously-produced tailings and waste rock, and a comparison of model source term chemistry with equivalent operation monitoring results.	13 App. M App. E
		d	Updated predictions for operations and Permanent Closure water quality, including discussion of any variances identified and associated implications on site water management.	App. E
WUL QZ14-031	109		Specifications for the Annual Report to include but not be limited to: i. activities undertaken in relation to the Adaptive Management Plan; ii. trend analysis and water levels in Minto and McGinty creeks; iii. proposed updates and revisions to the Adaptive Management Plan, and iv. any other revisions necessary to comply with the conditions of this Licence.	10 8.5 App. I Through out
WUL QZ14-031	114	a	Annual reporting on reclamation research activities.	16.3

Licence	Section	Clause	Requirement	Annual Report Section
QML-0001				
QML-0001	13.5		On or before March 31 of each year of the term of this License, the Licensee must submit an annual report, in writing, containing the information set out in Schedule D, covering the period of January 1 to December 31 of the prior year	This Report
QML-0001	D (Site Activities)	a	Summary of construction activities associated with the Undertaking	2.2
		b	Summary of mining activities	2.3
		c	Map showing the status of all structures, works, and installations associated with the Undertaking	Fig 1-1
		d	total amount of ore and waste removed from the underground workings and open pits for the year and for the life of the Undertaking	2.3
		e	Total amount and the average head grade of ore milled	2.3.6
		f	Total amount of concentrate produced and removed from the Undertaking	2.3.6
		g	Total amount of tailings deposited in each of the tailings facilities	2.3.4
		h	Total amount of waste rock removed from the mine and the amount deposited into each deposit location	2.3.3
		i	Total amount of waste rock stored in each waste rock storage facility;	2.3.3
		j	Details respecting any action taken as a result of the recommendations made by the engineer in relation to the inspection referred to in 13.2 of QML -0001	9.2
		k	Summary of any updates to estimates of ore reserves and the life of the mine, including reserve category, tonnage and grade	4
		l	Total amount and the average grade of each ore stockpiled	2.3.5
		m	remaining reserve life of the mine	4
QML-0001	D (As-built Drawings)	a	as-built drawings of the open pit and underground mines and of all engineered structures, works, and installations constructed or altered at the Undertaking during the year	2.2 App. A
		b	as-built drawing report of the 220 kW vertical stirred mill rougher/scavenger concentrate regrinding system the year following the installation	N/A
QML-0001	D (Environmental Monitoring)	a	Summary of the programs undertaken for environmental monitoring and surveillance as outlined in the <i>Environmental Monitoring, Surveillance and Reporting Plan</i> and the 2014 Wildlife Protection Plan, including an analysis of these data and any action taken or adaptive management strategies implemented to monitor or address any changes in environmental performance	5-9 11-14 10
		b	any update to the <i>Site Characterization Report</i> referred to in 13.1 of QML-0001	15
		c	summary of invasive plants that have been identified on site and measures taken to control or remove invasive plants	14.3

Licence	Section	Clause	Requirement	Annual Report Section
		d	summary of spills and accidents that occurred at the site and measures taken respond to any spills or accidents	2.5
		e	summary of the level of traffic, access control issues, wildlife incidents and other accidents, and any upgrade or maintenance work planned for the upcoming year	2.4
QML-0001		f	summary of any site improvements undertaken to address sediment and erosion control	14.2
QML-0001	D	a	summary of any underground stability incidents	2.3.2
	(Physical Monitoring)	b	summary of data collected to date as part of the Physical Monitoring Program	9
		c	details of results, including data collected, for the physical monitoring program	9
QML-0001	D (Reclamation and Closure)	a	any temporary closure or permanent closure that has occurred during the year	16
		b	summary of activities related to care and maintenance of the Undertaking, including any temporary closure activities if applicable	16
		c	summary of progressive and ongoing reclamation activities	16
		d	summary of proposed development and production and reclamation activities for the coming year	3 16.2
		e	summary of reclamation research and results	16.1
QML-0001	D (Socio-Economic Monitoring)	a	summary of action taken by the Licensee with respect to implementation of "Minto Socio-Economic Monitoring Program Framework" (the "Framework")	17 App. Q
		b	a copy of the annual report prepared by Minto Explorations Ltd., identified in paragraph 6.1 of the Framework	App. Q
		c	a summary of action taken by the Licensee with respect to implementing an approved socio-economic adjustment measures plan, as identified in the Framework	App. Q



2 Site Activities

Operation of the Minto Mine continued until October 2018, with the production of 23.0 million pounds (Mlb) of copper from the milling of 0.91 million tonnes (Mt) of ore.

Surface mining for the year totaled 0.71 million bank cubic meters (BCM). Surface mining took place in the Area 2 Stage 3 pit, completed in April 2018.

Underground mining took place in the Area 2 and Minto East zones during 2018. Both zones are accessed from the Minto South portal.

Waste rock produced from mining activities was hauled to the Main Pit Dump or Area 2 Tailings Management Facility as per the Waste Rock and Overburden Management Plan. No overburden was produced from mining in 2018. Milling was a combination of run-of-mine ore from both surface and underground operations, as well as ore stockpiled from previous mining.

Tailings produced from the milling process were deposited into the Area 2 Pit Tailings Management Facility as per the licensed Tailings Management Plan.

2.1 Exploration

Although no exploration drilling occurred at Minto in 2018, a total of 2,642 meters were drilled in 13 holes targeting various ore lenses with the intent of upgrading resources to probable reserves and to provide geological confidence for the optimization of the mine design. Drilling was conducted from April until June of 2018.

These totals include 289 meters of drilling in 4 underground holes targeting gaps in coverage on the fringe of the Copper Keel West ore lens. In addition, six surface holes, totaling 1,436m, were drilled from the bottom and along the crest of the Area 2 Stage 3 pit, also designed to fill in gaps in coverage for the aforementioned Copper Keel West ore lens.

Three holes, totaling 917m, targeted the Copper Keel Main ore lens. All three holes were designed to obtain geo-mechanical information for use in mine design.

2.2 Maintenance, Infrastructure and Construction Projects

There were no major maintenance activities conducted in 2018 on the physical works. One construction project was on-going in 2018, the Tailings Diversion Ditch (TDD) portal road re-alignment. The following is a summary of the project.

2.2.1 Tailings Diversion Ditch Portal Road Re-Alignment

As part of Phase V/VI development of the Area 2 Stage 3 Pit, a portion of the South Diversion Ditch was mined out. The water conveyance infrastructure was replaced by diverting routine flows to the Tailings Diversion Ditch (TDD) via an intake structure and pipeline. An overflow spillway into the Area 2 Stage 3 Pit would also be required to divert event flows that exceed the pipeline capacity. The design details are discussed in a report prepared by SRK Consulting (SRK, 2017)

Construction of the Tailings Diversion Ditch Portal Road Re-Alignment began in 2017 and continued in 2018. The 4k electrical cable and propane line were protected and buried. The area was grubbed of organic materials and construction grade waste material was utilized to establish the new portal haul road and airport access road. The water conveyance system was placed and covered. The intake channel was excavated, a geosynthetic clay liner was installed to limit seepage, with a non-woven geotextile placed overtop to provide a layer of protection. A layer of residuum provided an additional layer of protection and riprap was placed to provide protection against erosion. Water has been conveyed to the Tailings Diversion Ditch via the intake structure and pipeline, however some additional liner and riprap work is required in 2019 before the project is considered complete.

2.3 Mining Activities

Section 2.3 discusses the mining activities for 2018 including open pit and underground mining, waste rock and tailings management, ore stockpiles, operating results, and concentrate shipments.

2.3.1 Open Pit Mining

Mining of the Area 2 Stage 3 pit continued in 2018 with the Area 2 Stage 3 Expansion design. The pit was completed on April 16th, 2018 after which no further open pit mining was carried out.

2018 total mined waste and ore quantities are summarized in Table 2-1, below.

Table 2-1: Open Pit Mined Quantities: Mining Waste Volume and Ore Volume (2018)

Open Pit	Waste / Overburden (BCM)	Ore (BCM)	Ore (t)
Area 2 Stage 3 Expansion	503,834	204,721	536,654
Total	503,834	204,731	536,654

2.3.2 Underground Mining

Mining activities in the Area 2 and Minto East zones continued in 2018. Area 2 mining was completed on May 4th, after which all production came from Minto East until closure of the mine in October 2018. Total ore release from the two zones was 283,746 tonnes in 2018.

A ramp was started to the Copper Keel zone, another zone in the Minto South Underground. Approximately 300m of development was completed but the ramp did not reach the ore body prior to closure.

93,635 tonnes of waste rock were hauled to surface in 2018. See Appendix A for the underground development map.

2.3.3 Waste Rock Management

Waste rock dump development continued in 2018, as per the *Minto Mine Waste Rock and Overburden Management Plan*. Table 2-2 summarizes the waste materials and ultimate destinations, and the volumes deposited. Current waste rock inventory in the various waste rock and overburden dumps at the Minto Mine site are summarized in Table 2-3.

Table 2-2: Waste Rock Destination and Volumes – Unreconciled truck counts (2018)

Material Type	Destination	Volume (BCM)
Waste - Construction Grade	Roads/Ramps	9,900
Waste - Construction Grade	Tailings Diversion Ditch	300
Waste	Main Pit Dump	248,900
Waste	Main Waste Dump	207,900
Waste Rock - SAT	Main Pit Buttress	0
Waste Rock - SAT	A2S2 In-Pit	72,600
Total		539,600

Table 2-3: Waste Dump Location and Storage Volumes (2018)

Dump Location	Quantity Stored as of December 31, 2018 (m³)
Main Pit Buttress	4,230,000
A2S2 In-Pit	70,000
Main Pit Dump	1,480,000
Southwest Dump	12,120,000
Mill Valley Fill Extension	1,440,000
Reclamation Overburden Dump	4,300,000
Main Waste Dump	8,360,000
Main Waste Dump Expansion	3,810,000
Mill Valley Fill Extension 2	1,360,000
Total Waste Dumped	37,170,000

2.3.4 Tailings Management

All tailings produced in 2018 were deposited in the Area 2 Pit Tailings Management Facility (A2PTMF). Table 2-4 lists the deposition schedule.

Table 2-4: Tailings Deposition Schedule in 2018

Tailings Management Facility	Date Range	Quantity Deposited (dry metric tonnes)
A2PTMF	January – October	879,417
Total 2018 Tailings		879,417

A total of 879,417 dry metric tonnes (dmt) of tailings were discharged to the A2PTMF in 2018. Since November 2012, the Main Pit Tailings Management Facility (MPTMF) has received 3,346,606 tonnes of tailings. Since March 2015, the Area 2 Pit has received 4,635,595 tonnes of tailings.

Deposition to the A2PTMF is from a point at the northeast corner of the pit. A discharge line runs from the pit crest at the 806m elevation to a point on the highwall passed the overburden contact, at 787m: this ensures that the tailings stream runs down solid rock and does not cause erosion. As of year-end, the highest point of the tailings beach is at the 774.0m elevation and the water level in A2PTMF was 771.1m.

Deposition in the MPTMF is possible from two locations, near the middle of the pit via a floating tailings line and near the north wall of the pit. The highest point of the tailings beach is at 787.5m elevation. At year-end, the water level was measured at 784.5m.

The pipeline and pump which transfers supernatant water from A2PTMF to MPTMF, where the mill's process water intake is located, was repositioned in 2018 due to Area 2 Stage 3 Expansion pit mining activities.

As in previous years, tailings were not observed to remain ponded on the ice surface of either tailings management facility during the winter months. The relatively high tailings temperature, combined with the erosive effect of the tailings stream, melts through the ice at the discharge point.

Minto's filter press plant, previously used to prepare tailings for deposition to the Dry Stack Tailings Storage Facility (DSTSF), has been deactivated and did not operate in 2018. While the filtration equipment is still in place, a substantial portion of the building's electrical supply has been re-routed to the Minto South Portal.

2.3.5 Ore Stockpiles

Several ore stockpiles exist on the property. Southeast of the mill complex, three adjacent stockpile pads exist:

1. Mill Pond Pad – Blended and crushed mill feed (depleted)
2. East Stockpile –Sulphide and partially oxidized run-of-mine (ROM) ore stockpiles
3. South Stockpile –Partially oxidized run-of-mine (ROM) ore stockpiles

West of the Main Pit, adjacent to the Main Waste Dump, the Top of the World stockpile consisting of partially oxidized run-of-mine (ROM) ore still contains some material.

The stockpile areas are displayed in Figure 2-1. Ore is segregated by copper grade and percentage of acid-soluble copper as shown in Table 2-5.

Table 2-5: Ore Stockpiles

Material Type	Copper Grade Range	Soluble Copper
Blue Sulfide Ore	0.50 – 1.00% Cu	<15.0%
Green Sulfide Ore	1.00 – 2.00% Cu	<15.0%
Yellow Sulfide Ore	>2.00% Cu	<15.0%
Partially Oxidized Ore (POX)	>1.50% Cu	>15.0%
Low-Grade Partially Oxidized Ore (LG POX)	0.80 – 1.50% Cu	>15.0%

The higher-grade ores are fed to the mill as they are mined to maintain the highest possible head grade while mining ore. The lower-grade and partially oxidized stockpiles are depleted gradually and are used to supplement mill feed during periods of waste stripping.

Table 2-6: Stockpile Inventory

	December 31, 2017			December 31, 2018		
	Mass (tonnes)	Cu (%)	Ag (g/t)	Mass (tonnes)	Cu (%)	Ag (g/t)
Red	-	-	-	-	-	-
Yellow	-	-	-	-	-	-
Green	-	-	-	14,173	1.38	4.70
Blue	1,707	0.78	3.93	28,556	0.61	1.90
POX	235,296	1.21	3.50	217,792	1.57	4.38
LG POX	199,582	0.66	1.74	140,021	0.66	1.75
Portal Ore Pad	9,434	2.36	12.78	4,430	2.84	8.32
Live Pile	21,583	1.71	6.09	6,665	1.68	4.92
Total Ore	467,601	1.02	3.06	411,637	1.20	3.38

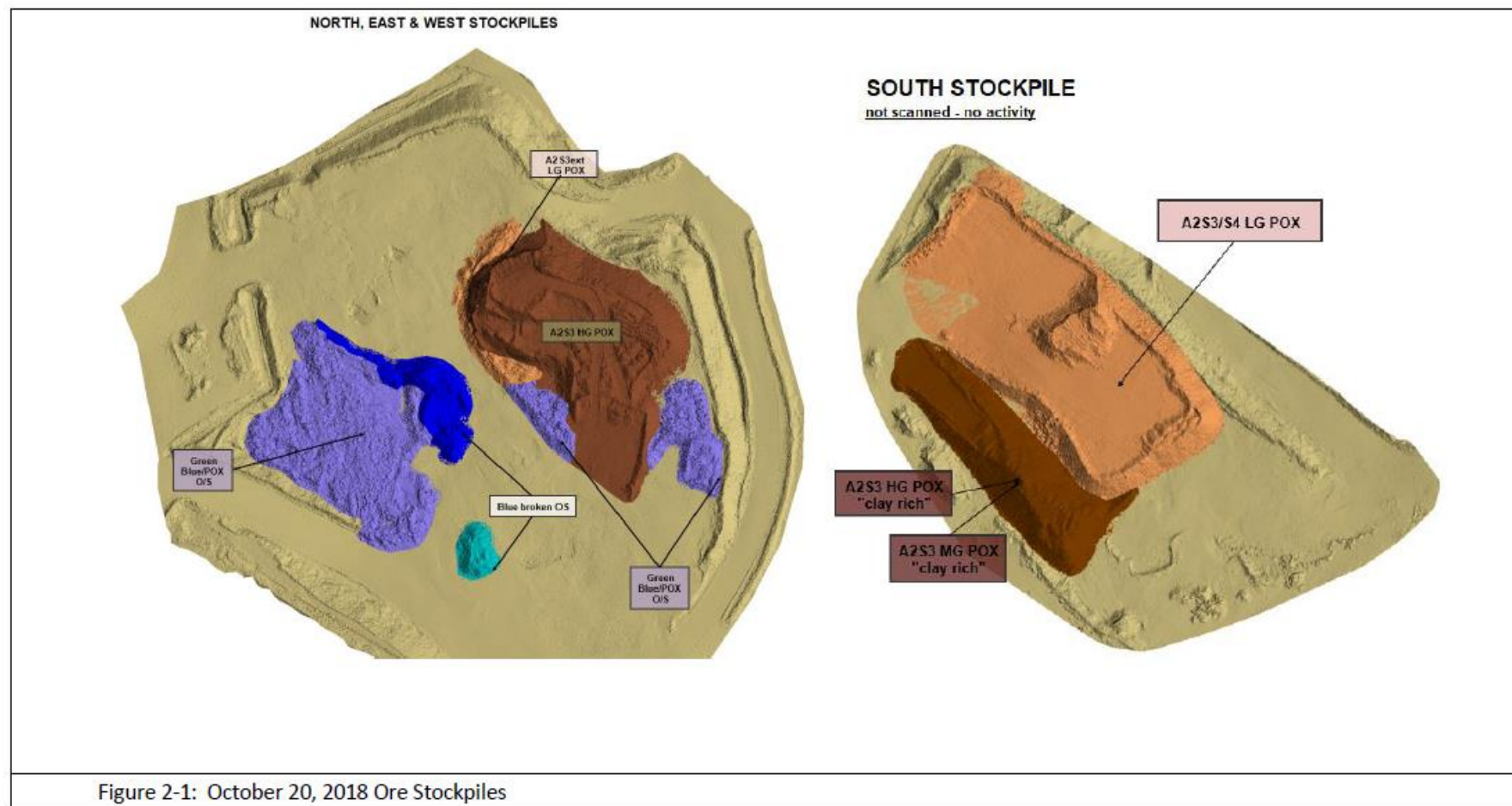


Figure 2-1: Ore Stockpiles - 2018

2.3.6 Operating Results

Ore processing and metal production results for the 2018 calendar year are summarized in Table 2-7, below.

Table 2-7: Operating Results (2018)

Metal Production	Quantity
Copper (t)	10,420.8
Gold (kg)	241.35
Silver (kg)	3,044.14
Ore Milled	
Ore processed (t)	906,790
Copper grade (%)	1.31
Gold grade (g/t)	0.44
Silver grade (g/t)	4.34
Recoveries	
Copper (%)	87.5
Gold (%)	61.1
Silver (%)	77.3
Concentrates Produced	
Copper concentrate (dmt)	27,370.7
Copper (%)	38.1
Gold (g/t)	8.82
Silver (g/t)	111.22

2.3.7 Concentrate Shipments

Minto produced 30,135 wet metric tonnes of concentrate at 9.17% moisture content, which corresponds to 27,371 dmt. The average concentrate grades are listed in Table 2-6, above. 683 truckloads of concentrate were shipped from Minto in 2018: 348 via the winter ice bridge and 335 during the summer barge season.

2.4 Mine Access Road

2.4.1 Traffic

From December 22nd, 2017 to April 23rd, 2018, access across the Yukon River was over an ice bridge during which time, heavy trucks made 544 round trips, medium trucks made 194 round trips, and light vehicles made 397 round trips across the ice bridge. Between April 24th and June 16th, 2018 there was no land access to the mine site. On June 17th, 2018, the summer tug and barge operation started for the season. During the barge operating season, heavy trucks made 406 round trips, medium trucks made 288 round trips, and light vehicles made 470 round trips to the Minto Mine via the mine access road. The barge operating season ended October 21st, 2018.

2.4.2 Access Control Issues

No access control issues were experienced in 2018.

2.4.3 Planned Access Road Maintenance for 2019

Beyond routine maintenance work, no major projects or upgrades are planned for 2019 regarding the access road. A gate maybe installed for the temporary closure period at 3km following the demobilization activities.

2.5 Accidents and Incidents

2.5.1 Incidents

For the calendar year of 2018, the Minto Mine site experienced 41 incidents that required follow up investigation. Five of these incidents were considered serious and were reported to Yukon Workers Compensation Health and Safety Board as required. A full breakdown of the types of incidents is as follows:

- 1 Lost Time Accident (LTA)
- 8 Medical aids (MA)
- 8 First Aids (FA)
- 16 Property Damage (PD)
- 8 Near Misses (NM)

Minto maintains a Mine Emergency Response Plan supported by a complement of emergency response personnel trained and certified in advanced first aid, firefighting and mine rescue along with equipment required for all response types. In addition, reporting and investigation of incidents is standard practice at the site.

2.5.2 Wildlife Incidents

Three separate reportable wildlife incidents took place on site in 2018. All incidents were discussed with the Conservation Officer during the events.

The first incident dealt with a hawk, which entered the warehouse through an open bay door on June 4th, 2018. It would later be reported to have left the building on June 6th. On June 11th, what is believed to be the same bird was found deceased inside the wash-bay facility, having appeared to have clipped something while flying through the rafters.

The second event pertained to a light-brown coloured black bear which managed to enter several buildings on site over a span of two days in July. The bear was hazed with bear bangers, vehicle honking, and shouting by both Environment and Safety staff. A directive was sent out to site staff to ensure all windows and doors (including bay-doors) were kept closed and reminded all workers to remove any food waste from buildings and vehicles on site. After the initial hazing, the bear was observed feeding on natural food sources away from camp infrastructure and no further actions were required throughout the year.

Lastly on September 26th, a deceased Lynx was found on the access road, it appeared to have been struck by an unknown vehicle. Following discussions and approval from the Conservation Officer, the carcass was offered to the Selkirk First Nation member, who operates an active trap line where the animal was found. The animal carcass was declined and the animal was incinerated to prevent further wildlife issues.

2.5.3 Reportable Spills

There was one reportable spill that occurred at Minto Mine during 2018. The volume and causes of the spill are summarized below in Table 2-8.

Table 2-8: Reportable Spills (2018)

Date	Amount	Substance	Cause
30-Dec-18	20 Litres	Hydraulic Fluid (ATF)	Cobalt Construction's Snow Cat was working to develop Minto's ice bridge crossing in preparation for flooding when at 4:15 pm, a hydraulic connection failed releasing approximately 20 litres of ATF hydraulic fluid to the river's ice surface.

The spill in Table 2-8 was reported as per the *Spills Regulations* of the Yukon Environment Act. The follow up spill report was submitted within 10-days of the occurrence. The spill was cleaned up by removing all contaminated ice from the river surface and transporting it to the mine's Land Treatment Facility (LTF). Additionally, non-reportable spills were tracked internally as per the WUL. Spills on site were cleaned up

with a variety of methods including, but not limited to, absorbent spills pads, soil excavation, soil treatment in the LTF and disposal in the Main Pit dump.

2.5.4 Spill Contingency Plan Review

An update to the Minto Mine Spill Contingency Plan is required annually as part of the Annual Report and the updated 2019 Minto Mine Spill Contingency Plan is provided in Appendix B.

3 Proposed Mining for 2019

No mining is planned for 2019. The mine is currently on care and maintenance and the underground is accessed for maintaining pumps and dewatering infrastructure only.

4 Mineral Resources and Reserves

Minto Mine's updated mineral resources and reserves are provided in Tables 4-1 and 4-2 respectively, below. The most recent update is from December 31, 2017. There were no updates in 2018.

Table 4-1: Updated Mineral Resources for Minto Mine (most recent Dec. 31, 2017)

Classification	Tonnes (kt)	Copper (%)	Silver (g/t)	Gold (g/t)	Contained Copper (kt)	Contained Silver (koz)	Contained Gold (koz)
Minto South Deposit (MSD) (Open Pit and Underground)							
Measured	1,685	1.48	5	0.56	25	250	30.3
Indicated	5,185	1.64	5	0.61	85	878	101.9
Total Measured + Indicated	6,870	1.60	5	0.60	110	1,128	132.2
Inferred	2,370	1.53	6	0.56	36	461	42.9
Ridgetop (Open Pit)							
Measured	1,531	0.98	2	0.25	15	105	12.3
Indicated	3,534	0.87	3	0.30	31	326	34.1
Total Measured + Indicated	5,065	0.9	3	0.28	46	431	46.4
Inferred	318	0.75	2	0.13	2	16	1.3
Minto North (Underground)							
Measured	221	0.94	3	0.21	2	20	1.5
Indicated	257	1.00	6	0.61	3	46	5.0
Total Measured + Indicated	477	0.97	4	0.42	5	67	6.5
Inferred	28	0.7	3	0.32	0	3	0.3
Minto East (Underground)							
Measured	-	-	-	-	-	-	-
Indicated	890	2.40	7	1.03	21	201	29.6
Total Measured + Indicated	890	2.40	7	1.03	21	201	29.6
Inferred	124	1.48	5	0.63	2	20	2.5
Minto East 2 (Underground)							
Measured	-	-	-	-	-	-	-
Indicated	2,778	1.72	7	0.80	48	629	71.8
Total Measured + Indicated	2,778	1.72	7	0.80	48	629	71.8
Inferred	1,889	1.38	4	0.50	26	247	30.1
Minto North 2 (formerly Inferno North)							
Measured	-	-	-	-	-	-	-
Indicated	-	-	-	-	-	-	-

Classification	Tonnes (kt)	Copper (%)	Silver (g/t)	Gold (g/t)	Contained Copper (kt)	Contained Silver (koz)	Contained Gold (koz)
Total Measured + Indicated	-	-	-	-	-	-	-
Inferred	1,419	1.42	5	0.51	20	214	23.3
Stockpiles							
Measured	468	1.02	3	0.25	5	46	3.8
Total Mineral Resources							
Total Measured	3,904	1.20	3	0.38	47	422	47.9
Total Indicated	12,644	1.48	5	0.60	188	2,080	242.4
Total Measured + Indicated Resources	16,548	1.42	5	0.55	234	2,502	290.3
Total Inferred Resources	6,147	1.42	5	0.51	87	962	100.4

Table 4-2: Updated Mineral Reserves for Minto Mine (most recent Dec. 31, 2017)

Classification	Tonnes (kt)	Copper (%)	Silver (g/t)	Gold (g/t)	Contained Copper (kt)	Contained Silver (koz)	Contained Gold (koz)
Minto North Open Pit							
Proven	-	-	-	-	-	-	-
Probable	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	-
MSD - Area 2 Open Pit							
Proven	1	0.76	3	0.18	0	0	0.0
Probable	622	1.05	1	0.27	7	17	5.4
Total	623	1.05	1	0.27	7	17	5.4
Minto East Underground							
Proven	-	-	-	-	-	-	-
Probable	617	2.09	6	0.90	13	119	17.8
Total	617	2.09	6	0.90	13	119	17.8
MSD - Area 2/118 Underground							
Proven	-	-	-	-	-	-	-
Probable	120	2.47	15	1.30	3	56	5.0
Total	120	2.47	15	1.30	3	56	5.0
MSD - Copper Keel Underground							
Proven	-	-	-	-	-	-	-

Classification	Tonnes (kt)	Copper (%)	Silver (g/t)	Gold (g/t)	Contained Copper (kt)	Contained Silver (koz)	Contained Gold (koz)
Probable	1,616	1.73	6	0.63	28	315	32.5
Total	1,616	1.73	6	0.63	28	315	32.5
MSD -Wildfire Underground							
Proven	-	-	-	-	-	-	-
Probable	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	-
Stockpiles							
Proven	468	1.02	3	0.25	5	46	4
Total	468	1.02	3	0.25	5	46	4
Total Mineral Reserves							
Proven	469	1.02	3	0.25	5	46	3.8
Probable	2,975	1.69	5	0.63	50	507	60.7
Total Mineral Reserves	3,444	1.60	5	0.58	55	553	64.4

5 Surface Water Quality Monitoring

Environmental monitoring programs are outlined in the *Environmental Monitoring, Surveillance and Reporting Plan* (EMSRP2016-02) and the results for the surface water quality monitoring conducted in 2018 are provided in this section. Where possible, the 2018 results have been compared to historical results to identify trends and compare 2018 values with previous values.

5.1 Surface Water Quality Program

Details of the Surface Water Surveillance Program, including sampling station locations and monitoring frequency, are outlined in the EMSRP2016-02 and the results are presented in this section for water quality stations outlined in the WUL. Water quality result statistics including the mean, minimum and maximum are presented in summary tables. For the purposes of calculating the mean, minimum and maximum concentrations, values less than the detection limit were taken to be half of the detection limit.

The WUL effluent quality standards were compared to the water quality result statistic summaries at stations W16, W16A, W17, W50 and WTP/RO. The WUL water quality objectives were compared to the water quality result statistic summary at station W2, and at W50 when W35 and W15 are frozen.

As water quality stations, may be adjusted from year-to-year because of environmental changes or modifications to infrastructure, an update to the water quality station locations listed in the WUL is provided in Table 5-1 below. All surveillance monitoring sites in use in 2018 are confirmed with a Global Positioning System (GPS) unit to determine current UTM coordinates. Coordinates presented in Table 5-1 are associated with the World Geodetic System 1984 (WGS 84) coordinate system. All water quality results collected under this program are provided in the monthly reports.

Table 5-1: Water Quality Site Descriptions and UTM Coordinates

Station	Description	UTM Coordinates – Zone 8	
		Easting	Northing
W1	Lower Reach of Minto Creek	392445	6948251
W2	Minto Creek, upstream of the Minto Creek/Yukon River confluence where the access road crosses Minto Creek	392584	6948402
W3	Minto Creek, at the federal MDMER compliance point	387000	6945778
W4	Yukon River, upstream of the confluence with Minto Creek	394070	6948203
W5	Yukon River, downstream of the confluence with Minto Creek	392583	6949119
W6	Tributary on the North side of Minto Creek	387583	6946392
W7	Mouth of the tributary on the south side of Minto Creek, approximately 0.8 km downstream of W3	387546	6946034
W8	Western collection sump from the DSTSF	385629	6945076
W8A	Eastern collection sump from the DSTSF	385716	6945012
W10	Headwaters of Minto Creek (south-west fork at headwaters)	383855	6943364
W12	Main Pit and Main Pit Tailings Management Facility	384544	6945137
W12A	Discharge from Main pit	*	*
W14	Tailings thickener overflow	385223	6945089
W15	Upper Minto Creek storm water collection sump, downstream of the overburden dump, just upstream of Main Pit	384181	6944708
W16	Water Storage Pond	386402	6945559
W16A	Discharge from the Water Storage Pond	386679	6945664
W17	Water Storage Pond dam seepage	386679	6945664
W30	Headwaters Minto Creek (north-west fork)	383693	6945026
W33	Up-gradient of South Diversion Ditch	385351	6944072
W35	South Diversion Ditch	385223	6944427
W36	Minto Creek detention structure (MCDS) – Decommissioned in 2015	385892	6945191
W37	100 m downstream of MCDS (W36 collection sump) and upstream of Water Storage Pond – Decommissioned in 2015	386180	6945294
W45	Area 2 Pit and Area 2 Pit Tailings Management Facility	384912	6944068
W46	Minto Creek, downstream of W7 and W6 tributaries	387873	6946301
W47	Area 118 Pit water	384775	6944153
W50	Minto Creek, approximately 50 m downstream of the toe of the Water Storage Pond Dam and downstream of the inflow of the treated water	386747	6945682
MC-1	Minto Creek upstream of Canyon	390967	6947528
WTP	Treated water from water treatment plant when RO not operating	385126	6945154
RO	Treated water from RO	385126	6945154
W51	Area 2 Stage 3 Pit	385160	6944240
W52	Ridgetop North Pit and Ridgetop North Pit Tailings Management Facility	*	*

Station	Description	UTM Coordinates – Zone 8	
		Easting	Northing
W53	Ridgetop South Pit	*	*
W54	Main Dam seepage	*	*
W55	Tailings Diversion Ditch	386209	6945007
W62	MVFES2 Collection Sump	386079	6945335
C4	Tributary on the south side of Minto Creek, downstream of W3	388407	6946571
C10	Tributary on the south side of Minto Creek, downstream of W3	391868	6947914
MN	Minto North pit water	384342	6946090
MN-0.2	Upper west arm of McGinty Creek (Reference Station)	382267	6947299
MN-0.5	West arm of McGinty Creek just upstream of the confluence with the east arm	385251	6951262
MN-1.5	Upper east arm of McGinty Creek downstream of the Minto North deposit	384473	6947055
MN-2.5	East arm of McGinty Creek just upstream of confluence with the west arm	385493	6950788
MN-4.5	Lower mainstream McGinty Creek near confluence with Yukon River	386231	6952851
UG 1	Minto South underground mine dewatering	384916	6944098
UG 2	Wildfire underground mine dewatering	*	*
UG 3	Copper Keel underground mine dewatering	*	*
UG 4	Minto East underground mine dewatering	384961	6945020

*Water quality sites not developed

5.1.1 Water Quality Monitoring Conformance

2018 conformance with the external water sampling requirements is summarized in Table 5-2, below. Flow monitoring at water quality surveillance sites is highly variable because of site and seasonal conditions and is not presented in Table 5-2, however, full details were provided in the Monthly Reports submitted to the YWB. Additionally, the specifics of non-conformance in relation to external and internal water sampling requirements are included in the Monthly Reports. Quality Assurance and Quality Control (QA/QC) sampling is not included in sampling events described in Table 5-2, but is provided in section 5.1.2.

Table 5-2: Water Quality Sampling Monitoring Conformance Summary (2018)

Site Name	2018 WQ sampling events	2018 Reason(s) for non-conformance events
W1	N/A	N/A
W2	22	Site was frozen during the first and fourth quarter. Sampled as per schedule for remainder of 2018.
W3	51	Sampled as per schedule.
W4	4	Sampled as per schedule.
W5	4	Sampled as per schedule.
W6	5	Site frozen for 6 months of the year. Sampled as per schedule for remainder of 2018.
W7	6	Site frozen for 6 months of the year. Sampled as per schedule for remainder of 2018.
W8	0	Site destroyed in 2017.
W8A	46	Weekly samples not collected once in May, and all of June due to site being dry/frozen. Sampled as per schedule otherwise.
W10	8	Site frozen January - April. Sampled as per schedule otherwise.
W12	13	Sampled as per schedule.
W12A	0	No discharge from W12A in 2017.
W14	10	Sampled as per schedule. Not sampled in Nov/Dec due to mill and tailing shutdown.
W15	15	Site frozen for March. Sampled as per schedule otherwise.
W16	34	Sampled as per schedule.
W16a	9	Sampled as per schedule.
W17	52	Sampled as per schedule.
W30	8	Site was frozen for first three and final months of 2018. Sampled as per schedule otherwise.
W33	0	Site destroyed in 2017. Replaced with impacted site W33s
W33s	5	Site frozen for 7 months of the year.
W35	10	Site frozen for 5 months of 2018. Sampled as per schedule otherwise.
W36	0	Decommissioned in 2015.
W37	0	Decommissioned in 2015.
W45	10	Site was not sampled for three months due to removal of the pump and freezing conditions in October to December.
W46	6	Site frozen for five months, dry for one. Sampled as per schedule for remainder of 2018.
W47	0	Decommissioned and backfilled in January 2017.
W50	8	Site dry while not discharging. Sampled as per schedule during discharge in 2018.
MC-1	26	Site frozen for 5 1/2 months. Sampled as per schedule for remainder of 2018.
WTP	0	No treatment or discharge for 2018.
RO		
W51	2	Site sampled in February and July. Was inaccessible/unsafe to enter for the remainder of the year.
W52	0	Site not established.

Site Name	2018 WQ sampling events	2018 Reason(s) for non-conformance events
W53	0	Site not established.
W54	0	Site not established.
W55	11	Flow present in May, June and August. Site dry for remainder of 2018.
W62	12	Sampled as per schedule.
C4	6	Site frozen for 6 months. Sampled as per schedule for remainder of 2018.
C10	1	Site frozen for 6 months. Sampled once in April and dry for remainder of 2018.
MN	4	Site frozen for 8 months, sampled as per schedule for remainder of 2018.
MN-0.2	6	Site frozen for 6 months. Sampled as per schedule for remainder of 2018.
MN-0.5	7	Site frozen for 5 months. Sampled as per schedule for remainder of 2018.
MN-1.5	6	Site frozen for 6 months. Sampled as per schedule for remainder of 2018.
MN-2.5	7	Site frozen for 5 months. Sampled as per schedule for remainder of 2018.
MN-4.5	5	Site frozen for 7 months. Sampled as per schedule for remainder of 2018.
UG1	12	Sampled as per schedule.
UG4	7	Site established in June. Sampled as per schedule for remainder of 2018.

5.1.2 Quality Assurance and Quality Control Program

As required by Clause 104 of the WUL, Minto is required to submit the results and interpretations of the Quality Assurance and Quality Control Program (QA/QC Program). The QA/QC program is directed through the EMSRP. Implementation of the Minto QA/QC Program occurred since November 2012.

The primary objective of the QA/QC Program is to ensure that data collected, analyzed and evaluated through the environmental monitoring programs at Minto are representative of the environmental conditions present at the time of sample collection.

The QA/QC Program has been developed using recognized QA/QC protocols. Specific procedures for data collection at the Minto Mine are detailed in Standard Operating Procedures (SOPs). SOPs are internal documents to the Minto Mine that may be modified or improved as required.

The main components of the QA/QC Program presented in the following sections include QA/QC with regards to water quality monitoring, external and on-site laboratory reporting, and environmental programs monitoring. QA/QC results and interpretations are presented in each Monthly Report.

5.1.2.1 Water Quality QA/QC

Procedures for water quality monitoring at the Minto Mine are described in the EMSRP and further detailed in the Minto Mine Surface Water Quality Monitoring Standard Operating Procedure. The SOP is reviewed at the start of each field season and signed off by Minto Environment department staff to help ensure consistency in sampling procedures.

In 2018, 523 water quality samples (surface and groundwater) were collected for the water quality monitoring programs. QC samples represented 34% of the total number of samples collected in 2018, and

included 78 field duplicates, 13 field blanks, 2 trip blanks, and 85 field splits. The Minto Mine Surface Water Quality Monitoring Standard Operating Procedure describes a 1:10 quality control to routine sampling ratio and this ratio was achieved in 2018.

5.1.2.2 External Laboratory QA/QC

The 2018 external laboratory water quality analysis were performed by ALS Environmental in Burnaby, BC. As described in the EMSRP, all results provided by the external laboratory were accompanied by a Quality Control Report. If procedural deviations or exceedances in standard holding time occurred, the details of such nonconformities were included in each report. Additionally, each report contained QC batch numbers enhancing sample result traceability.

5.1.2.3 On-site Laboratory QA/QC

Procedures for analyzing water samples at the on-site laboratory are detailed in a variety of SOPs such as, but not limited to: The Laboratory QA/QC Guidelines SOP; Preparation of Dissolved and Total Metals (Cu, Al, Cd) SOP; Preparation of Dissolved and Total Selenium SOP; and Total Dissolved Solids SOP. All on-site laboratory equipment was calibrated per the manufacturer's specifications in 2018.

On-site laboratory analysis of water quality samples occurred at W2, W3, W8A, W16, W16A, W17 and W50 as per the WUL Schedule 1 – Part 2 monitoring requirements, as environmental conditions allowed. No internal samples were provided to the internal laboratory from W8, as the site was destroyed in 2017. Additionally, the on-site laboratory analyzed water from sites W15, W35, RO, and WTP intake daily during discharge conditions to inform day-to-day discharge-related decisions. Samples from W12 were also analyzed.

The 2018 QC procedures performed by the on-site laboratory included spiked blanks and calibration checks. If two or more QC failures occurred, the 2018 QC procedures involved re-analyzing the entire batch of samples. Additionally, one replicate sample is analyzed for each batch analysis. In the event the replicate sample results do not match; the entire batch is reanalyzed.

QA/QC results such as duplicates, field splits, trip blanks and field blanks are verified monthly. Results are compared and reported internally to improve on sampling and analysis.

On-site and external laboratory water quality results for water quality sites W2, W3, W8A, W16, W16A and W50 are presented in each Monthly Report submitted to the Water Board. In monthly reports, it was noted that discrepancies in results from the external and on-site laboratories occurred and were likely a result of different methods and/or equipment utilized in analyzing water samples, different processing times between sampling and processing the samples, and the associated use of non-preserved versus preserved samples.

5.2 Compliance

5.2.1 Discharge Compliance – WQ Effluent Standards

5.2.1.1 W16A – EQS Compliance Point

For the station W16A, copper, aluminum, cadmium and selenium concentrations, with corresponding standards (WUL Clause 9) are displayed in Table 5-3. This is shown graphically in Figure 5-1 and Figure 5-2. The TSS value that exceeded the EQS (5/14/2013) was re-run on the same day and had a value of 17 mg/L, this was prior to the station becoming a compliance point. Other parameters are presented in the summary table because they are monitored under the Adaptive Management Plan.

Table 5-3: W16A Water Quality Results Summary (2007-2018)

W16A	Water Quality Objective (WUL Clause 9)	2007 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters		Mean	Min	Max	Mean	Min	Max
pH	6.0-9.0	8.01	6.86	8.33	8.35	8.27	8.43
TSS (mg/L)	15	4.82	0.5	55.1	2.04	1.5	4.1
Nutrients (mg/L)							
Ammonia Nitrogen	0.75	0.0993	0.0071	0.430	0.0236	0.0081	0.0493
Nitrite Nitrogen	0.18	0.02674	0.0025	0.0920	0.0097	0.0074	0.0111
Nitrate Nitrogen	27.3	3.249	0.549	6.30	1.87	1.62	2.01
Dissolved Metals (mg/L)							
Aluminum	0.3	0.01115	0.0015	0.0732	0.0113	0.0019	0.0145
Arsenic	0.015	0.000346	0.00023	0.00059	0.00043	0.00037	0.00049
Cadmium	0.00015*	0.00001383	0.0000025	0.000089	0.00000816	0.0000025	0.0000109
Chromium	0.003	0.000346	0.00005	0.0005	0.000119	0.00005	0.00018
Copper	0.039	0.02185	0.00793	0.0349	0.0335	0.0288	0.0394
Iron	3.3	0.0672	0.0105	0.301	0.061	0.016	0.083
Lead	0.012	0.0001492	0.000025	0.00173	0.000214	0.000096	0.000900
Molybdenum	0.219	0.00441	0.001	0.0098	0.00267	0.00247	0.00295
Nickel	0.33	0.00077	0.0005	0.0025	0.00092	0.00079	0.00103
Selenium	0.006	0.001204	0.00019	0.0021	0.000874	0.000672	0.00102
Zinc	0.09	0.00205	0.0005	0.0059	0.00174	0.0005	0.0104

Bold values indicate exceedances of the WUL standards

*Based on measured hardness

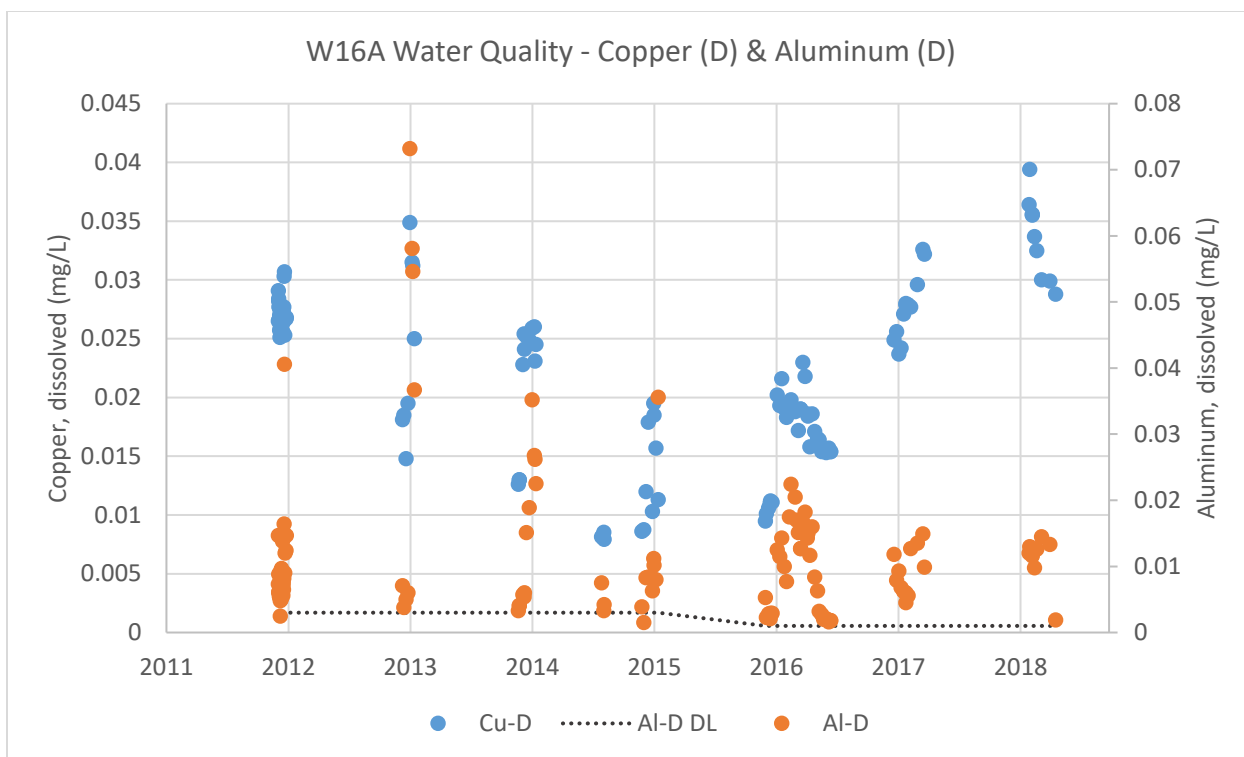
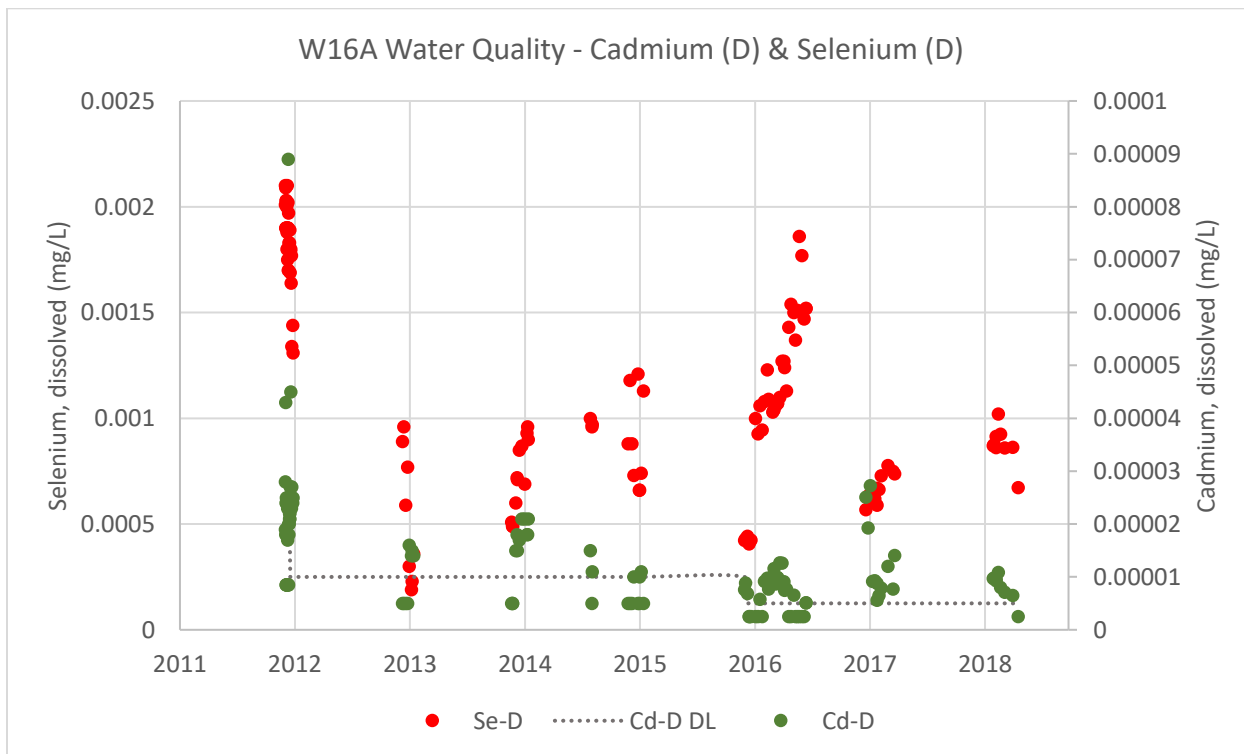


Figure 5-1: W16A Copper and Aluminum Concentrations (2012-2018)

DL is Analytical Detection Limit



*Note that the cadmium standard is based on a hardness of 63 mg/L which is a conservative estimate of hardness at the WQO station.

Figure 5-2: W16A Cadmium and Selenium Concentrations (2012-2018)

DL is Analytical Detection Limit

5.2.1.2 W50 – EQS Compliance Point

The Effluent Quality Standards (EQS) (Clause 9 of the WUL) were applied and met at W50 from the period of June 10th to August 28th, 2018 when water was encountered. The water quality statistics for 2018 where W50 was the EQS compliance point are summarized below in Table 5-4. The summary from 2009 to 2016 has some exceeded parameters, those were triggered prior to 2015, with different standards. The summary for dissolved aluminum, copper, cadmium and selenium are also presented graphically in Figure 5-3 and 5-4 below.

Table 5-4: W50 Water Quality Results Summary (2009-2018)

W50	Water Quality Objective (WUL Clause 9)	2009 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters		Mean	Min	Max	Mean	Min	Max
pH	6.0-9.0	8.04	6.82	8.4	8.29	8.14	8.42
TSS (mg/L)	15	5.15	0.5	42	1.76	1.5	3.6
Nutrients (mg/L)							
Ammonia Nitrogen	0.75	0.083	0.0025	1.000	0.0137	0.0063	0.023
Nitrite Nitrogen	0.18	0.02549	0.0025	0.1580	0.0058	0.0035	0.0081
Nitrate Nitrogen	27.3	3.7485	0.01	16.20	1.77	1.58	1.97
Dissolved Metals (mg/L)							
Aluminum	0.3	0.01551	0.0013	0.12	0.0084	0.0034	0.0126
Arsenic	0.015	0.000349	0.00012	0.0008	0.00043	0.00038	0.0005
Cadmium	0.00015*	0.00001384	0.0000025	0.00028	0.00000419	0.0000025	0.0000077
Chromium	0.003	0.000428	0.00005	0.0017	0.000122	0.00005	0.00018
Copper	0.039	0.01593	0.0005	0.075	0.0287	0.0244	0.0321
Iron	3.3	0.05122	0.0025	0.3	0.047	0.017	0.068
Lead	0.012	0.0001329	0.000025	0.0008	0.0000972	0.000025	0.000172
Molybdenum	0.219	0.00586	0.0005	0.019	0.00277	0.00259	0.00301
Nickel	0.33	0.000888	0.00025	0.003	0.00082	0.0007	0.00092
Selenium	0.006	0.001165	0.00005	0.0049	0.000861	0.000741	0.00101
Zinc	0.09	0.0026	0.0005	0.018	0.00066	0.0005	0.0018

Bold values indicate exceedances of the current WUL standards

*Based on measured hardness

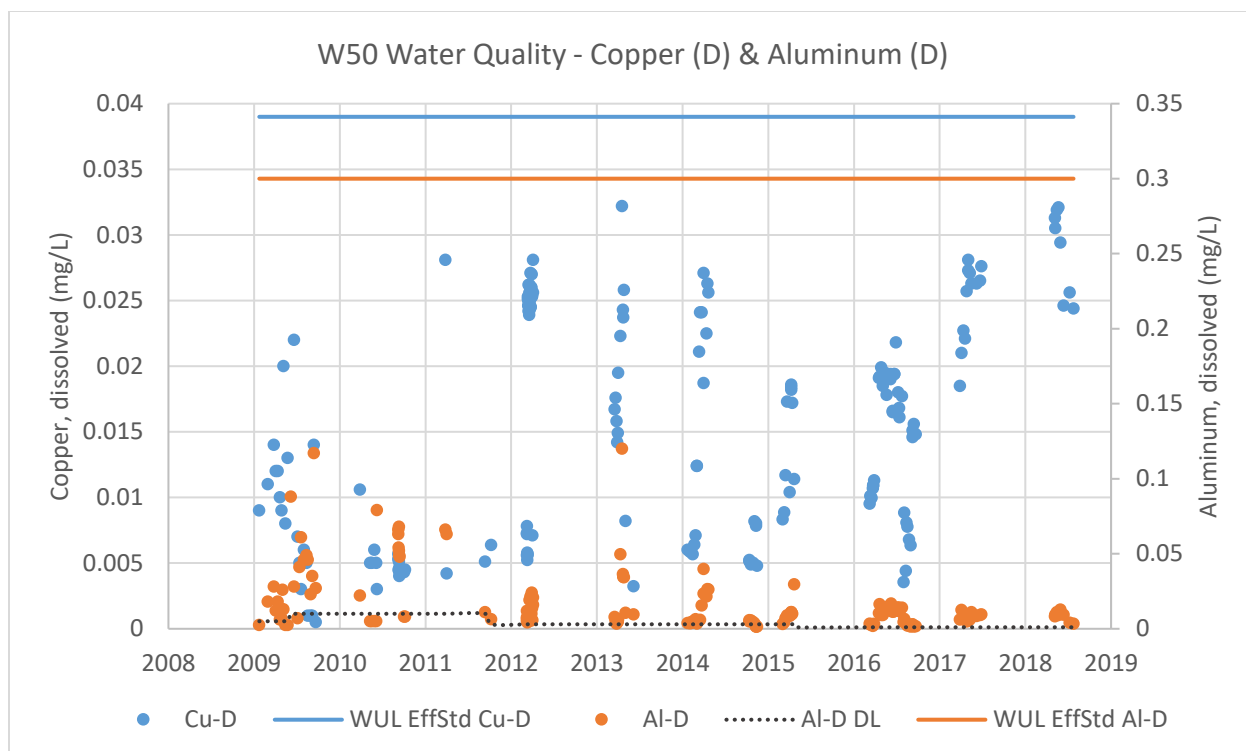
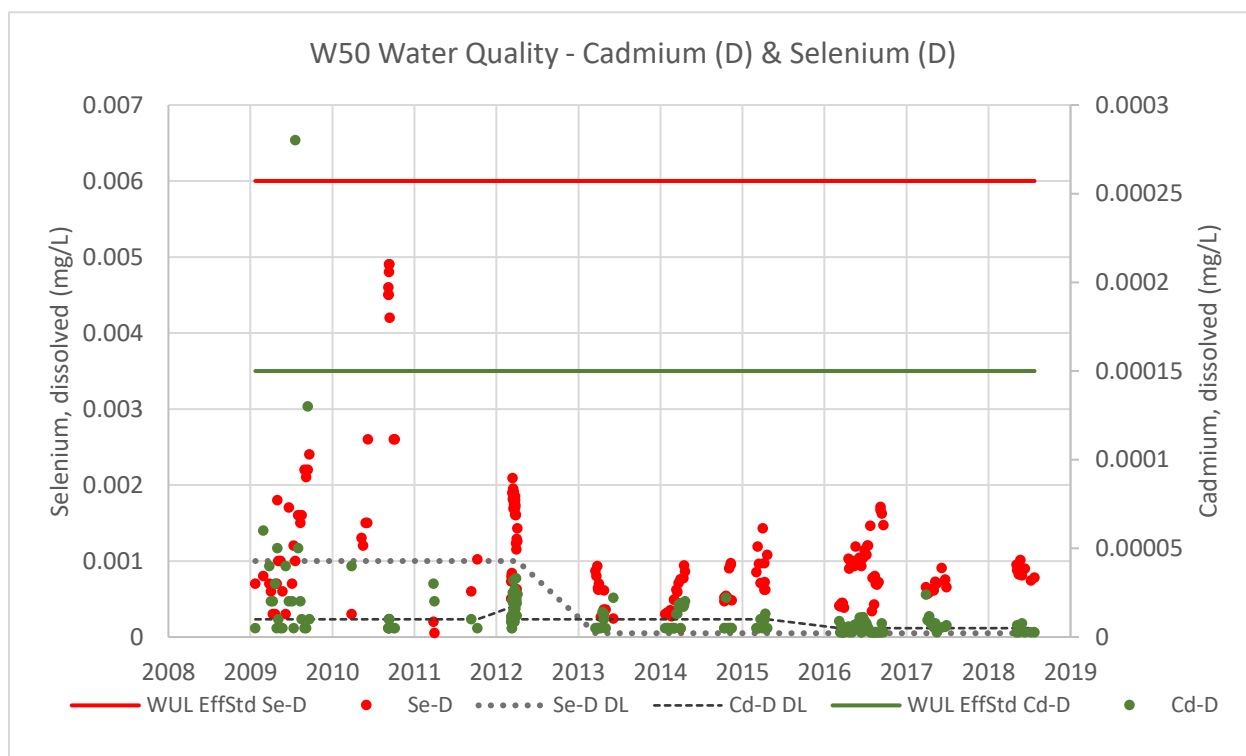


Figure 5-3: W50 Copper and Aluminum Concentrations (2009-2018)

DL is Analytical Detection Limit



*Note that the cadmium standard is based on a hardness of 63 mg/L which is a conservative estimate of hardness at the WQO station.

Figure 5-4: W50 Cadmium and Selenium Concentrations (2009-2018)

DL is Analytical Detection Limit

5.2.1.3 W17 – EQS Compliance Point

During 2018, there was no water discharged from W17 to the Minto Creek, therefore EQS were not applied to this station.

5.2.2 Discharge Compliance – Bioassays

Monthly and quarterly bioassays are conducted at several surface water quality sites, as per WUL requirements. These tests are to ensure the water is not toxic for aquatic organisms.

The monthly and quarterly testing outcomes for site W2 can be found in Tables 5-5a and 5-5b. Tables 5-6 to 5-8 show the monthly testing outcomes for sites W50, W16A, and W3 respectively.

Table 5-5a: WUL W2 Monthly Bioassay Sample Compliance

W2 - Monthly Results (When Discharging)	
Month	Analysis
	CD-7d
Jan	ND
Feb	ND
Mar	ND
Apr	ND
May	Pass
Jun	Pass
Jul	NC
Aug	*NA
Sep	*NA
Oct	ND
Nov	ND
Dec	ND
ND= Not Discharging	
NA= External Lab Issues; No results	
NC= Not Collected; Frozen/Dry	

*The CD-7d testing for August and September was unable to be completed due to a shortage of viable embryos necessary for the analysis. The testing for July was unable to be completed as the site was found dry.

Table 5-6b: WUL W2 Quarterly Bioassay Sample Compliance

W2 - Quarterly Results			
Month	Analysis		
	CD-7d	CT-30d	CA-72h
Quarter 1	NC	NC	NC
Quarter 2	Pass	Pass	Pass
Quarter 3	*NA	*NA	Pass
Quarter 4	NC	NC	NC
NA= External Lab Issues; No results			
NC= Not Collected; Frozen/Dry			

*The CD-7d and CT-30d testing for Quarter 3 was unable to be completed due to a shortage of viable embryos necessary for the analysis. Testing for Quarters 1 and 4 were not completed due to the site being found dry.

Table 5-7: WUL W50 Monthly Bioassay Sample Compliance

W50 - Monthly Results			
Month	Analysis		
	CD-7d	96-hr LT50 Trout	48-hr LT50 Daphnia
Jan	NC	NC	NC
Feb	NC	NC	NC
Mar	NC	NC	NC
Apr	NC	NC	NC
May	NC	NC	NC
Jun	Pass	Pass	Pass
Jul	Pass	Pass	Pass
Aug	*NA	Pass	Pass
Sep	NC	NC	NC
Oct	NC	NC	NC
Nov	NC	NC	NC
Dec	NC	NC	NC
NA= External Lab Issues; No results			
NC= Not Collected; Frozen/Dry			

*The CD-7d testing for Quarter 3 was unable to be completed due to a shortage of viable embryos necessary for the analysis. The testing for January to May, and September to December was not completed due to the site being found dry.

Table 5-8: WUL W16A Monthly Bioassay Sample Compliance

W16A - Monthly Results (When Discharging)		
Month	Analysis	
	96-hr LT50 Trout	48-hr LT50 Daphnia
Jan	ND	ND
Feb	ND	ND
Mar	ND	ND
Apr	ND	ND
May	ND	ND
Jun	Pass	Pass
Jul	Pass	Pass
Aug	Pass	Pass
Sep	ND	ND
Oct	ND	ND
Nov	ND	ND
Dec	ND	ND
ND= Not Discharging		

Table 5-9: WUL W3 Monthly Bioassay Sample Compliance

W3 - Monthly Results (When Discharging)		
Month	Analysis	
	96-hr LT50 Trout	48-hr LT50 Daphnia
Jan	ND	ND
Feb	ND	ND
Mar	ND	ND
Apr	ND	ND
May	ND	ND
Jun	Pass	Pass
Jul	Pass	Pass
Aug	Pass	Pass
Sep	ND	ND
Oct	ND	ND
Nov	ND	ND
Dec	ND	ND
ND= Not Discharging		

5.2.3 Water Quality Objectives Compliance – Minto Creek

5.2.3.1 W2 – WQO Compliance Point

As of April 9th, W15 and W35 were no longer frozen and W2 became the WQO station until W15 and W35 froze again on October 9th, 2018. Following the date in October, W50 became the WQO station.

The Water Quality Objectives (WQO) (Clause 11 of the WUL) were met at the W2 during the period between April 10th and September 25th, 2018. The water quality statistics during the period where W2 was the WQO compliance point are summarized below in Table 5-9. The maximum dissolved copper concentration was collected on April 10th, 2018 at 0.0184mg/L, the DOC for that sample was 11.0mg/L, and therefore did not exceed the WQO.

Table 5-10: W2 Water Quality Results Summary (2018)

W2	Water Quality Objective (WUL Clause 11)	2005 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters		Mean	Min	Max	Mean	Min	Max
pH	6.0-9.0	8.10	7.03	8.46	8.20	7.57	8.52
TSS (mg/L)		50.21	<1.0	2600	21.40	<3.0	181
Nutrients (mg/L)							
Ammonia Nitrogen	0.25	0.03544	<.001	0.83	0.00709	<0.0050	0.0162
Nitrite Nitrogen	0.06	0.00879	<0.0010	0.36	0.00117	<0.0010	0.0029
Nitrate Nitrogen	9.1	1.32925	0.003	9.4	0.08086	<0.0050	0.381
Dissolved Metals (mg/L)							
Aluminum	0.1	0.01891	0.0028	0.201	0.0161	0.0038	0.0738
Arsenic	0.005	0.000517	<0.0002	0.00122	0.00050	0.00034	0.00083
Cadmium	0.00015*	0.00001472	<0.0000050	0.00026	0.00000725	<0.0000050	0.0000216
Chromium	0.001	0.000518	<0.00010	0.0069	0.000218	<0.00010	0.00039
Copper	0.013	0.00322	<0.001	0.0227	0.00501	0.00163	0.0184
Iron	1.1	0.1624	0.019	0.905	0.073	0.018	0.229
Lead	0.004	0.0001766	<0.000050	0.0009	0.0000500	<0.000050	<0.000050
Molybdenum	0.073	0.002624	0.00018	0.015	0.001368	0.000374	0.00219
Nickel	0.11	0.001199	<0.0005	0.004	0.00110	0.00056	0.00164
Selenium	0.002	0.000617	0.000074	0.0026	0.000157	0.000082	0.000346
Zinc	0.03	0.00427	<0.0010	0.02	0.00133	<0.0010	0.0035

*Based on measured hardness

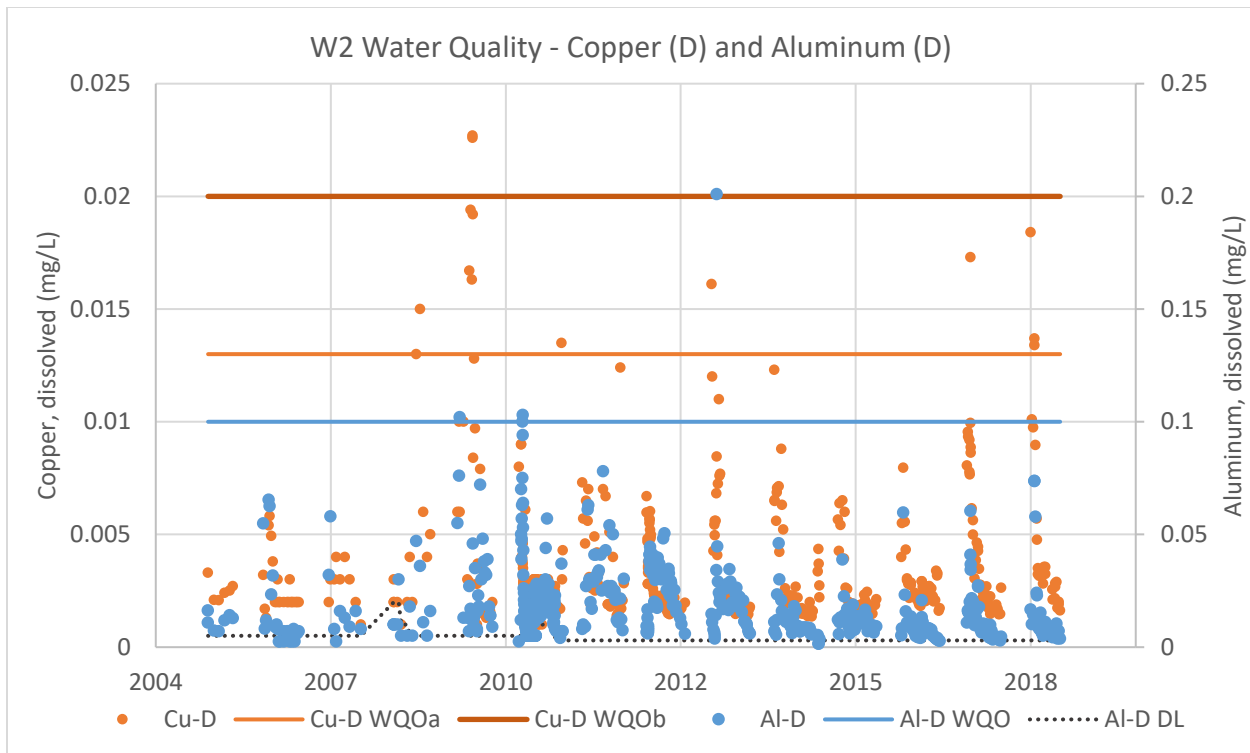


Figure 5-5: W2 Copper and Aluminum Concentrations (2005-2018)

DL is Analytical Detection Limit

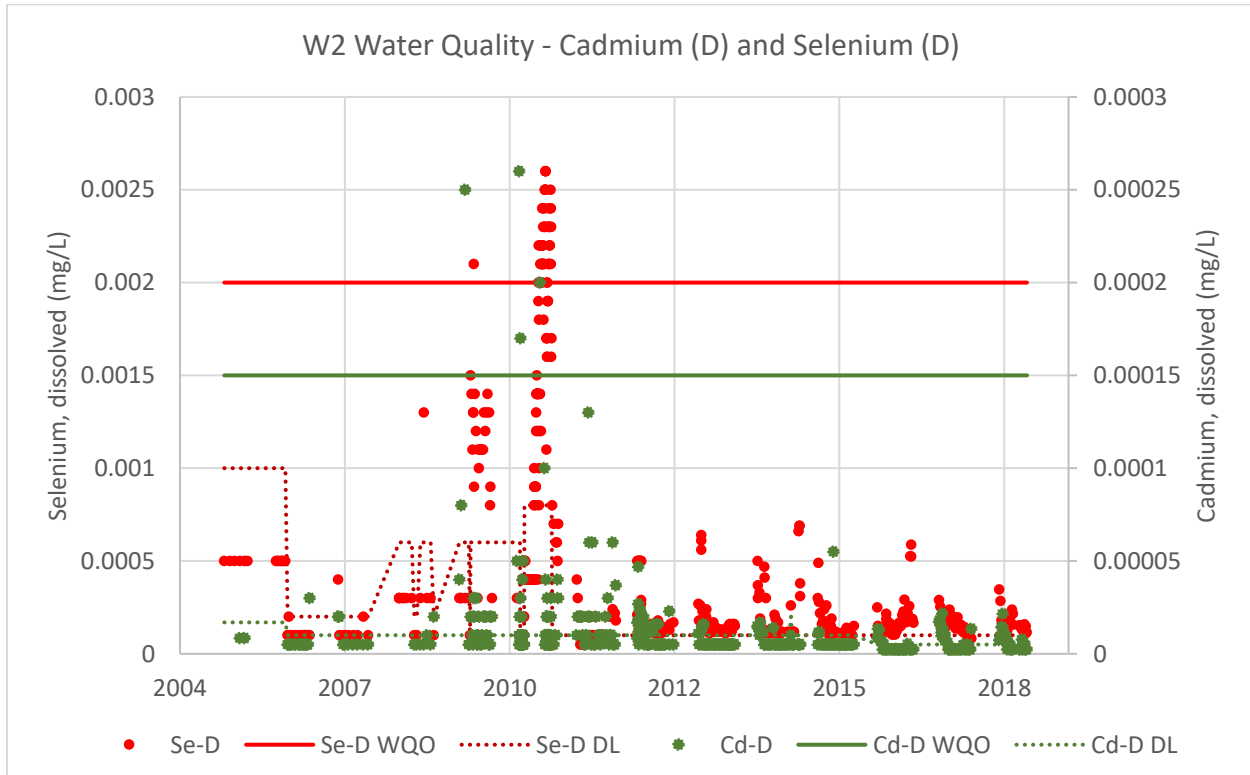


Figure 5-6: W2 Cadmium and Selenium Concentrations (2005-2018)

DL is Analytical Detection Limit

5.2.3.2 W50 – WQO Compliance Point

From January 1st until April 9th, W15 and W35 were frozen and W50 was the WQO station. Following April 11th until October 9th, W2 was then the WQO station. After which, W15 and W35 froze and W50 once again became the WQO station. During the period that W50 was the WQO compliance point, no water samples were collected from the station as it was dry.

5.2.3.3 Discharge Compliance – RO

In 2018, the WTP and the RO system was not operated.

5.3 Surface Water Quality Surveillance Stations

5.3.1 W2 – Minto Creek at Lower Road Crossing Water Quality

The water quality statistics for W2 from 2007 to 2018 are presented in Section 5.2.3.1 above.

5.3.2 W3 – Minto Creek, at the Federal (MDMER) Compliance Point

The water quality statistics for W3 from 2007 to 2018 are summarized below in Table 5-10. A total of 52 routine samples were collected from station W3 during the 2018 monitoring period. The results for dissolved copper, dissolved aluminum, dissolved cadmium, and dissolved selenium for W3 from 2007 to 2017 are also presented in Figure 5-7 and Figure 5-8 below. Three outlier data points dating from 2009 and early 2010 were removed from the W3 Cadmium and Selenium graph to better show the dataset on the graph (5/27/2009, 12/15/2009 and 1/11/2010).

Table 5-11: W3 Water Quality Results Summary (2007-2018)

W3	2007 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.1	7.4	8.6	8.25	7.77	8.54
TSS (mg/L)	7.17	<1.0	985	3.45	<3.0	8.9
Nutrients (mg/L)						
Ammonia Nitrogen	0.0526	-0.0100	0.6200	0.0100	<0.0050	0.0341
Nitrite Nitrogen	0.02584	<0.0010	0.347	0.00112	<0.0010	0.0037
Nitrate Nitrogen	2.6869	<0.020	18.7	0.2236	0.0649	1.53
Dissolved Metals (mg/L)						
Aluminum	0.01937	0.001	0.373	0.0065	<0.0010	0.0657
Arsenic	0.000336	0.00012	0.0014	0.000254	0.00019	0.00042
Cadmium	0.0008418	<0.0000050	0.565	0.00000855	<0.0000050	0.0000237
Chromium	0.000822	<0.00010	0.0039	0.00012	<0.00010	0.00042
Copper	0.00537	<0.001	0.067	0.00525	0.00152	0.0291
Iron	0.0438	<0.005	0.7500	0.0312	<0.010	0.2030
Lead	0.0002517	0.000009	0.0603	0.0000508	<0.000050	0.00008
Molybdenum	0.00556	0.00066	0.103	0.00449	0.00264	0.00623
Nickel	0.001113	<0.00050	0.006	0.00092	0.00053	0.00245
Selenium	0.0009754	<0.000050	0.0348	0.000339	0.000211	0.000834
Zinc	0.0050	0.0007	0.1430	0.0032	<0.0010	0.0241

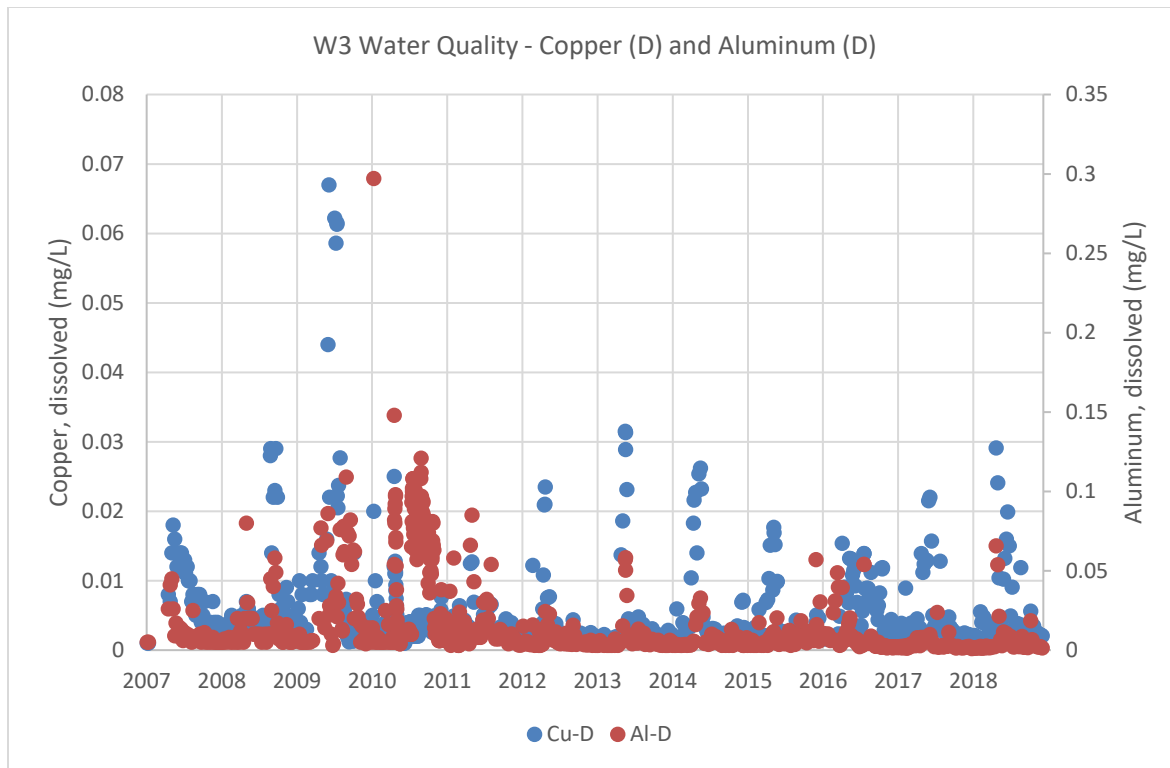


Figure 5-7: W3 Copper and Aluminum Concentrations (2007-2018)

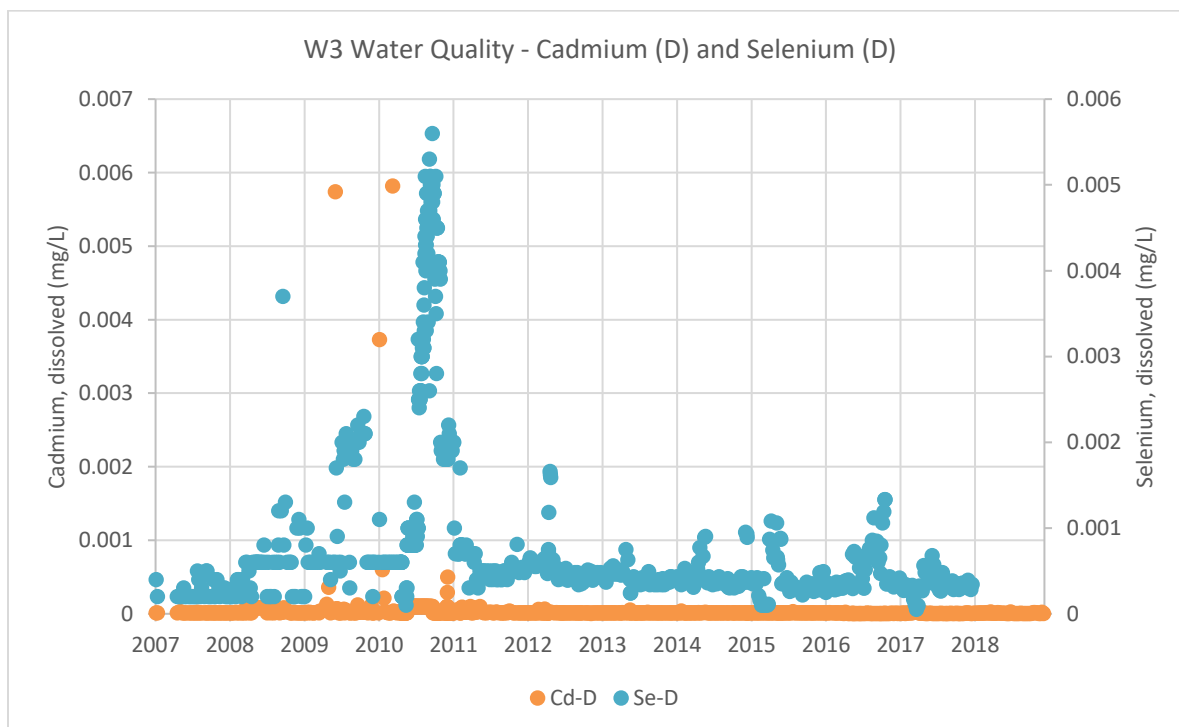


Figure 5-8: W3 Cadmium and Selenium Concentrations (2007-2018)

5.3.3 W4 – Yukon River, Upstream of the confluence with Minto Creek

The water quality statistics for W4 from 2011 to 2017 are summarized below in Table 5-11. A total of four routine samples were collected from station W4 during the 2018 monitoring period.

Table 5-12: W4 Water Quality Results Summary (2005-2018)

W4	2005 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	7.93	5.48	8.26	8.00	7.98	8.03
TSS (mg/L)	21.19	<1.0	270	11.88	<3.0	22.1
Nutrients (mg/L)						
Ammonia Nitrogen	0.03589	<0.0050	2.4	0.00508	<0.0050	0.0053
Nitrite Nitrogen	0.00596	<0.0010	<0.050	0.00100	<0.0010	<0.0010
Nitrate Nitrogen	0.07333	<0.0050	0.849	0.0691	0.0261	0.189
Dissolved Metals (mg/L)						
Aluminum	0.01382	0.0017	0.167	0.01465	<0.0010	0.0264
Arsenic	0.000452	<0.00010	0.00105	0.00044	0.00034	0.00054
Cadmium	1.774E-05	<0.0000050	0.0014	5.45E-06	<0.0000050	0.0000068
Chromium	0.000970	<0.00010	<0.0020	0.000118	<0.00010	0.00017
Copper	0.001093	<0.00020	0.00819	0.00106	0.00034	0.00165
Iron	0.03637	<0.0050	0.307	0.031	0.011	0.049
Lead	0.0001980	<0.000050	<0.00050	0.0000500	<0.000050	<0.000050
Molybdenum	0.001083	0.000684	0.0021	0.000973	0.000581	0.00126
Nickel	0.001000	<0.00050	0.002	0.000612	<0.00050	0.00090
Selenium	0.000168	<0.00010	<0.0010	0.000128	0.000112	0.000153
Zinc	0.00497	<0.0010	0.0278	0.00113	<0.0010	0.0015

5.3.4 W5 – Yukon River, Downstream of the Confluence with Minto Creek

The water quality statistics for W5 from 2009 to 2018 are summarized below in Table 5-12. A total of four routine samples were collected from station W5 during the 2018 monitoring period.

Table 5-13: W5 Water Quality Results Summary (2009-2018)

W5	2009 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	7.96	7.58	8.25	8.00	7.96	8.04
TSS (mg/L)	36.41	<1.0	340	20.2	4.0	28.0
Nutrients (mg/L)						
Ammonia Nitrogen	0.02453	<0.0050	0.382	0.00540	<0.0050	0.0066
Nitrite Nitrogen	0.00605	<0.0010	<0.050	0.00100	<0.0010	<0.0010
Nitrate Nitrogen	0.0581	0.0057	<0.4	0.0374	0.0210	0.0761
Dissolved Metals (mg/L)						
Aluminum	0.01424	<0.0030	0.0637	0.0157	0.0046	0.0329
Arsenic	0.000498	0.00036	0.00086	0.00046	0.00041	0.00053
Cadmium	1.195E-05	<0.0000050	<0.000050	1.162E-05	<0.0000050	0.0000211
Chromium	0.000965	<0.00010	<0.0010	0.000158	<0.00010	0.00026
Copper	0.00132	0.00047	0.00694	0.00224	0.00054	0.00360
Iron	0.0870	0.009	0.712	0.0395	<0.010	0.076
Lead	0.0001996	<0.000050	<0.00050	0.0000560	<0.000050	0.000074
Molybdenum	0.001148	0.000868	0.0018	0.001184	0.000996	0.00131
Nickel	0.001012	<0.00050	0.002	0.000550	<0.00050	0.00070
Selenium	0.000181	<0.00010	<0.0010	0.000165	0.000128	0.000211
Zinc	0.00512	<0.0010	0.0355	0.00342	<0.0010	0.0097

5.3.5 W6 – Tributary on the North side of Minto Creek

The water quality statistics for W6 from 2007 to 2017 are summarized below in Table 5-13. A total of five routine samples were collected from station W6 during the 2018 monitoring period.

Table 5-14: W6 Water Quality Results Summary (2006-2018)

W6	2007 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.00	7.34	8.4	8.12	8.03	8.23
TSS (mg/L)	79.28	<1.0	1160	10.49	<3.0	38.5
Nutrients (mg/L)						
Ammonia Nitrogen	0.03116	<0.0050	0.17	0.00789	<0.0050	0.0130
Nitrite Nitrogen	0.00623	<0.0010	0.07	0.00100	<0.0010	<0.0010
Nitrate Nitrogen	0.29926	<0.0050	8.09	0.01097	<0.0050	<0.025
Dissolved Metals (mg/L)						
Aluminum	0.01314	<0.0030	0.097	0.0097	0.0064	0.0165
Arsenic	0.00045	0.0002	0.00081	0.00050	0.00046	0.00054
Cadmium	0.00001359	<0.0000050	0.00023	0.00000533	<0.0000050	0.0000073
Chromium	0.00040	0.00017	0.0013	0.000256	0.00020	<0.00030
Copper	0.00255	0.0008	0.043	0.00158	0.00114	0.00294
Iron	0.0712	0.01	0.2	0.076	0.063	0.095
Lead	0.0001736	<0.000050	0.0005	0.0000500	<0.000050	<0.000050
Molybdenum	0.001296	0.000247	0.015	0.000473	0.000354	0.000548
Nickel	0.00117	0.0006	0.002	0.00148	0.00134	0.00176
Selenium	0.000207	0.000057	0.002	0.000083	0.000065	0.000101
Zinc	0.00478	<0.0010	0.049	0.00100	<0.0010	<0.0010

5.3.6 W7 – North Flowing Tributary to Minto Creek

The water quality statistics for W7 from 2006 to 2018 are summarized below in Table 5-14. A total of six routine samples were collected from station W7 during the 2018 monitoring period.

Table 5-15: W7 Water Quality Results Summary (2007-2018)

W7	2007 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	7.96	5.51	8.41	8.12	8.00	8.22
TSS (mg/L)	36.66	<1.0	705	16.92	<3.0	61.4
Nutrients (mg/L)						
Ammonia Nitrogen	0.02904	<0.0050	0.34	0.0136	0.0098	0.0271
Nitrite Nitrogen	0.01240	<0.0010	0.14	0.00100	<0.0010	<0.0010
Nitrate Nitrogen	0.1129	0.0050	0.324	0.0872	0.0104	0.172
Dissolved Metals (mg/L)						
Aluminum	0.02043	<0.0030	0.407	0.0179	0.0037	0.0389
Arsenic	0.00044	<0.0002	0.001	0.00047	0.00041	0.00061
Cadmium	0.00001459	<0.0000050	0.00028	0.00000566	<0.0000050	0.0000075
Chromium	0.00084	0.00013	0.002	0.00028	0.00017	0.00041
Copper	0.00192	0.00063	0.0154	0.00257	0.00098	0.00671
Iron	0.1799	0.0102	1.06	0.190	0.094	0.601
Lead	0.0001760	<0.000050	0.0017	0.0000500	<0.000050	<0.000050
Molybdenum	0.001258	0.00013	0.002	0.001280	0.000699	0.00151
Nickel	0.00120	<0.0005	0.004	0.00127	0.00079	0.00185
Selenium	0.000196	0.000092	0.0022	0.000166	0.000129	0.000212
Zinc	0.00407	<0.0010	0.0302	0.00100	<0.0010	<0.0010

5.3.7 W8 – Western Collection Sump from DSTSF

W8 sump was destroyed in mid-December 2017 during reclamation operations, buried under waste material, as such, no samples were collected from W8 during the 2018 monitoring period. Water quality statistics for W8 from 2009 to 2013 are presented in Table 5-15 below. Trend analyses for seepage parameters results are presented in the Seepage section 7.1.

Table 5-16: Water Quality Result Summary (2009-2013)

Station Name	2009 - 2013 Summary Statistics		
Parameters	Mean	Min	Max
pH	7.98	7.49	8.4
TSS (mg/L)	45	<2	660
Nutrients (mg/L)			
Ammonia Nitrogen	0.541	0.005	4.2
Nitrite Nitrogen	0.841	<0.005	4.5
Nitrate Nitrogen	43.87	<0.01	116
Dissolved Metals (mg/L)			
Aluminum	0.0135	<0.0030	0.144
Arsenic	0.00063	0.0002	0.0085
Cadmium	0.000145	<0.00001	0.00211
Chromium	0.0012	<0.0004	0.0053
Copper	0.1216	0.008	0.352
Iron	0.109	0.014	0.826
Lead	0.0002	<0.0001	0.0007
Molybdenum	0.01369	0.0004	0.064
Nickel	0.0023	<0.001	0.009
Selenium	0.00698	<0.0001	0.0193
Zinc	0.306	<0.001	9.49

5.3.8 W8A – Eastern Collection Sump from DSTSF

W8A was collected on a weekly basis per WUL requirements, a total of 54 samples were collected during the 2018 monitoring period. Water quality statistics from 2009 to 2018 are summarized below in Table 5-16. Furthermore, trend analyses for seepage parameters results are presented in the Seepage section 7.1.

Table 5-17: Water Quality Result Summary (2009-2018)

Station Name	2009 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	7.98	5.04	8.6	7.84	7.19	8.34
TSS (mg/L)	44.81	<1.0	6540	46.8	3.3	200
Nutrients (mg/L)						
Ammonia Nitrogen	0.1351	0.007	1.6	0.2548	0.039	0.443
Nitrite Nitrogen	0.09302	<0.0010	1.18	0.3617	0.0127	1.11
Nitrate Nitrogen	9.22103	<0.0050	72.00	4.44	0.058	16.90
Dissolved Metals (mg/L)						
Aluminum	0.01242	0.00262	0.157	0.01113	0.006	0.0383
Arsenic	0.000537	<0.00010	0.00145	0.00059	0.00044	0.00091
Cadmium	0.000182	<0.000010	0.0013	0.00024	0.000135	0.000457
Chromium	0.000886	0.0001	0.002	0.000577	0.00021	0.00108
Copper	0.103558	<0.00020	0.272	0.0788	0.0405	0.167
Iron	0.25281	<0.0050	7.00	0.399	0.078	0.84
Lead	0.000173	0.000013	0.00102	5.38E-05	<0.000050	<0.00010
Molybdenum	0.01053	0.00033	0.049	0.0109	0.00522	0.0154
Nickel	0.001492	0.000677	0.006	0.00163	0.001	0.0027
Selenium	0.006276	<0.00010	0.018	0.00482	0.0012	0.00939
Zinc	0.59042	<0.001	5.17	0.2857	0.0467	0.881

5.3.9 W10 – Minto Creek Headwaters (South-West Fork)

The water quality statistics for W10 from 2007 to 2018 are summarized below in Table 5-17. A total of 8 routine samples were collected from station W10 during the 2018 monitoring period.

Table 5-18: W10 Water Quality Results Summary (2007-2018)

W10	2007 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	7.44	6.00	8.57	7.95	7.00	8.30
TSS (mg/L)	22.13	<1.0	390	26.43	<3.0	119
Nutrients (mg/L)						
Ammonia Nitrogen	0.19286	<0.0050	3.25	0.0558	0.0069	0.179
Nitrite Nitrogen	0.01679	<0.0010	0.148	0.01654	<0.0010	0.0391
Nitrate Nitrogen	0.91392	<0.0050	19.8	8.82333	<0.0050	17.6
Dissolved Metals (mg/L)						
Aluminum	0.11522	0.0025	0.418	0.031	0.0023	0.135
Arsenic	0.000501	<0.00010	0.00268	0.00035	0.0001	0.001
Cadmium	0.00003886	<0.0000050	0.0007	0.00001107	<0.0000050	0.0000411
Chromium	0.00091	<0.00010	0.00241	0.000158	<0.00010	0.0005
Copper	0.031018	<0.00020	0.138	0.01151	0.00164	0.036
Iron	3.53504	<0.0050	76.5	0.4	0.064	0.89
Lead	0.000185	<0.000050	0.0022	0.00005	<0.000050	<0.000050
Molybdenum	0.000804	0.00003	0.0015	0.001171	0.000218	0.00493
Nickel	0.00155	<0.00050	0.00573	0.00062	<0.00050	0.00127
Selenium	0.0002544	<0.000050	<0.001	0.000225	0.000076	0.000967
Zinc	0.00712	<0.0010	0.062	0.00309	<0.0010	0.0078

5.3.10 W12 – Water in the Main Pit

The water quality statistics for W12 from 2007 to 2018 are summarized below in Table 5-18. A total of 15 routine samples were collected from station W12 during the 2018 monitoring period.

Table 5-19: W12 Water Quality Results Summary (2007-2017)

W12	2007 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.06	6.20	10.60	8.09	7.84	8.23
TSS (mg/L)	17.72	<1.0	251	11.7	4.9	42.8
Nutrients (mg/L)						
Ammonia Nitrogen	2.58427	<0.0050	24	4	2.78	4.74
Nitrite Nitrogen	1.13786	<0.0050	8.78	4.91	1.86	8.49
Nitrate Nitrogen	20.4734	<0.01	141	7.57	4.57	13.2
Dissolved Metals (mg/L)						
Aluminum	0.02064	0.0016	0.124	0.0081	0.0031	0.043
Arsenic	0.000664	<0.00010	0.003	0.00043	0.00039	0.00051
Cadmium	0.00005856	<0.0000050	0.00049	0.0001085	<0.000060	<0.00020
Chromium	0.000824	<0.00010	0.0025	0.000269	<0.00010	0.00132
Copper	0.05473	0.00046	0.476	0.0436	0.0168	0.0641
Iron	0.03891	<0.0050	0.386	0.0281	0.012	0.084
Lead	0.0001884	<0.000050	0.0005	0.0002106	<0.000050	0.00208
Molybdenum	0.0484	<0.0010	0.0972	0.072	0.0543	0.0975
Nickel	0.00180	<0.0005	0.0046	0.00429	0.00305	0.0065
Selenium	0.00788	<0.00010	0.0207	0.00781	0.005880	0.0116
Zinc	0.00566	0.001	0.031	0.00529	0.0022	0.0106

5.3.11 W12A – Discharge in the Main Pit

There was no discharge from the Main Pit in 2018 and no discharge from the Main Pit in previous years.

5.3.12 W14 – Tailings Thickener Overflow

The water quality statistics for W14 from 2007 to 2018 are summarized below in Table 5-19. A total of ten routine samples were collected from station W14 during the 2018 monitoring period as the mill was shut down in October 2018 and the site became inactive.

Table 5-20: W14 Water Quality Results Summary (2007-2018)

W14	2007 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.00	7.29	8.69	8.11	8.03	8.23
TSS (mg/L)	117.3	<5	1120	36.8	15.3	63.4
Nutrients (mg/L)						
Ammonia Nitrogen	3.426	<0.05	13	7.39	2.97	12.3
Nitrite Nitrogen	1.4105	0.0183	6.19	5.28	2.78	8.42
Nitrate Nitrogen	34.9	12.3	86.7	21.5	11.1	40.0
Dissolved Metals (mg/L)						
Aluminum	0.1134	0.0078	1.91	0.0320	0.0164	0.0684
Arsenic	0.00059	<0.0002	0.0052	0.00040	0.00032	0.00055
Cadmium	0.00004701	<0.0000050	0.0003	0.0000412	<0.000010	<0.000070
Chromium	0.000807	<0.00010	0.0036	0.000200	<0.00020	<0.00020
Copper	0.01373	0.0002	0.723	0.00560	0.00223	0.00990
Iron	0.08310	<0.0050	4.8	0.0314	<0.020	0.121
Lead	0.0001944	<0.000050	0.0011	0.000120	<0.00010	0.00026
Molybdenum	0.0994	0.0458	0.181	0.123	0.103	0.158
Nickel	0.00151	<0.0005	0.0082	0.0062	0.0019	0.0109
Selenium	0.03146	0.00166	0.229	0.01069	0.00788	0.0162
Zinc	0.00471	<0.0010	0.028	0.00226	<0.0020	0.0043

5.3.13 W15 – Upper Minto Creek Storm-water Collection Point

The water quality statistics for W15 from 2007 to 2018 are summarized below in Table 5-20. A total of 15 routine samples were collected from station W15 during the 2018 monitoring period. The results for dissolved copper, dissolved aluminum, dissolved cadmium, and dissolved selenium for W15 from 2007 to 2018 are also presented in Figure 5-9 and Figure 5-10 below.

Table 5-21: W15 Water Quality Results Summary (2007-2018)

W15	2007 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	7.95	6.11	8.48	8.17	7.73	8.4
TSS (mg/L)	17.54	<1.0	370	7.96	<3.0	39.8
Nutrients (mg/L)						
Ammonia Nitrogen	0.12043	<0.0050	5.3	0.0606	0.0129	0.21
Nitrite Nitrogen	0.10152	<0.0050	3.78	0.0755	0.0034	0.224
Nitrate Nitrogen	12.2682	<0.01	265	12.96	2.7	46.7
Dissolved Metals (mg/L)						
Aluminum	0.0494	0.0019	2.65	0.02281	0.0039	0.164
Arsenic	0.000524	<0.00010	0.0022	0.00044	0.0002	0.00069
Cadmium	0.00003652	<0.0000050	0.00234	0.00001911	<0.0000050	0.0000988
Chromium	0.000878	<0.00010	0.0053	0.000181	<0.00010	0.00033
Copper	0.023728	<0.00020	0.415	0.0267	0.0149	0.0614
Iron	0.37241	<0.0050	6.48	0.1022	<0.010	0.269
Lead	0.0001914	0.000031	0.0027	0.0000513	<0.000050	0.000071
Molybdenum	0.00398	0.0001	0.113	0.00416	0.0013	0.0194
Nickel	0.00126	<0.00050	0.008	0.00093	<0.00050	0.00142
Selenium	0.002811	<0.00010	0.0504	0.00503	0.001120	0.0157
Zinc	0.0052	<0.0010	0.041	0.00371	<0.0010	0.0206

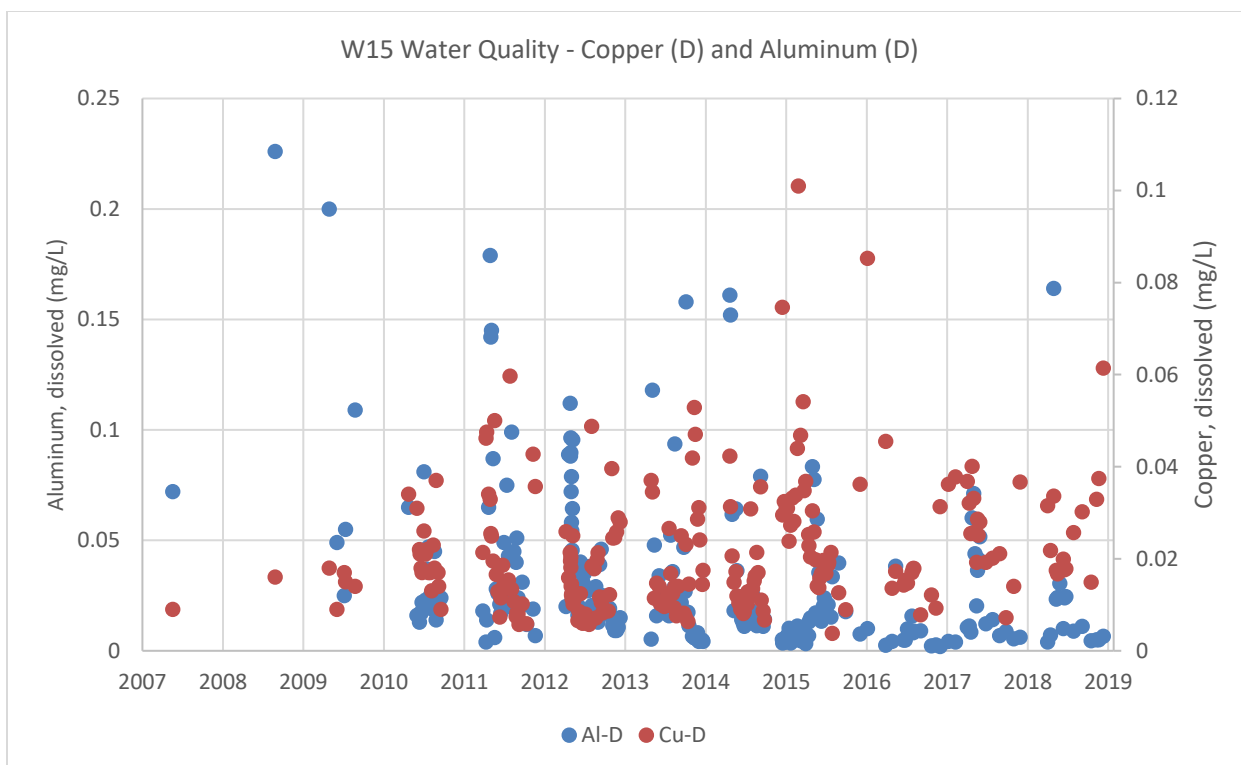


Figure 5-9: W15 Copper and Aluminum Concentrations (2007-2018)

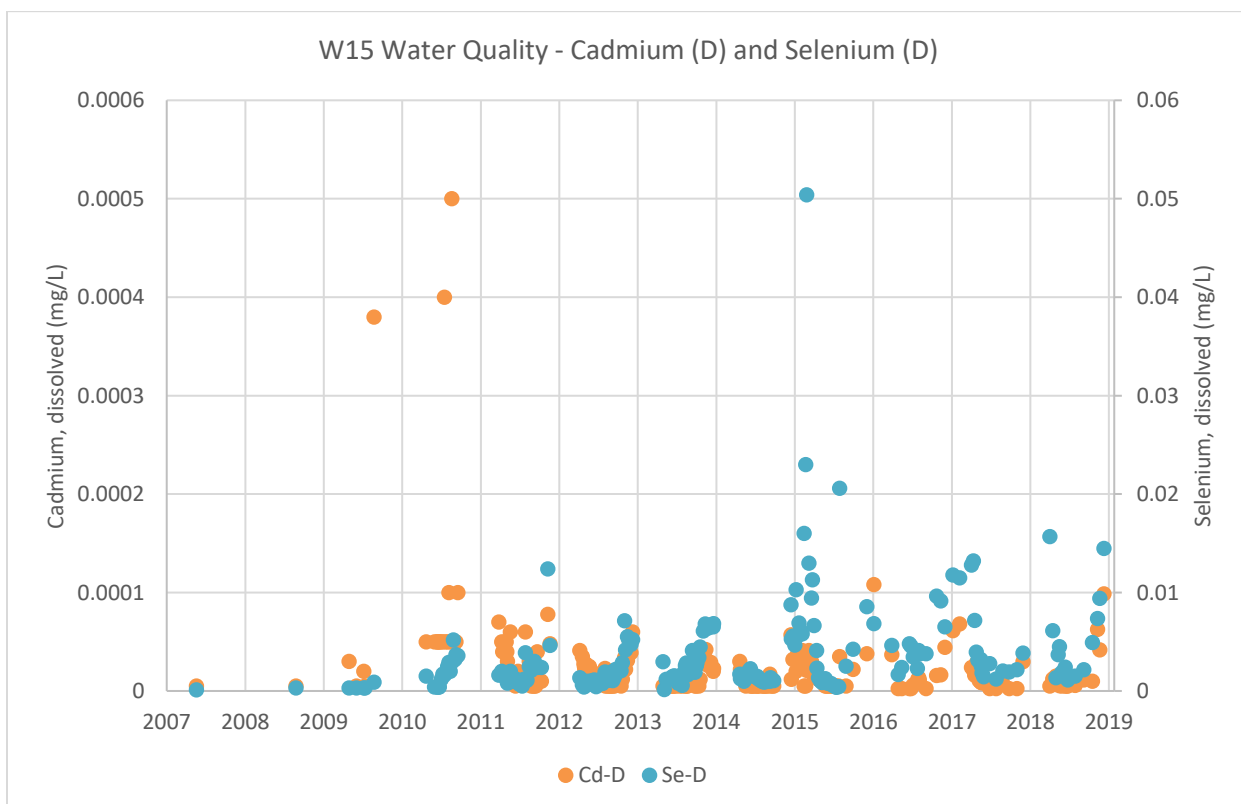


Figure 5-10: W15 Cadmium and Selenium Concentrations (2007-2018)

5.3.14 W16 – Water Storage Pond

The water quality statistics for W16 from 2007 to 2018 are summarized below in Table 5-21. A total of 34 routine samples were collected from station W16 during the 2018 monitoring period. The results for dissolved copper, dissolved aluminum, dissolved cadmium, and dissolved selenium for W16 from 2007 to 2018 are also presented in Figure 5-11 and Figure 5-12 below. An outlier in cadmium concentration for W16 collected on 5/5/2009 was removed for presenting the dataset in Figure 5-12.

Table 5-22: W16 Water Quality Results Summary (2007-2018)

W16	2007 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.00	6.74	8.81	8.25	7.79	8.43
TSS (mg/L)	7.72	<1.0	181	11.21	<3.0	123
Nutrients (mg/L)						
Ammonia Nitrogen	0.13707	<0.0050	2.00	0.0257	0.0058	0.10
Nitrite Nitrogen	0.09838	<0.0010	8.62	0.0085	0.0025	0.0216
Nitrate Nitrogen	3.4608	0.01	35	1.478	0.389	2
Dissolved Metals (mg/L)						
Aluminum	0.01685	0.0013	0.234	0.0122	0.0019	0.0485
Arsenic	0.000407	<0.00010	0.0015	0.00042	0.00028	0.00057
Cadmium	0.00003358	<0.0000050	0.00557	0.00002257	<0.0000050	0.000177
Chromium	0.000895	<0.00010	0.0172	0.000148	<0.00010	0.00029
Copper	0.02391	0.00158	0.123	0.0342	0.0196	0.0574
Iron	0.1156	0.0066	1.36	0.057	0.011	0.209
Lead	0.0001931	0.000020	<0.0010	0.0000518	<0.000050	0.000112
Molybdenum	0.005576	0.000653	0.0271	0.00279	0.00154	0.00397
Nickel	0.00123	<0.00050	0.009	0.00089	0.00053	0.00128
Selenium	0.001163	<0.00010	0.0064	0.000745	0.000370	0.000961
Zinc	0.0058	<0.0010	0.027	0.00314	<0.0010	0.0281

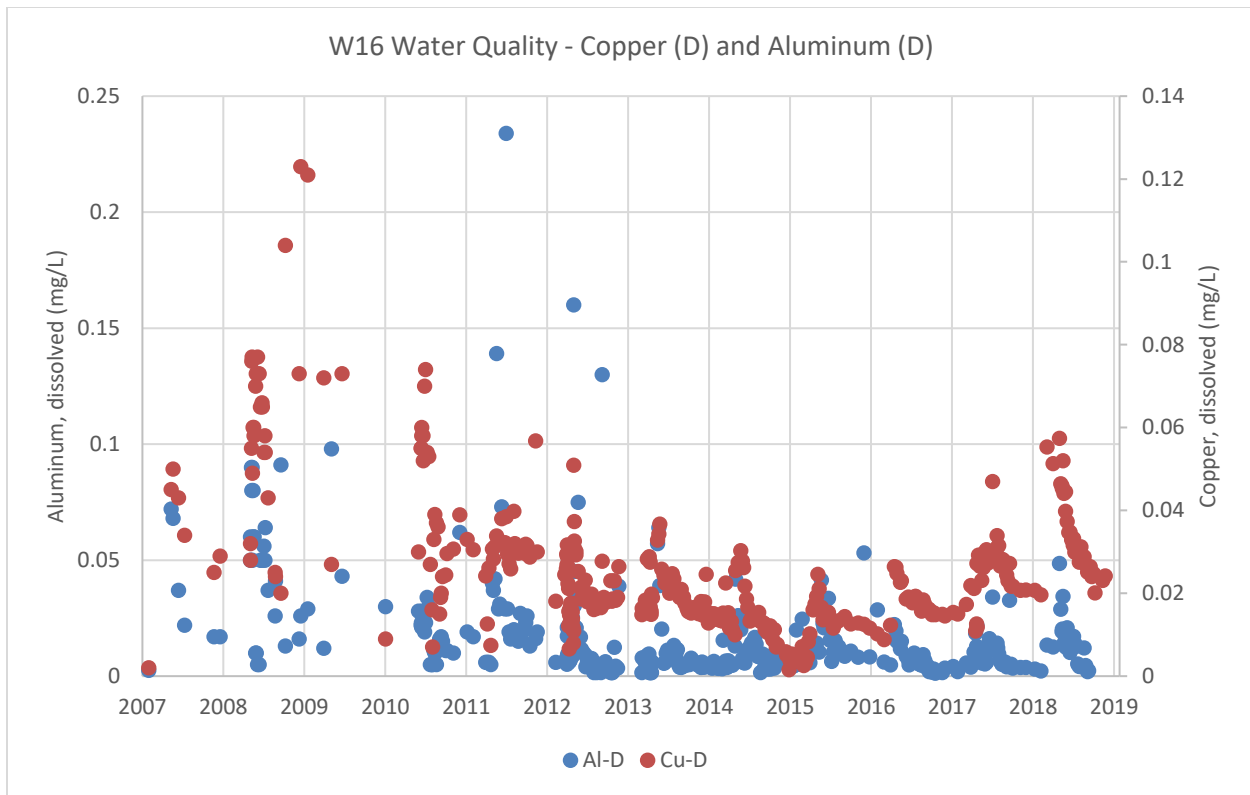


Figure 5-11: W16 Copper and Aluminum Concentrations (2007-2018)

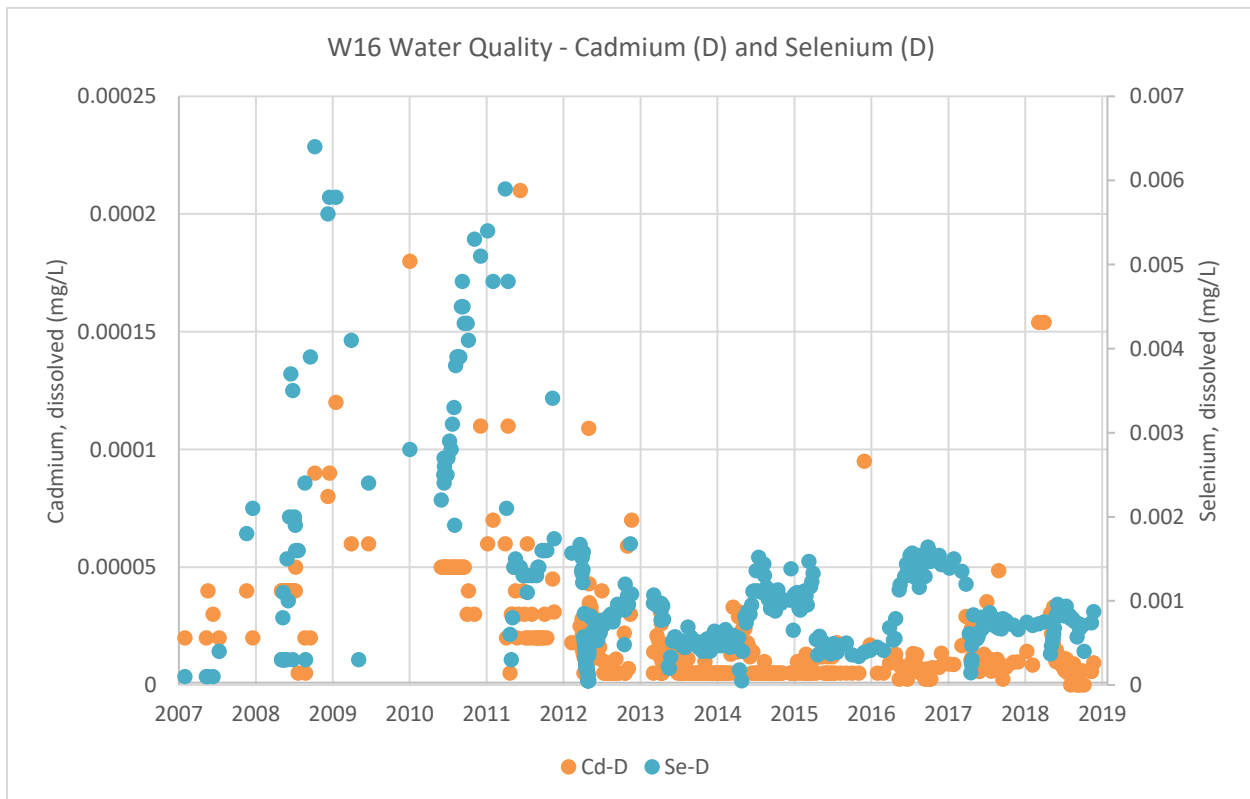


Figure 5-12: W16 Cadmium and Selenium Concentrations (2007-2018)

5.3.15 W17 – Water Storage Pond Dam Seepage

The summary results for this station are presented in the seepage section 7.4 along with trend analyses for dissolved copper, aluminum, cadmium and selenium concentrations throughout the years. A total of 57 samples were collected at this station during the 2018 monitoring period. All water from W17 was pumped back to the WSP, there was no discharge from this station.

5.3.16 W30 – Headwaters Minto Creek (northwest fork)

The water quality statistics for W30 from 2009 to 2018 are summarized below in Table 5-22. A total of seven routine samples were collected from station W30 during the 2018 monitoring period.

Table 5-23: W30 Water Quality Results Summary (2009-2018)

W33	2007 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	7.81	6.15	8.43	8.19	7.71	8.37
TSS (mg/L)	17.16	<1.0	1110	12.73	<3.0	45.3
Nutrients (mg/L)						
Ammonia Nitrogen	0.1122	<0.005	0.85	0.0248	0.0058	0.074
Nitrite Nitrogen	0.03035	<0.0010	0.579	0.01370	<0.0010	0.0538
Nitrate Nitrogen	3.385	<0.01	78.6	0.71799	<0.0050	3.01
Dissolved Metals (mg/L)						
Aluminum	0.05487	<0.001	0.217	0.0114	0.0029	0.0336
Arsenic	0.000571	0.000054	0.00132	0.00075	0.00046	0.00118
Cadmium	0.00150769	<0.0000050	0.143	0.00001169	<0.0000050	0.0000356
Chromium	0.000898	<0.00010	0.0149	0.000103	<0.00010	0.00012
Copper	0.03266	0.0067	0.179	0.0288	0.0138	0.0699
Iron	0.2042	<0.001	0.783	0.071	0.017	0.165
Lead	0.0001849	<0.000050	0.001	0.0000500	<0.000050	<0.000050
Molybdenum	0.00214	<0.0002	0.0098	0.00497	0.00139	0.00807
Nickel	0.001166	<0.00050	0.024	0.000506	<0.00050	0.00054
Selenium	0.005124	0.0004	0.343	0.001919	0.000701	0.00481
Zinc	0.00470	<0.0010	0.0164	0.00147	<0.0010	0.0031

5.3.17 W33/W33s – Above Tailings Diversion Ditches

The water quality statistics for W33 from 2009 to 2017 are summarized below in Table 5-23. A total of seven routine samples were collected from station W33 during the 2017 monitoring period. W33 was buried during construction at the end of December 2017. In 2018, the water was found seeping out of the road construction about 50 meters north of the original site and the samples were collected at that site for the 2018 monitoring period.

Table 5-24: W33 Water Quality Results Summary (2009-2018)

W33	2007 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	7.65	5.98	8.25	7.96	7.75	8.11
TSS (mg/L)	9.92	<1.0	218	22.28	<3.0	101
Nutrients (mg/L)						
Ammonia Nitrogen	0.05372	<0.0050	<0.5	0.0902	0.0163	0.416
Nitrite Nitrogen	0.01578	<0.0010	0.251	0.2349	0.0053	1.28
Nitrate Nitrogen	3.2973	<0.01	60.4	24.401	0.157	139
Dissolved Metals (mg/L)						
Aluminum	0.04601	<0.0030	0.31	0.2279	0.0214	1.13
Arsenic	0.000365	<0.00010	<0.001	0.00045	0.00033	0.00094
Cadmium	0.00002927	<0.0000050	<0.0001	0.00002437	<0.0000050	0.000103
Chromium	0.00108	0.00027	0.0022	0.00051	0.00036	0.00089
Copper	0.013630	<0.00020	0.106	0.0440	0.0200	0.136
Iron	0.15379	<0.0050	0.956	0.310	0.056	1.40
Lead	0.0001827	<0.000050	0.0007	0.0001807	<0.000050	0.000834
Molybdenum	0.000946	0.0002	0.003	0.002344	0.000564	0.0101
Nickel	0.00149	<0.0010	0.003	0.00150	0.00116	0.00163
Selenium	0.000396	<0.00010	0.006	0.000680	0.000121	0.00317
Zinc	0.00548	<0.0010	<0.01	0.00287	<0.0010	0.0099

5.3.18 W35 – Storm Water Collection Point – South Diversion Ditch

The water quality statistics for W35 from 2012 to 2018 are summarized below in Table 5-24. A total of ten routine samples were collected from station W35 during the 2018 monitoring period. The results for dissolved copper, dissolved aluminum, dissolved cadmium, and dissolved selenium for W35 from 2012 to 2018 are also presented in Figure 5-13 and Figure 5-14 below. Depending on water quality the water is routed to the TDD or to the A2S3 Pit.

Table 5-25: W35 Water Quality Results Summary (2012-2018)

W35	2009 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	7.97	7.52	8.18	7.90	6.77	8.26
TSS (mg/L)	13.67	<3.0	56.3	21.39	<1.0	465
Nutrients (mg/L)						
Ammonia Nitrogen	0.0368	0.0070	0.197	0.0448	0.0059	0.303
Nitrite Nitrogen	0.0214	0.0012	0.0552	0.03177	0.0017	0.335
Nitrate Nitrogen	13.975	0.179	89.8	5.4597	<0.020	28.7
Dissolved Metals (mg/L)						
Aluminum	0.0283	0.0099	0.0666	0.0268	0.0061	0.104
Arsenic	0.00037	0.00028	0.00066	0.00035	0.00023	0.00056
Cadmium	0.0000132	0.0000063	0.0000337	0.00001233	<0.0000050	0.000046
Chromium	0.000292	<0.00010	0.00046	0.00072	0.00018	<0.0010
Copper	0.0468	0.0251	0.0911	0.0357	0.017	0.0836
Iron	0.056	0.015	0.124	0.0878	0.0144	0.323
Lead	0.0000538	<0.000050	0.000081	0.0001389	<0.000050	<0.00020
Molybdenum	0.002609	0.000378	0.00741	0.001285	0.000485	0.0055
Nickel	0.001187	<0.00050	0.00178	0.00122	0.00064	0.00173
Selenium	0.000475	0.000102	0.00197	0.000227	<0.00010	0.00048
Zinc	0.00417	<0.0010	0.0280	0.00372	<0.0010	0.0068

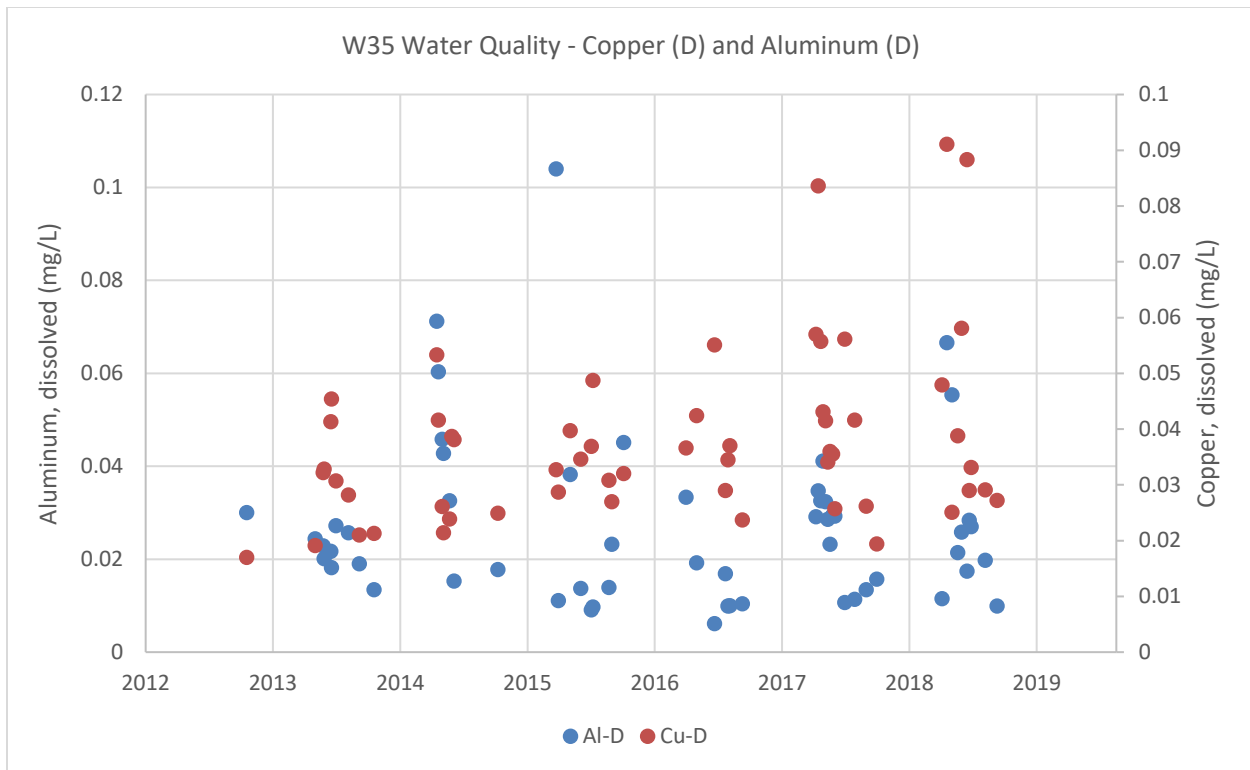


Figure 5-13: W35 Copper and Aluminum Concentrations (2012-2018)

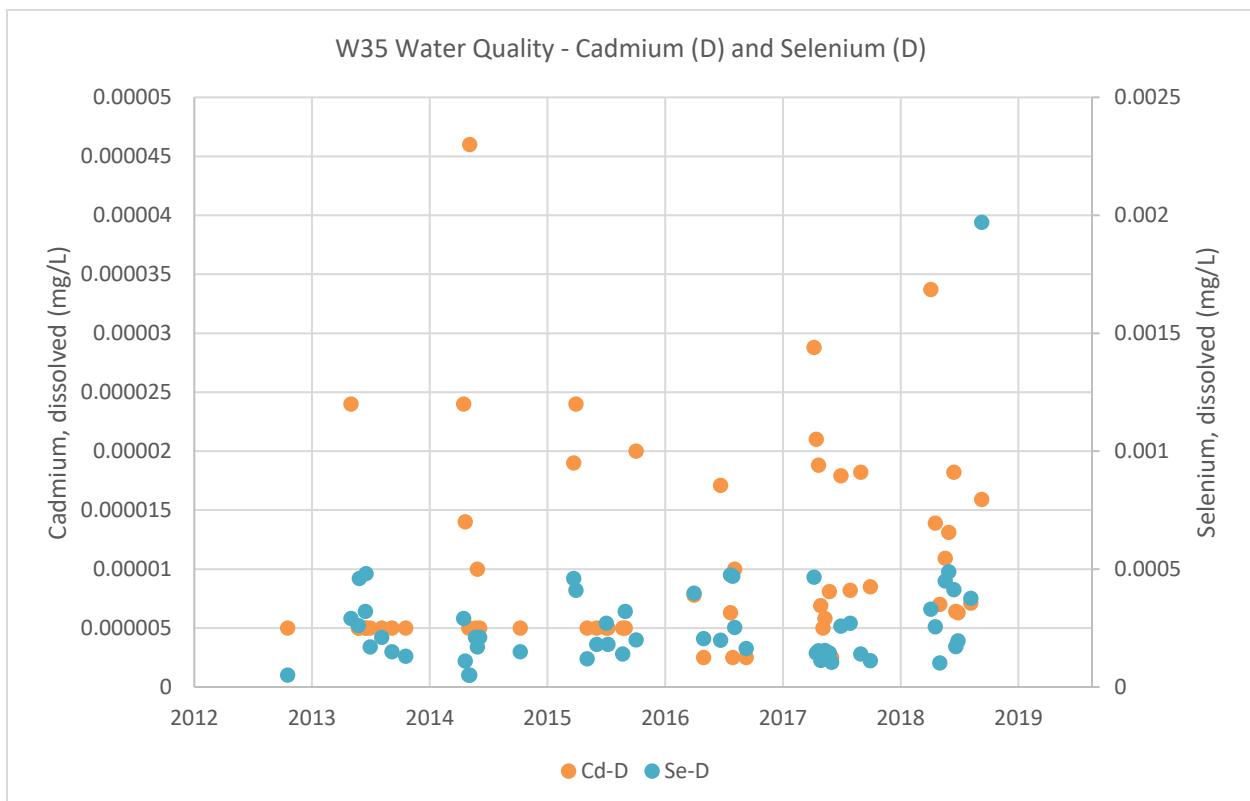


Figure 5-14: W35 Cadmium and Selenium Concentrations (2012-2018)

5.3.19 W36 – Minto Creek Detention Structure Pond

W36 was decommissioned during the construction of the Mill Valley Fill Extension Phase 2 (MVFE2) in 2015. As such, no samples were taken in 2018.

5.3.20 W37 – 100 m downstream of MCDS (W37 Collection Sump) and upstream of Water Storage Pond

W37 was decommissioned during the construction of the Mill Valley Fill Extension Phase 2 (MVFE2) in 2015 and replaced by W62. As such, no samples were taken in 2018.

5.3.21 W45– Area 2 Pit

The water quality statistics for W45 from 2012 to 2018 are summarized below in Table 5-25. A total of ten routine samples were collected from station W45 during the 2018 monitoring period. The pump was removed from the A2 pit and the sampling site was frozen October 30th, 2018.

Table 5-26: W45 Water Quality Results Summary (2012-2018)

W45	2012 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.03	7.76	8.27	8.06	7.95	8.11
TSS (mg/L)	32.68	<1.0	291	87.1	15.3	283
Nutrients (mg/L)						
Ammonia Nitrogen	5.753	0.072	37	6.49	3.96	9.63
Nitrite Nitrogen	2.2484	0.0223	11.4	4.47	2.18	5.95
Nitrate Nitrogen	23.24	1.65	77.2	17.5	11.4	24.6
Dissolved Metals (mg/L)						
Aluminum	0.0186	0.0032	0.337	0.0116	0.0079	0.0174
Arsenic	0.00090	0.00032	0.00234	0.00040	0.00034	0.00052
Cadmium	0.00011174	<0.0000050	0.000517	0.0000683	<0.000010	<0.00020
Chromium	0.000676	<0.00010	<0.0010	0.000200	<0.00020	<0.00020
Copper	0.05199	0.00025	0.276	0.00774	0.00263	0.0137
Iron	0.06589	<0.0050	0.726	0.0260	<0.020	0.085
Lead	0.0001672	<0.000050	0.00066	0.000103	<0.00010	0.00012
Molybdenum	0.0617	0.0033	0.121	0.1029	0.0859	0.134
Nickel	0.00267	<0.0010	0.0082	0.0067	0.0042	0.0095
Selenium	0.01047	0.00048	0.0298	0.00845	0.00733	0.0130
Zinc	0.00911	<0.0010	0.0673	0.00995	<0.0020	0.0851

5.3.22 W46 – Minto Creek, Downstream of W7 and W6

The water quality statistics for W46 from 2012 to 2018 are summarized below in Table 5-26. A total of 9 routine samples were collected from station W46 during the 2018 monitoring period.

Table 5-27: W46 Water Quality Results Summary (2012-2018)

W46	2012-2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.09	7.49	8.35	8.2	8.09	8.37
TSS (mg/L)	44.28	<1.0	693	25.72	<3.0	177
Nutrients (mg/L)						
Ammonia Nitrogen	0.0289	0.0062	0.16	0.0207	0.0072	0.0385
Nitrite Nitrogen	0.00448	<0.0010	0.0242	0.0016	<0.0010	0.0063
Nitrate Nitrogen	0.3484	0.0130	3.28	0.1488	<0.025	0.338
Dissolved Metals (mg/L)						
Aluminum	0.00960	<0.0030	0.0449	0.00820	0.0032	0.0253
Arsenic	0.00046	0.0003	0.00078	0.00046	0.00043	0.00055
Cadmium	0.00000965	<0.0000050	0.0000217	0.00000709	<0.0000050	0.0000191
Chromium	0.00074	0.00011	<0.0010	0.000154	<0.00010	0.0002
Copper	0.00271	0.00089	0.0108	0.00228	0.00155	0.00409
Iron	0.1722	0.0183	0.646	0.167	0.078	0.302
Lead	0.0001524	<0.000050	0.00022	0.00005	<0.000050	<0.000050
Molybdenum	0.00205	<0.0010	0.007	0.00199	0.00119	0.00293
Nickel	0.00112	0.00068	0.0021	0.00093	0.0008	0.00119
Selenium	0.000225	<0.00010	0.000887	0.000193	0.000114	0.000252
Zinc	0.00421	<0.0010	0.015	0.00109	<0.0010	0.0015

5.3.23 W47 – Area 118 Pit Water

W47 was decommissioned and backfilled during the construction of the Area 2 Stage 3 pit in January 2017. As such, no samples were taken in 2018.

5.3.24 W50 – Minto Creek, 50m Downstream of the Toe of the Water Storage Pond Dam

The water quality statistics for W50 are presented in Section 5.2.1.2 above.

5.3.25 W51 – Area 2 Stage 3 Pit

The water quality statistics for W51 from 2017 are summarized below in Table 5-27. W51 was developed in 2017 with the mining activities in the Area 2 Stage 3 pit. A total of three routine samples were collected from station W51 during the 2018 monitoring period. No other samples were collected because the sump was consumed by mining activities.

Table 5-28: W51 Water Quality Results Summary (2017-2018)

W51	2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.27	8.12	8.41	8.05	7.88	8.17
TSS (mg/L)	36.9	3.1	70.7	214.8	7.3	505
Nutrients (mg/L)						
Ammonia Nitrogen	1.284	0.627	1.94	6.85	3.47	12.2
Nitrite Nitrogen	0.341	0.126	0.555	1.030	0.430	1.51
Nitrate Nitrogen	7.96	4.13	11.8	23.3	16.1	34.8
Dissolved Metals (mg/L)						
Aluminum	0.0034	0.0024	0.0045	0.0034	0.0012	0.0055
Arsenic	0.00084	0.00083	0.00084	0.00096	0.00028	0.00169
Cadmium	0.000038	<0.000025	<0.000050	0.0001394	0.0000142	0.000230
Chromium	0.0001	<0.00010	<0.00010	0.000143	<0.00010	<0.00020
Copper	0.0626	0.0354	0.0898	0.1306	0.0919	0.161
Iron	0.01	<0.010	<0.010	0.0323	<0.010	0.067
Lead	0.00005	<0.000050	<0.000050	0.0001067	<0.000050	0.00022
Molybdenum	0.0301	0.0269	0.0333	0.02499	0.00436	0.0411
Nickel	0.00050	<0.00050	<0.00050	0.00088	0.00058	0.0013
Selenium	0.00296	0.002730	0.00319	0.00466	0.00406	0.00551
Zinc	0.0014	<0.0010	0.0017	0.0095	0.0022	0.0222

5.3.26 W52 – Ridgetop North Pit

The Ridgetop North Pit was not developed in 2018; therefore, water quality results are not available.

5.3.27 W53 – Ridgetop South Pit

The Ridgetop South Pit was not developed in 2018; therefore, water quality results are not available.

5.3.28 W54 – Main Pit Dam Seepage

The Main Pit Dam was not developed in 2018; therefore, water quality results are not available.

5.3.29 W55 – Tailings Diversion Ditch

The water quality statistics for W55 from 2016 and 2018 are summarized below in Table 5-28. 12 routine samples were collected from station W55 during the 2018 monitoring period.

Table 5-29: W55 Water Quality Results Summary (2016-2018)

W55	2016 -2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	7.82	7.52	8.10	8.05	7.88	8.31
TSS (mg/L)	13.62	<3.0	43.3	5.64	<3.0	17.7
Nutrients (mg/L)						
Ammonia Nitrogen	0.0189	0.0131	0.0390	0.0223	0.0067	0.0819
Nitrite Nitrogen	0.00268	<0.0010	0.0060	0.01808	<0.0010	0.144
Nitrate Nitrogen	0.06353	<0.0050	0.221	8.621	0.165	20.9
Dissolved Metals (mg/L)						
Aluminum	0.0554	0.0265	0.0691	0.0243	0.0116	0.0577
Arsenic	0.00075	0.00060	0.00114	0.00052	0.00044	0.00084
Cadmium	0.0000179	0.0000056	0.0000339	0.0000117	0.0000071	0.0000270
Chromium	0.00037	0.00029	0.00047	0.00032	0.00020	0.00047
Copper	0.0760	0.0149	0.140	0.0530	0.0294	0.0877
Iron	0.164	0.114	0.338	0.060	0.023	0.174
Lead	0.0000640	<0.000050	0.000104	0.0000507	<0.000050	0.000058
Molybdenum	0.001300	0.000633	0.00297	0.00167	0.00110	0.00223
Nickel	0.00188	0.00140	0.00219	0.00121	0.00080	0.00154
Selenium	0.000346	0.000158	0.000675	0.000505	0.000272	0.000985
Zinc	0.00140	<0.0010	0.0020	0.00170	<0.0010	0.0047

5.3.30 W62 – Mill Valley Fill Extension Phase 2 Collection Sump

The water quality statistics for W62 from 2016 and 2018 are summarized below in Table 5-29. A total of 12 routine samples were collected from station W62 during the 2018 monitoring period.

Table 5-30: W62 Water Quality Results Summary (2016-2018)

W62	2016-2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.25	7.90	8.42	8.27	7.89	8.46
TSS (mg/L)	7.97	<3.0	58	10.32	<3.0	35.3
Nutrients (mg/L)						
Ammonia Nitrogen	0.0244	<0.0050	0.23	0.013	0.0057	0.0242
Nitrite Nitrogen	0.03274	<0.0010	0.119	0.04299	<0.0050	0.0786
Nitrate Nitrogen	6.7867	0.0084	11.3	9.13	3.88	26.5
Dissolved Metals (mg/L)						
Aluminum	0.0053	0.0022	0.0308	0.0048	0.0017	0.0108
Arsenic	0.00037	0.00011	0.00044	0.00051	0.00036	0.00072
Cadmium	0.00001886	<0.0000050	0.0000383	0.0000329	0.0000175	0.0000798
Chromium	0.000222	<0.00010	<0.0010	0.000193	<0.00010	0.00037
Copper	0.04656	0.00195	0.0633	0.0573	0.0379	0.0711
Iron	0.0363	0.0113	0.072	0.0315	<0.010	0.057
Lead	0.0000627	<0.000050	<0.00020	0.00005	<0.000050	<0.000050
Molybdenum	0.006286	0.00042	0.00822	0.00875	0.00506	0.0138
Nickel	0.00105	0.00082	0.00161	0.00111	0.00074	0.00159
Selenium	0.003213	0.000095	0.00485	0.00387	0.001590	0.0115
Zinc	0.1563	0.0018	0.799	0.0642	0.0138	0.176

5.3.31 MC-1 – Minto Creek Upstream of Canyon near Km 8 on Mine Access Road

The water quality statistics for MC-1 from 2009 to 2018 are summarized below in Table 5-30. A total of 29 routine samples were collected from station MC-1 during the 2018 monitoring period.

Table 5-31: MC-1 Water Quality Results Summary (2009-2018)

MC1	2009 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.15	5.27	8.54	8.28	7.68	8.54
TSS (mg/L)	53.72	<1.0	793	26.46	<3.0	321
Nutrients (mg/L)						
Ammonia Nitrogen	0.02997	<0.0050	0.36	0.00790	<0.0050	0.0151
Nitrite Nitrogen	0.00522	<0.0010	0.0342	0.00122	<0.0010	0.0052
Nitrate Nitrogen	0.41159	<0.0050	7.3	0.07835	<0.0050	0.439
Dissolved Metals (mg/L)						
Aluminum	0.01556	<0.0010	0.07	0.0120	0.0043	0.0678
Arsenic	0.000575	<0.00010	0.00125	0.00052	0.00031	0.00065
Cadmium	0.00001194	<0.0000050	0.0002	0.00000768	<0.0000050	0.0000301
Chromium	0.000237	<0.00010	0.0021	0.000198	<0.00010	0.00040
Copper	0.002865	<0.00020	0.0106	0.00356	0.00149	0.0138
Iron	0.2147	<0.010	1.11	0.088	0.018	0.173
Lead	0.0001682	<0.000050	<0.00050	0.0000500	<0.000050	<0.000050
Molybdenum	0.0017341	<0.000050	0.008	0.001564	0.000365	0.00249
Nickel	0.001238	<0.00050	0.004	0.001039	<0.00050	0.00168
Selenium	0.0002550	<0.000050	0.0022	0.000174	0.000082	0.000420
Zinc	0.00418	<0.0010	0.0334	0.00162	<0.0010	0.0070

5.3.32 WTP and RO – Treated Water

An explanation of operations and water quality statistics for WTP and RO are presented in Section 5.2.3.3 above.

5.3.33 C4 – Tributary on the south side of Minto Creek

The water quality statistics for C4 from 2012 to 2018 are summarized below in Table 5-31. A total of six routine samples were collected from station C4 during the 2018 monitoring period.

Table 5-32: C4 Water Quality Results Summary (2012-2018)

C4	2012 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.05	7.59	8.31	8.24	8.03	8.53
TSS (mg/L)	172.49	2.3	1260	3.14	<3.0	3.7
Nutrients (mg/L)						
Ammonia Nitrogen	0.0773	0.005	0.36	0.00919	<0.0050	0.0145
Nitrite Nitrogen	0.00488	<0.0010	0.0229	0.00100	<0.0010	<0.0010
Nitrate Nitrogen	0.10738	<0.0050	2.31	0.01906	<0.0050	0.0314
Dissolved Metals (mg/L)						
Aluminum	0.0225	0.0048	0.0622	0.0098	0.0075	0.0141
Arsenic	0.00130	0.00029	0.00559	0.00060	0.00034	0.00083
Cadmium	0.00001031	<0.0000050	0.0000337	0.00000721	<0.0000050	0.0000155
Chromium	0.00077	0.00022	0.0013	0.000261	<0.00010	0.00036
Copper	0.00195	0.00087	0.0102	0.00280	0.00120	0.00611
Iron	1.263	0.056	14.2	0.242	0.015	0.458
Lead	0.0001398	<0.000050	0.00022	0.0000500	<0.000050	<0.000050
Molybdenum	0.001128	0.000379	0.0068	0.000962	0.000602	0.00177
Nickel	0.00227	<0.0010	0.0061	0.001481	<0.00050	0.00199
Selenium	0.000122	0.000076	0.00068	0.000154	0.000065	0.000386
Zinc	0.00148	<0.0010	0.0031	0.00118	<0.0010	0.0020

5.3.34 C10 – Tributary on the south side of Minto Creek

The water quality statistics for C10 from 2012 to 2018 are summarized below in Table 5-32. Though the site was monitored six times during the 2018 monitoring period, only one sample was collected on April 16th, 2018.

Table 5-33: C10 Water Quality Results Summary (2012-2018)

C10	2012 - 2017 Summary Statistics			2018 Summary Results
Parameters	Mean	Min	Max	16-Apr-2018 Results
pH	8.15	7.73	8.39	8.52
TSS (mg/L)	276.69	<1.0	2210	3
Nutrients (mg/L)				
Ammonia Nitrogen	0.06310	<0.0050	0.2	0.005
Nitrite Nitrogen	0.00782	<0.0010	0.0344	0.001
Nitrate Nitrogen	0.12328	<0.0050	0.417	0.005
Dissolved Metals (mg/L)				
Aluminum	0.2373	0.0075	5.84	0.0107
Arsenic	0.00118	0.0004	0.00551	0.00055
Cadmium	0.00002217	<0.0000050	0.000344	0.0000181
Chromium	0.00110	0.00017	0.0093	0.00022
Copper	0.00281	0.00091	0.0339	0.00607
Iron	1.443	0.033	19.9	0.027
Lead	0.0004478	<0.000050	0.00772	0.00005
Molybdenum	0.001056	0.000384	0.0019	0.00119
Nickel	0.00259	0.00096	0.0215	0.0007
Selenium	0.000105	0.000063	0.000210	0.000294
Zinc	0.00601	<0.0010	0.0603	0.0024

5.3.35 MN – Minto North Pit Water

The water quality statistics for MN from 2015 to 2018 are summarized below in Table 5-33. Five routine samples were collected from station MN during the 2018 monitoring period, once safe access to the pit water could be established. The water was frozen as of October 5th, 2018.

Table 5-34: MN Water Quality Results Summary (2015-2018)

MN	2015 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	7.86	7.56	8.16	8.03	7.84	8.23
TSS (mg/L)	59.50	<3.0	142	271.34	<3.0	1040
Nutrients (mg/L)						
Ammonia Nitrogen	12.698	0.612	51	1.384	0.166	7.10
Nitrite Nitrogen	4.950	0.105	14.7	0.1363	0.0300	0.318
Nitrate Nitrogen	139.3	14.2	342	17.80	7.71	26.5
Dissolved Metals (mg/L)						
Aluminum	0.0082	0.0025	0.0266	0.0073	0.0018	0.0196
Arsenic	0.00062	0.0002	0.00142	0.00040	0.00035	0.00047
Cadmium	0.0000619	<0.000010	0.000283	0.0000714	0.0000312	0.000118
Chromium	0.000372	<0.00010	<0.0010	0.000100	<0.00010	<0.00010
Copper	0.1500	0.0119	0.562	0.03361	0.00837	0.100
Iron	0.0966	<0.010	0.449	0.0161	<0.010	0.046
Lead	0.0000958	<0.000050	<0.00020	0.0005014	<0.000050	0.00225
Molybdenum	0.0209	0.0077	0.0384	0.0206	0.0165	0.0262
Nickel	0.001284	<0.00050	0.0041	0.000500	<0.00050	<0.00050
Selenium	0.01556	0.00385	0.0627	0.01388	0.00957	0.0192
Zinc	0.00477	<0.0010	0.0159	0.01669	<0.0010	0.0884

5.3.36 MN-0.2 – Upper West Arm of McGinty Creek

The water quality statistics for MN-0.2 from 2009 to 2018 are summarized below in Table 5-34. A total of six routine samples were collected from station MN-0.2 during the 2018 monitoring period.

Table 5-35: MN-0.2 Water Quality Results Summary (2011-2018)

MN-0.2	2009 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	7.35	6.55	7.85	7.44	7.20	7.58
TSS (mg/L)	18.54	<1.0	300	52.51	<3.0	395
Nutrients (mg/L)						
Ammonia Nitrogen	0.0218	<0.005	0.11	0.00680	<0.0050	0.0101
Nitrite Nitrogen	0.00820	<0.0010	<0.050	0.00100	<0.0010	<0.0010
Nitrate Nitrogen	0.03399	<0.0020	0.23	0.00521	<0.0050	0.0067
Dissolved Metals (mg/L)						
Aluminum	0.0756	0.0337	0.199	0.0933	0.0713	0.122
Arsenic	0.000562	0.00025	0.00388	0.00043	0.00025	0.00053
Cadmium	0.00001211	<0.0000050	0.000053	0.00000609	<0.0000050	0.0000137
Chromium	0.00067	0.0002	0.0011	0.000512	0.00026	<0.00070
Copper	0.00265	0.00128	0.00527	0.00333	0.00204	0.00842
Iron	0.625	0.084	10.3	0.336	0.158	0.496
Lead	0.0001055	0.000009	0.000271	0.0000500	<0.000050	<0.000050
Molybdenum	0.000500	<0.00005	<0.0010	0.000187	0.000121	0.000243
Nickel	0.00161	0.00104	0.00272	0.00129	0.00102	0.00145
Selenium	0.0000820	<0.000040	0.00012	0.000082	0.000060	0.000103
Zinc	0.00346	0.0001	0.0131	0.00141	<0.0010	0.0043

5.3.37 MN-0.5 – West Arm of McGinty Creek

The water quality statistics for MN-0.5 from 2009 to 2018 are summarized below in Table 5-35. A total of seven routine samples were collected from station MN-0.5 during the 2018 monitoring period.

Table 5-36: MN-0.5 Water Quality Results Summary (2009-2018)

MN-0.5	2009 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	7.88	7.1	8.27	8.02	7.86	8.14
TSS (mg/L)	68.46	<1.0	737	7.85	<3.0	15.4
Nutrients (mg/L)						
Ammonia Nitrogen	0.02745	<0.0050	0.33	0.00532	<0.0050	0.0074
Nitrite Nitrogen	0.00722	<0.0010	<0.050	0.00100	<0.0010	<0.0010
Nitrate Nitrogen	0.08573	<0.0050	1.69	0.03705	<0.0050	0.116
Dissolved Metals (mg/L)						
Aluminum	0.03706	<0.0030	0.580	0.0157	0.0102	0.0334
Arsenic	0.000442	0.00026	0.00089	0.00037	0.00030	0.00045
Cadmium	0.00001432	<0.0000050	0.000186	0.00000696	<0.0000050	0.0000146
Chromium	0.00057	<0.0001	0.0016	0.000232	0.00012	0.00041
Copper	0.00213	0.00071	0.0264	0.00198	0.00111	0.00371
Iron	0.1692	0.0062	0.929	0.065	0.025	0.139
Lead	0.0001183	0.000006	0.000991	0.0000500	<0.000050	<0.000050
Molybdenum	0.000929	0.00011	0.00143	0.000909	0.000479	0.00113
Nickel	0.00118	0.00048	0.00432	0.00093	0.00063	0.00124
Selenium	0.000192	0.00005	0.00063	0.000183	0.000161	0.000212
Zinc	0.00363	0.00016	0.0459	0.00141	<0.0010	0.0026

5.3.38 MN-1.5 – Upper East Arm of McGinty Creek

The water quality statistics for MN-1.5 from 2009 to 2018 are summarized below in Table 5-36. A total of six routine samples were collected from station MN-1.5 during the 2018 monitoring period.

Table 5-37: MN-1.5 Water Quality Results Summary (2010-2018)

MN-0.5	2009 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	7.38	6	8.1	7.72	7.42	7.90
TSS (mg/L)	253.08	<1	8200	7.10	<3.0	20.1
Nutrients (mg/L)						
Ammonia Nitrogen	0.05357	<0.0050	0.66	0.00755	<0.0050	0.0105
Nitrite Nitrogen	0.00692	<0.0010	0.053	0.00100	<0.0010	<0.0010
Nitrate Nitrogen	0.03573	<0.0050	0.2	0.00915	<0.0050	0.0144
Dissolved Metals (mg/L)						
Aluminum	0.1031	0.0282	0.259	0.0574	0.0350	0.0720
Arsenic	0.000500	0.00015	0.00113	0.00038	0.00031	0.00047
Cadmium	0.00001741	<0.0000050	0.000106	0.00000832	<0.0000050	0.0000249
Chromium	0.00050	0.0002	0.0009	0.000580	0.00042	0.00071
Copper	0.00594	0.00278	0.00983	0.00546	0.00472	0.00622
Iron	0.599	0.126	1.62	0.253	0.074	0.451
Lead	0.0000618	0.000008	0.000527	0.0000500	<0.000050	<0.000050
Molybdenum	0.000357	0.00008	0.000924	0.000316	0.000264	<0.00040
Nickel	0.00125	0.00078	0.00233	0.00109	0.00104	0.00114
Selenium	0.000079	<0.00004	0.00015	0.000075	0.000063	0.000091
Zinc	0.00348	0.0003	0.012	0.00158	<0.0010	0.0040

5.3.39 MN-2.5 – East Arm of McGinty Creek

The water quality statistics for MN-2.5 from 2009 to 2018 are summarized below in Table 5-37. A total of seven routine samples were collected from station MN-2.5 during the 2018 monitoring period.

Table 5-38: MN-2.5 Water Quality Results Summary (2010-2018)

MN-2.5	2009 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	7.87	7.1	8.5	7.96	7.81	8.17
TSS (mg/L)	38.44	<1.0	350	32.50	<3.0	80.0
Nutrients (mg/L)						
Ammonia Nitrogen	0.02982	<0.0050	0.3	0.00838	<0.0050	0.0106
Nitrite Nitrogen	0.00688	<0.0010	<0.050	0.00100	<0.0010	<0.0010
Nitrate Nitrogen	0.04261	<0.0050	<0.20	0.01929	<0.0050	0.0599
Dissolved Metals (mg/L)						
Aluminum	0.0227	0.0050	0.112	0.0124	0.0068	0.0185
Arsenic	0.000416	0.00016	0.00149	0.00032	0.00023	0.00038
Cadmium	0.00001318	<0.0000050	0.000075	0.00000644	<0.0000050	0.0000130
Chromium	0.00050	<0.0001	<0.0010	0.000183	<0.00010	0.00030
Copper	0.00208	0.00071	0.00463	0.00201	0.00139	0.00263
Iron	0.2039	0.0225	0.867	0.054	0.040	0.085
Lead	0.0001041	<0.000005	0.000822	0.0000500	<0.000050	<0.000050
Molybdenum	0.000733	0.00011	0.00117	0.000595	0.000289	0.000774
Nickel	0.001257	0.00073	0.00376	0.00106	0.00070	0.00136
Selenium	0.0000911	0.00004	0.00038	0.000090	0.000067	0.000129
Zinc	0.00286	0.0004	0.0061	0.00157	<0.0010	0.0026

5.3.40 MN-4.5 – McGinty Creek near confluence with Yukon River

The water quality statistics for MN-4.5 from 2009 to 2018 are summarized below in Table 5-38. A total of six routine samples were collected from station MN-4.5 during the 2018 monitoring period.

Table 5-39: MN-4.5 Water Quality Results Summary (2010-2018)

MN-4.5	2009- 2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	7.90	7.1	8.26	8.04	7.78	8.14
TSS (mg/L)	38.71	<1.0	570	7.04	<3.0	30.7
Nutrients (mg/L)						
Ammonia Nitrogen	0.02362	<0.0050	0.27	0.00618	<0.0050	0.0082
Nitrite Nitrogen	0.00412	<0.0010	0.017	0.00100	<0.0010	<0.0010
Nitrate Nitrogen	0.07671	<0.0050	0.323	0.04322	<0.0050	0.123
Dissolved Metals (mg/L)						
Aluminum	0.0266	0.0044	0.174	0.0133	0.0093	0.0241
Arsenic	0.000402	0.00019	0.00065	0.00036	0.00027	0.00038
Cadmium	0.00001323	<0.0000050	0.000135	0.00000549	<0.0000050	0.0000089
Chromium	0.000298	<0.00010	<0.0010	0.000215	0.00010	<0.00030
Copper	0.00208	0.00113	0.00471	0.00224	0.00158	0.00511
Iron	0.1372	<0.010	0.562	0.045	0.025	0.056
Lead	0.0000649	<0.000005	0.000467	0.0000620	<0.000050	0.000146
Molybdenum	0.000795	0.00017	0.00122	0.000895	0.000752	0.00100
Nickel	0.001154	0.00054	0.00188	0.00098	0.00068	0.00110
Selenium	0.000153	0.00006	0.000366	0.000169	0.000120	0.000213
Zinc	0.00215	0.0002	0.0144	0.00118	<0.0010	0.0017

5.3.41 UG1 – Minto South Underground Mine Dewatering

The water quality statistics for UG1 from 2015 to 2018 are summarized below in Table 5-39. A total of 13 routine samples were collected from station UG1 during the 2018 monitoring period.

Table 5-40: UG1 Water Quality Results Summary (2015-2018)

UG1	2015 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	7.89	7.70	8.14	7.91	7.86	7.98
TSS (mg/L)	118.3	3.8	545	254.7	24	886
Nutrients (mg/L)						
Ammonia Nitrogen	20.72	6.01	75	7.02	1.69	16.7
Nitrite Nitrogen	1.394	0.344	3.18	0.705	0.313	1.04
Nitrate Nitrogen	37.4	13.2	81.9	12.81	2.33	27.1
Dissolved Metals (mg/L)						
Aluminum	0.0304	0.0067	0.51	0.0145	0.0048	0.0492
Arsenic	0.00118	0.00056	0.0026	0.00101	0.00071	0.00156
Cadmium	0.0001539	<0.000010	0.000398	0.0001296	0.000014	0.000341
Chromium	0.000502	0.00012	0.00228	0.000362	<0.00010	0.00261
Copper	0.0224	0.00374	0.178	0.02274	0.00641	0.0717
Iron	0.0538	0.0052	1.16	0.0162	<0.010	<0.020
Lead	0.0001393	<0.000050	0.00063	0.0000808	<0.000050	<0.00010
Molybdenum	0.0203	0.0083	0.0394	0.0219	0.0162	0.0266
Nickel	0.00292	0.00110	0.007	0.00187	0.00061	0.00339
Selenium	0.00115	0.000220	0.00557	0.001242	0.000510	0.00185
Zinc	0.0174	<0.0020	0.134	0.0101	0.0015	0.0325

5.3.42 UG2 – Wildfire Underground Mine Dewatering

This station was not established in 2018.

5.3.43 UG3 – Copper Keel Underground Mine Dewatering

This station was not established in 2018.

5.3.44 UG4 – Minto East Underground Mine Dewatering

The UG4 station was established in June of 2018. Water Quality results for 2018 are summarized below in Table 5-40. A total of 7 routine samples were collected from station UG4 during the 2018 monitoring period.

Table 5-41: UG4 Water Quality Results Summary (2018)

UG4	2018 Summary Statistics		
Parameters	Mean	Min	Max
pH	8.00	7.90	8.10
TSS (mg/L)	399.3	7.2	1230
Nutrients (mg/L)			
Ammonia Nitrogen	3.1967	0.097	15.1
Nitrite Nitrogen	0.294	0.066	0.642
Nitrate Nitrogen	5.751	0.439	25.9
Dissolved Metals (mg/L)			
Aluminum	0.0081	0.0022	0.0154
Arsenic	0.00103	0.00094	0.00134
Cadmium	0.0001134	0.0000398	0.000234
Chromium	0.000119	<0.00010	0.00023
Copper	0.03123	0.00167	0.0753
Iron	0.0159	<0.010	0.037
Lead	0.000147	<0.000050	0.000626
Molybdenum	0.021	0.0182	0.0241
Nickel	0.00132	<0.00050	0.0032
Selenium	0.00342	0.001350	0.00855
Zinc	0.0045	0.0018	0.0083

6 Groundwater Monitoring Program

Groundwater monitoring program details are provided in section 2.2 of the Minto Mine Environmental Monitoring, Surveillance and Reporting Plan. The primary monitoring objective of the groundwater monitoring program is to identify potential impacts on groundwater from Minto Mine.

Mine facilities that are monitored for groundwater impacts include, but are not limited to the DSTSF, Mill area, Main Pit, Area 2 Pit, Minto North Pit, waste rock dumps, and the Water Storage Pond. Additionally, groundwater monitoring of hydrogeological conditions in areas of proposed future mine components including the Ridgetop North Pit and Ridgetop South Pit is also conducted. The Groundwater Monitoring Program is comprised of operational and baseline monitoring. Water quality samples for the program are collected according to standard procedures such as those summarized in the ASTM (2007) *Standard Guide for Sampling Ground-Water Monitoring Wells*. The main components of the groundwater monitoring program include groundwater quality, vibrating wire piezometers, and ground temperature cable monitoring.

6.1 Groundwater Quality Monitoring Conformance

Minto's 2018 conformance with groundwater sampling requirements is summarized in Table 6-1, below. Quality Assurance and Quality Control (QA/QC) sampling is not included in Table 6-1, but is described in Section 6-2.

Sampling of wells and drive points was conducted as per the EMSRP and GW Plan 2016-02 requirements and the Adaptive Management Plan for groundwater as monthly or quarterly frequency. Samples that were missed for MW09-03 coincided with Westbay annual maintenance.

Table 6-1: Groundwater Quality Monitoring Conformance Summary (2018)

Mine Project Component	Monitoring Installation	Quality	Level	Monitoring Frequency	2018 Groundwater Compliance
Up-gradient of Mine Activities	MW17-08-01	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW17-08-02	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW17-08-03	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW17-08-04	X	X	Quarterly	2 of 4 collected. Sample port was dry in Q1 and Q2 of 2018.
Southwest Waste Dump	MW12-DP1	X	X	Quarterly	No samples collected. DP was destroyed in August 2017.
	MW12-DP2	X	X	Quarterly	No samples collected. DP was dry in 2018.
	MW12-DP3	X	X	Quarterly	No samples collected. DP was dry in 2018.
	MW17-09-01	X	X	Quarterly	No samples collected. Well was frozen from Q1 to Q2 and found dry from Q3 to Q4.
Main Waste Dump	MW09-01-01	X	X	Quarterly	Since MW09-01 has been dry since October 2014 it was replaced by MW17-10.
	MW09-01-02	X	X	Quarterly	Since MW09-01 has been dry since October 2014 it was replaced by MW17-10.
	MW09-01-03	X	X	Quarterly	Since MW09-01 has been dry since October 2014 it was replaced by MW17-10.
	MW17-10-1	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW17-10-2	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW17-10-3	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW17-10-4	X	X	Quarterly	No samples were collected. The port was found dry during all of 2018.
Dry Stack Tailings Storage Facility and Mill Valley Fill Expansion	MW12-06-01		X	Quarterly	4 of 4 collected. Sampled as per AMP schedule.
	MW12-06-02	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW12-06-03		X	Quarterly	4 of 4 collected. Sampled as per AMP schedule.
	MW12-06-04	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW12-06-05		X	Quarterly	4 of 4 collected. Sampled as per AMP schedule.
	MW12-06-06	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
Main Pit	MW12-07-01	X	X	Quarterly	2 of 4 collected. Port has been dry since May 2018.
	MW12-07-02	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW12-07-03		X	Quarterly	No samples were collected. The port was found dry during all of 2018.
Minto North Pit	MW09-03-01	X	X	Quarterly	9 of 12 collected as per the AMP schedule. Samples not collected were due to equipment maintenance schedule conflicts.

Mine Project Component	Monitoring Installation	Quality	Level	Monitoring Frequency	2018 Groundwater Compliance
	MW09-03-02	X	X	Quarterly	9 of 12 collected as per the AMP schedule. Samples not collected were due to equipment maintenance schedule conflicts.
	MW09-03-03	X	X	Quarterly	No samples were collected. The port was found dry during all of 2018.
	MW17-11-01	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW17-11-02	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW17-11-03	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW17-11-04	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW17-11-05	X	X	Quarterly	3 of 4 samples collected. Port was dry in Q4.
Water Storage Pond	MW12-05-01	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW12-05-02	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW12-05-03	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW12-05-04	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW12-05-05	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW12-05-06	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW12-05-07	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW17-12-01	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW17-12-02	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW17-12-03	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW17-12-04	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW17-12-05	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW17-12-06	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW17-12-07	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW17-12-08	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.

6.2 Groundwater Quality Control and Assurance

In 2018, 168 groundwater samples were taken at Minto. A total of 17 duplicate QC samples were taken from groundwater sampling sites, representing 10.1% of the total number of samples collected in 2018.

The EMSRP recommends field duplicate sampling be conducted at a frequency of one field duplicate sample per ten groundwater monitoring samples. The recommended rate of field duplicate sampling was achieved in 2018.

Minto currently employs compliance management system software to track programs and actions that meet licence requirements. To achieve the QA/QC objective of 1:10 samples, the compliance system was updated in 2016 and used successfully in the following years to ensure that environmental staff completed the required field duplicates.

6.3 Groundwater Monitoring Stations

The EMSRP details the groundwater wells at the Minto Mine, including operative and inoperative wells. Figure 6-1 shows a location map of the operative wells. Stations that were collected more than twice in 2018 have results presented as follows: Mean, Minimum and Maximum values and are compared to their historical results ranging in active years.

Wells MW09-01, MW11-02, MW12-DP1, MW12-DP2, MW12-DP3 and MW17-09 did not produce water during 2018 sampling events to sample, thus no results are presented.

Complete results for the 2018 Groundwater Monitoring Program groundwater wells are presented in Appendix C.



Figure 6-1: Minto Mine Groundwater Well Locations (2018)

6.3.1 MW09-01

Groundwater well MW09-01 was dry during 2018, thus no results are presented. Historically, this is consistent with sampling data from that well, as there have only been two sampled successfully drawn from MW09-01 since 2013. A new well was installed in summer 2017, MW17-10, to capture groundwater at the Main Waste Dump. MW09-01 will no longer be monitored in 2019.

6.3.2 MW09-03

Groundwater well MW09-03 water quality results from 2018 are summarized in Table 6-2 and Table 6-3, and compared to historical data. MW09-03 produced results from sampling zones 01 and 02, while zone 03 produced no water during 2018. As such, only results for zones 01 and 02 are presented below. As per the AMP, this well is on an increased sampling frequency, being sampled monthly, samples missed were due to necessary equipment maintenance being conducted on the Westbay equipment.

Table 6-2: MW09-03-01 Water Quality Results Summary (2009 - 2018)

MW09-03-01	2009 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.19	7.94	8.86	8.23	8.06	8.38
TDS (mg/L)	205	146	652	172.7	165	179
Sulfate-dissolved (mg/L)	23.64	0.53	117	19.0	17.9	20.2
Nutrients (mg/L)						
Ammonia Nitrogen	0.0528	0.024	0.17	0.0421	0.0333	0.0544
Nitrate Nitrogen	0.06461	<0.0050	0.669	0.00910	<0.0050	0.0183
Nitrite Nitrogen	0.6443	0.0654	9.27	0.2232	0.0261	0.530
Dissolved Metals (mg/L)						
Silver	0.00001557	<0.0000050	0.00005	0.0000103	<0.000010	0.000013
Aluminum	0.00420	0.0014	0.0105	0.0074	0.0021	0.0198
Arsenic	0.000489	0.000037	0.00109	0.00161	0.00067	0.00933
Cadmium	0.00005078	<0.0000050	0.000683	0.00004207	<0.0000050	0.000110
Chromium	0.000562	<0.00010	0.00111	0.000207	<0.00010	0.00073
Copper	0.001249	<0.00020	0.019	0.001628	<0.00020	0.00411
Lead	0.0001502	0.000036	0.0011	0.0000564	<0.000050	0.000088
Molybdenum	0.00859	0.0035	0.0806	0.00537	0.00445	0.00960
Nickel	0.00173	0.00073	0.008	0.00092	0.00067	0.00132
Selenium	0.0003610	<0.000050	0.008	0.0002174	<0.000050	0.000972
Zinc	0.01386	<0.0050	0.0593	0.0270	0.0033	0.0913

Table 6-3: MW09-03-02 Water Quality Results Summary (2009-2018)

MW09-03-02	2009 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.06	7.59	8.32	8.19	7.98	8.31
TDS (mg/L)	377	172	716	189	146	301
Sulfate-dissolved (mg/L)	10.852	<0.50	110	7.49	5.64	8.86
Nutrients (mg/L)						
Ammonia Nitrogen	0.10224	<0.0050	0.33	0.00701	<0.0050	0.0145
Nitrate Nitrogen	1.14674	<0.0050	3.72	3.60	2.25	8.02
Nitrite Nitrogen	0.2701	0.0429	1.93	0.1603	0.0339	0.297
Dissolved Metals (mg/L)						
Silver	0.0000160	<0.000010	0.00004	0.0000109	<0.000010	0.000016
Aluminum	0.00395	<0.0010	0.013	0.00662	<0.0010	0.0187
Arsenic	0.000432	<0.00010	0.0012	0.000191	<0.00010	0.00040
Cadmium	0.00004813	<0.0000050	0.00072	0.0000541	0.0000253	0.0000963
Chromium	0.000502	<0.00010	0.0013	0.000229	<0.00010	0.00064
Copper	0.002506	<0.00020	0.022	0.00285	0.00127	0.00494
Lead	0.0001167	<0.000050	0.0003	0.0000567	<0.000050	0.000087
Molybdenum	0.01522	0.00329	0.101	0.00514	0.00322	0.00779
Nickel	0.001016	<0.00050	0.004	0.000522	<0.00050	0.00066
Selenium	0.0005003	<0.000050	0.0067	0.000370	0.000163	0.000566
Zinc	0.01786	<0.0050	0.0727	0.0499	0.0191	0.105

6.3.3 MW11-02

MW11-02 was dry during the 2018 sampling events, thus water quality results are not presented.

6.3.4 MW11-03

MW11-03 was dry during the 2018 sampling events, thus water quality results are not presented.

6.3.5 MW11-04A

MW11-04A was dry during the 2018 sampling events. The results presented below in Table 6-4 are the outcomes of the 2012-2017 sampling seasons.

Table 6-4: MW11-04A Water Quality Results Summary (2012 – 2017)

MW11-04A	2012 - 2017 Summary Statistics		
Parameters	Mean	Min	Max
pH	11.19	10.3	11.7
TDS (mg/L)	196	148	396
Sulfate-dissolved (mg/L)	5.40	3.47	7.7
Nutrients (mg/L)			
Ammonia Nitrogen	0.2953	0.0191	1.5
Nitrate Nitrogen	1.28	1	1.64
Nitrite Nitrogen	0.0140	0.0071	0.0234
Dissolved Metals (mg/L)			
Silver	0.0000177	<0.000010	0.000035
Aluminum	0.759	0.142	1.68
Arsenic	0.00254	0.00043	0.00433
Cadmium	0.00001163	<0.0000050	0.000045
Chromium	0.00302	0.0017	0.008
Copper	0.0691	0.0119	0.137
Lead	0.0001471	<0.000050	<0.00020
Molybdenum	0.00293	0.0019	0.01
Nickel	0.000822	<0.00050	<0.0010
Selenium	0.00238	0.00175	0.00334
Zinc	0.00404	0.0016	<0.0050

6.3.6 MW12-DP1

Drivepoint well MW12-DP1 was destroyed in August 2017 when the permafrost into which the well had been installed, degraded; compromising the ground integrity and the well. As such, water quality results are not presented.

6.3.7 MW12-DP2

Drivepoint well MW12-DP2 was dry or frozen during the 2018 sampling events, thus water quality results are not presented.

6.3.8 MW12-DP3

Drivepoint well MW12-DP3 was dry or frozen during the 2018 sampling events, thus water quality results are not presented.

6.3.9 MW12-05

Groundwater well MW12-05 water quality results from 2018 are summarized in Table 6-5 through Table 6-11, and compared to historical data. Zones 01, 03, 05 and 07 were sampled and analyzed during 2018 under the Groundwater Monitoring Plan, while Zones 02, 04, and 06 were also sampled in response to the Adaptive Management Plan.

Table 6-5: MW12-05-01 Water Quality Results Summary (2012 - 2018)

MW12-05-01	2012 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.02	7.69	8.31	7.94	7.72	8.13
TDS (mg/L)	1409	706	1820	1822.5	1810	1840
Sulfate-dissolved (mg/L)	856	350	1200	1205.0	1190	1240
Nutrients (mg/L)						
Ammonia Nitrogen	0.10806	<0.0050	0.602	0.0401	0.0215	0.0673
Nitrate Nitrogen	0.0412	<0.010	0.368	0.0688	<0.025	<0.10
Nitrite Nitrogen	0.0834	0.0277	0.427	0.0170	0.0082	0.020
Dissolved Metals (mg/L)						
Silver	0.0000176	<0.000010	<0.000020	0.0000150	<0.000010	<0.000020
Aluminum	0.0067	0.0031	0.0182	0.0058	0.0038	0.0092
Arsenic	0.00093	0.00059	0.00216	0.00174	0.00063	0.00498
Cadmium	0.00001654	<0.0000050	0.00014	0.00001665	<0.0000050	0.000029
Chromium	0.00074	0.00023	<0.0010	0.00020	0.00014	0.00028
Copper	0.000862	<0.00020	0.00836	0.000300	<0.00020	<0.00040
Lead	0.0001480	<0.000050	<0.00020	0.0000750	<0.000050	<0.00010
Molybdenum	0.001185	0.000125	0.012	0.000204	0.000159	0.00023
Nickel	0.001016	<0.00050	0.0043	0.000750	<0.00050	<0.0010
Selenium	0.000402	0.000083	0.00225	0.00116	0.00018	0.00239
Zinc	0.00511	<0.0010	0.0402	0.0064	0.0021	0.0153

Table 6-6: MW12-05-02 Water Quality Results Summary (2016-2018)

MW12-05-02	2016 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.16	7.90	8.43	8.09	7.89	8.28
TDS (mg/L)	1424	389	1870	1777.5	1740	1810
Sulfate-dissolved (mg/L)	843.8	41.2	1160	1145	1080	1210
Nutrients (mg/L)						
Ammonia Nitrogen	0.0951	0.0095	0.642	0.0430	0.0203	0.0779
Nitrate Nitrogen	0.03444	<0.0050	<0.050	0.0688	<0.025	<0.10
Nitrite Nitrogen	0.0895	0.0162	0.377	0.0274	0.0114	0.058
Dissolved Metals (mg/L)						
Silver	0.0000134	<0.000010	<0.000020	0.0000225	<0.000010	<0.000050
Aluminum	0.0047	0.0036	0.0061	0.0058	0.0040	0.0088
Arsenic	0.000349	<0.00020	0.00063	0.000828	0.00034	0.00190
Cadmium	0.00000667	<0.0000050	<0.000010	0.00001125	<0.0000050	<0.000025
Chromium	0.00040	0.00025	0.00093	0.000285	0.00015	<0.00050
Copper	0.000289	<0.00020	0.00060	0.000450	<0.00020	<0.0010
Lead	0.0000667	<0.000050	<0.00010	0.0001125	<0.000050	<0.00025
Molybdenum	0.000574	0.000147	0.00112	0.000225	0.00014	0.000264
Nickel	0.000667	<0.00050	<0.0010	0.001125	<0.00050	<0.0025
Selenium	0.0004717	<0.000050	0.00275	0.000985	<0.00010	0.00222
Zinc	0.00727	<0.0010	0.0261	0.0033	0.0011	0.0065

Table 6-7: MW12-05-03 Water Quality Results Summary (2012 - 2018)

MW12-05-03	2012 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.06	7.72	8.31	8.04	7.85	8.29
TDS (mg/L)	1330	880	1570	1320.0	1280	1370
Sulfate-dissolved (mg/L)	741	456	883	788	730	844
Nutrients (mg/L)						
Ammonia Nitrogen	0.03929	<0.0050	0.11	0.0286	0.0145	0.0413
Nitrate Nitrogen	0.0301	<0.010	0.068	0.0512	<0.025	0.105
Nitrite Nitrogen	0.0769	0.0193	0.372	0.0244	0.0119	0.038
Dissolved Metals (mg/L)						
Silver	0.0000159	0.000005	0.000021	0.0000150	<0.000010	<0.000020
Aluminum	0.00655	0.0011	0.0233	0.0064	0.0029	0.0144
Arsenic	0.000321	0.00017	0.00077	0.000740	<0.00020	0.00220
Cadmium	0.00002838	<0.0000050	0.000324	0.00001775	<0.0000050	0.000040
Chromium	0.000601	<0.00010	<0.0010	0.000202	0.00015	0.00026
Copper	0.000694	<0.00020	0.00579	0.000665	<0.00020	0.00170
Lead	0.0001647	<0.000050	0.000665	0.0000750	<0.000050	<0.00010
Molybdenum	0.001959	0.000229	0.0121	0.000202	0.00017	0.000249
Nickel	0.001006	<0.00050	0.00328	0.000750	<0.00050	<0.0010
Selenium	0.0001345	<0.000050	0.000562	0.000221	<0.00010	0.000410
Zinc	0.00669	<0.0010	0.0312	0.0081	0.0012	0.0190

Table 6-8: MW12-05-04 Water Quality Results Summary (2016 - 2018)

MW12-05-04	2016 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.14	7.87	8.32	8.15	7.97	8.41
TDS (mg/L)	283.4	262	296	283.8	271	296
Sulfate-dissolved (mg/L)	34.5	25.2	47.3	38.0	27.0	44.3
Nutrients (mg/L)						
Ammonia Nitrogen	0.02978	<0.0050	0.144	0.0239	0.0095	0.0405
Nitrate Nitrogen	0.01913	<0.0050	0.0569	0.02165	<0.0050	0.0677
Nitrite Nitrogen	0.0810	0.0124	0.320	0.01170	<0.0010	0.0277
Dissolved Metals (mg/L)						
Silver	0.0000100	<0.000010	<0.000010	0.0000100	<0.000010	<0.000010
Aluminum	0.0034	0.0021	0.0049	0.0128	0.0030	0.0338
Arsenic	0.000133	<0.00010	0.00024	0.00092	0.00010	0.00330
Cadmium	0.00000512	<0.0000050	0.0000063	0.00000670	<0.0000050	0.0000114
Chromium	0.000138	<0.00010	0.00023	0.000128	<0.00010	0.00018
Copper	0.000234	<0.00020	0.00048	0.000682	<0.00020	0.00171
Lead	0.0000500	<0.000050	<0.000050	0.0000635	<0.000050	0.000104
Molybdenum	0.00377	0.00142	0.00508	0.00295	0.00215	0.00418
Nickel	0.000500	<0.00050	<0.00050	0.000500	<0.00050	<0.00050
Selenium	0.0003456	<0.000050	0.00171	0.000659	0.000247	0.000884
Zinc	0.00459	<0.0010	0.0141	0.0024	0.0011	0.0032

Table 6-9: MW12-05-05 Water Quality Results Summary (2012 - 2018)

MW12-05-05	2012 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.12	7.82	8.35	8.02	7.79	8.37
TDS (mg/L)	283.6	252	338	283.8	269	295
Sulfate-dissolved (mg/L)	45.6	33.3	62.4	49.1	47.5	50.1
Nutrients (mg/L)						
Ammonia Nitrogen	0.01900	<0.0050	0.054	0.0202	0.0069	0.0443
Nitrate Nitrogen	0.351	0.194	0.817	0.0703	0.0147	0.137
Nitrite Nitrogen	0.1081	0.03	0.398	0.0208	0.0051	0.0585
Dissolved Metals (mg/L)						
Silver	0.00001432	<0.0000050	<0.000020	0.0000100	<0.000010	0.000010
Aluminum	0.00426	0.0023	0.0106	0.0042	0.0020	0.0072
Arsenic	0.000254	<0.00010	0.00122	0.00064	0.00014	0.00151
Cadmium	0.00000966	<0.0000050	0.00003	0.00001285	<0.0000050	0.0000238
Chromium	0.000479	<0.00010	<0.0010	0.000103	<0.00010	0.00012
Copper	0.00105	0.00034	0.00360	0.00128	0.00099	0.00160
Lead	0.0001134	<0.000050	<0.00020	0.0000500	<0.000050	<0.000050
Molybdenum	0.00460	0.0035	0.0153	0.00427	0.00387	0.00478
Nickel	0.000855	<0.00050	0.0019	0.000538	<0.00050	0.00061
Selenium	0.0001143	<0.000050	0.000173	0.0003437	<0.000050	0.00112
Zinc	0.02083	0.0032	0.118	0.0244	0.0033	0.0628

Table 6-10: MW12-05-06 Water Quality Results Summary (2016 – 2018)

MW12-05-06	2016 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.09	7.98	8.20	8.06	7.87	8.35
TDS (mg/L)	277.7	265	302	286.5	278	298
Sulfate-dissolved (mg/L)	44.9	41.9	49.5	50.3	48.5	51.8
Nutrients (mg/L)						
Ammonia Nitrogen	0.00646	<0.0050	0.0181	0.00500	<0.0050	<0.0050
Nitrate Nitrogen	0.348	0.229	0.463	0.0969	0.0510	0.181
Nitrite Nitrogen	0.0373	0.0230	0.0663	0.0142	0.0073	0.0213
Dissolved Metals (mg/L)						
Silver	0.0000100	<0.000010	<0.000010	0.0000100	<0.000010	<0.000010
Aluminum	0.0025	0.0021	0.0042	0.0280	0.0020	0.0808
Arsenic	0.00017	0.00011	0.00047	0.00028	0.00012	0.00054
Cadmium	0.00001273	<0.0000050	0.0000179	0.0000153	0.0000077	0.0000209
Chromium	0.000106	<0.00010	0.00015	0.000100	<0.00010	<0.00010
Copper	0.00125	0.00087	0.00197	0.00551	0.00128	0.0148
Lead	0.0000500	<0.000050	<0.000050	0.0000500	<0.000050	<0.000050
Molybdenum	0.00357	0.00331	0.00379	0.00468	0.00417	0.00521
Nickel	0.00063	0.00054	0.00073	0.001200	<0.00050	0.00195
Selenium	0.000139	0.000070	0.000190	0.000186	0.000089	0.000376
Zinc	0.0433	0.0073	0.115	0.0125	0.0066	0.0214

Table 6-11: MW12-05-07 Water Quality Results Summary (2012 - 2018)

MW12-05-07	2012 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.19	7.76	8.45	8.07	7.86	8.44
TDS (mg/L)	292	252	362	290	277	321
Sulfate-dissolved (mg/L)	29.9	11.4	45.2	48.2	41.4	52
Nutrients (mg/L)						
Ammonia Nitrogen	0.08699	<0.0050	0.465	0.10760	0.0433	0.154
Nitrate Nitrogen	0.03147	<0.0050	<0.20	0.00638	<0.0050	0.0105
Nitrite Nitrogen	0.20475	<0.0010	2.91	0.00512	<0.0010	0.0104
Dissolved Metals (mg/L)						
Silver	0.0000140	<0.0000050	<0.000020	0.0000100	<0.000010	<0.000010
Aluminum	0.00465	0.0018	0.0127	0.0068	0.0023	0.016
Arsenic	0.000375	0.00022	0.000917	0.00071	0.00035	0.00115
Cadmium	0.00000758	<0.0000050	0.000019	0.00000518	<0.0000050	0.0000057
Chromium	0.000529	<0.00010	<0.0010	0.000160	0.0001	0.00023
Copper	0.00032	<0.00020	0.00158	0.000728	<0.00020	0.00186
Lead	0.0001334	0.000039	0.00055	0.0000500	<0.000050	<0.000050
Molybdenum	0.00237	0.00109	0.0038	0.00285	0.00259	0.00337
Nickel	0.000766	<0.00050	0.0015	0.000615	<0.00050	0.00096
Selenium	0.0003388	<0.000050	0.001680	0.00051	0.000135	0.00149
Zinc	0.00388	<0.0010	0.0136	0.0035	0.0027	0.0046

6.3.10 MW12-06

Groundwater well MW12-06 water quality results from 2018 are summarized in Table 6-12 through Table 6-17, and compared to historical data. Zones 02, 04, and 06 were sampled and analyzed during 2018 under the Groundwater Monitoring Plan, while Zones 01, 03, and 05 were also sampled in response to the Adaptive Management Plan.

Table 6-12: MW12-06-01 Water Quality Results Summary (2016 - 2018)

MW12-06-01	2016 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	7.96	7.6	8.33	7.9	7.4	8.28
TDS (mg/L)	418	387	499	443.5	405	491
Sulfate-dissolved (mg/L)	3.21	1.14	<5.0	0.88	0.42	<1.5
Nutrients (mg/L)						
Ammonia Nitrogen	0.2898	0.0067	0.955	0.11070	0.086	0.128
Nitrate Nitrogen	0.2338	0.0139	0.82	0.0401	0.0165	0.088
Nitrite Nitrogen	0.9073	0.0379	3.31	0.1332	0.0522	0.316
Dissolved Metals (mg/L)						
Silver	0.0000100	<0.000010	<0.000010	0.0000100	<0.000010	<0.000010
Aluminum	0.0162	0.0148	0.0182	0.0221	0.0158	0.0277
Arsenic	0.00675	0.00571	0.00828	0.00808	0.00667	0.0095
Cadmium	0.00000752	<0.0000050	0.0000112	0.000015	0.0000065	0.0000248
Chromium	0.0034	0.00312	0.00402	0.004010	0.00362	0.00449
Copper	0.00109	0.00034	0.00337	0.000698	<0.00020	0.00104
Lead	0.0000593	<0.000050	0.000085	0.0000500	<0.000050	<0.000050
Molybdenum	0.001103	0.000867	0.00172	0.00111	0.000938	0.00146
Nickel	0.000557	<0.00050	0.00073	0.000665	<0.00050	0.00086
Selenium	0.001218	0.000170	0.003740	0.000644	0.000262	0.00115
Zinc	0.00398	0.0025	0.0066	0.0072	0.0023	0.0155

Table 6-13: MW12-06-02 Water Quality Results Summary (2012 - 2018)

MW12-06-02	2012 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8	7.65	8.20	8.05	7.82	8.23
TDS (mg/L)	647.9	612	693	639.8	630	653
Sulfate-dissolved (mg/L)	207.9	177	227	212.8	209	215
Nutrients (mg/L)						
Ammonia Nitrogen	0.0384	0.0074	0.075	0.05120	0.0379	0.0663
Nitrate Nitrogen	0.1818	0.025	1.83	0.0281	0.0105	0.05
Nitrite Nitrogen	0.6909	0.0882	7.21	0.1078	0.0401	0.196
Dissolved Metals (mg/L)						
Silver	0.0000147	0.000008	<0.000020	0.0000225	<0.000010	<0.000050
Aluminum	0.00334	<0.0010	0.0102	0.0023	<0.0010	<0.0050
Arsenic	0.00438	0.00227	0.00664	0.00434	0.0037	0.00595
Cadmium	0.00001193	<0.0000050	0.000047	0.000045	<0.0000050	0.00016
Chromium	0.000489	<0.00010	<0.0010	0.000230	<0.00010	<0.00050
Copper	0.001274	<0.00020	0.0202	0.000458	<0.00020	<0.0010
Lead	0.0001156	0.000029	<0.00020	0.0001125	<0.000050	<0.00025
Molybdenum	0.00792	0.0051	0.0164	0.00848	0.00775	0.00922
Nickel	0.000858	<0.00050	0.00235	0.001125	<0.00050	<0.0025
Selenium	0.0002007	<0.000050	0.000740	0.000235	0.000182	0.000307
Zinc	0.00552	0.0016	0.0111	0.0061	<0.0050	0.0072

Table 6-14: MW12-06-03 Water Quality Results Summary (2016 - 2018)

MW12-06-03	2016 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.01	7.74	8.25	8.13	7.92	8.34
TDS (mg/L)	641.1	615	671	633	623	646
Sulfate-dissolved (mg/L)	205.3	175	221	208.2	206	211
Nutrients (mg/L)						
Ammonia Nitrogen	0.0358	0.0076	0.0673	0.06820	0.0511	0.0791
Nitrate Nitrogen	0.1255	0.028	0.269	0.0211	0.0094	<0.025
Nitrite Nitrogen	0.507	0.1150	1.07	0.0599	0.0342	0.0692
Dissolved Metals (mg/L)						
Silver	0.0000100	<0.000010	<0.000010	0.0000100	<0.000010	<0.000010
Aluminum	0.00164	<0.0010	0.0028	0.0053	<0.0010	0.0177
Arsenic	0.00066	0.00052	0.00092	0.00093	0.00068	0.00156
Cadmium	0.00000781	<0.0000050	0.0000247	0.000005	<0.0000050	<0.0000050
Chromium	0.000236	<0.00010	0.00039	0.000190	0.00017	0.0002
Copper	0.0002	<0.00020	<0.00020	0.000845	<0.00020	0.00267
Lead	0.0000500	<0.000050	<0.000050	0.0000520	<0.000050	0.000058
Molybdenum	0.0025	0.00174	0.004	0.0023	0.00155	0.00322
Nickel	0.0005	<0.00050	<0.00050	0.000500	<0.00050	<0.00050
Selenium	0.0001641	<0.000050	0.000447	0.000102	0.000063	0.000132
Zinc	0.00616	0.002	0.0096	0.0043	0.0023	0.0057

Table 6-15: MW12-06-04 Water Quality Results Summary (2012 - 2018)

MW12-06-04	2012 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.09	7.76	8.29	8.18	7.88	8.37
TDS (mg/L)	630	594	735	622.8	619	627
Sulfate-dissolved (mg/L)	174	159	197	184	180	186
Nutrients (mg/L)						
Ammonia Nitrogen	0.01355	<0.0050	0.028	0.01020	0.0069	0.013
Nitrate Nitrogen	0.2359	0.0089	2	0.0232	0.0129	0.028
Nitrite Nitrogen	0.9289	0.0352	7.92	0.0774	0.0482	0.107
Dissolved Metals (mg/L)						
Silver	0.0000162	<0.0000050	<0.000020	0.0000100	<0.000010	<0.000010
Aluminum	0.00383	0.0014	0.012	0.0017	<0.0010	0.0031
Arsenic	0.00242	0.00163	0.00515	0.00255	0.00223	0.00339
Cadmium	0.00001072	<0.0000050	0.000039	0.00000522	<0.0000050	0.0000061
Chromium	0.000574	<0.00010	<0.0010	0.000100	<0.00010	<0.00010
Copper	0.003175	0.000106	0.0722	0.0002	<0.00020	<0.00020
Lead	0.0001292	0.000031	<0.00020	0.0000500	<0.000050	<0.000050
Molybdenum	0.00841	0.0074	0.0102	0.00837	0.00817	0.00852
Nickel	0.000785	<0.00050	0.0011	0.000500	<0.00050	<0.00050
Selenium	0.0002202	<0.000050	0.001010	0.000088	<0.000050	0.000137
Zinc	0.01599	<0.0050	0.0686	0.0161	0.0088	0.0218

Table 6-16: MW12-06-05 Water Quality Results Summary (2016 - 2018)

MW12-06-05	2016 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.01	7.73	8.21	8.16	7.94	8.37
TDS (mg/L)	629.2	610	646	628.7	614	641
Sulfate-dissolved (mg/L)	182.2	176	190	182.7	176	189
Nutrients (mg/L)						
Ammonia Nitrogen	0.00629	<0.0050	0.0131	0.00777	<0.0050	0.0121
Nitrate Nitrogen	0.0538	0.0155	0.255	0.0236	0.0168	<0.025
Nitrite Nitrogen	0.1931	0.0252	1	0.0453	0.0315	0.0637
Dissolved Metals (mg/L)						
Silver	0.0000100	<0.000010	<0.000010	0.0000100	<0.000010	<0.000010
Aluminum	0.0017	<0.0010	0.0029	0.0018	0.0012	0.0024
Arsenic	0.00079	0.00058	0.0011	0.00097	0.00072	0.00146
Cadmium	0.000007	<0.0000050	0.0000112	0.00000782	<0.0000050	0.0000187
Chromium	0.0001	<0.00010	<0.00010	0.000107	<0.00010	0.00014
Copper	0.000244	<0.00020	0.00041	0.000222	<0.00020	0.00027
Lead	0.0000500	<0.000050	<0.000050	0.0000500	<0.000050	<0.000050
Molybdenum	0.00907	0.00833	0.00993	0.00924	0.00876	0.00948
Nickel	0.000618	<0.00050	0.00083	0.000570	0.00055	0.00061
Selenium	0.0000779	<0.000050	0.000183	0.0000525	<0.000050	0.000065
Zinc	0.023	0.0094	0.0637	0.0183	0.0113	0.0326

Table 6-17: MW12-06-06 Water Quality Results Summary (2012 - 2018)

MW12-06-06	2012 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.09	7.75	8.30	8.23	8	8.39
TDS (mg/L)	515.9	472	538	522.2	514	531
Sulfate-dissolved (mg/L)	153.2	143	171	153.8	153	155
Nutrients (mg/L)						
Ammonia Nitrogen	0.01462	<0.0050	0.085	0.00708	<0.0050	0.0133
Nitrate Nitrogen	1.03	0.45	1.31	0.968	0.9520	1
Nitrite Nitrogen	0.1103	0.0455	0.499	0.0601	0.0503	0.0755
Dissolved Metals (mg/L)						
Silver	0.0000138	<0.0000050	<0.000020	0.0000100	<0.000010	<0.000010
Aluminum	0.00348	<0.0010	0.0142	0.0028	<0.0010	0.0074
Arsenic	0.000117	0.00009	0.00019	0.00031	0.00015	0.00065
Cadmium	0.00001758	<0.0000050	0.000124	0.0000121	0.0000069	0.000025
Chromium	0.000466	<0.00010	<0.0010	0.000115	<0.00010	0.00016
Copper	0.000381	<0.00020	0.00155	0.000578	<0.00020	0.00096
Lead	0.0001106	<0.000050	<0.00020	0.0000500	<0.000050	<0.000050
Molybdenum	0.00567	0.0048	0.0066	0.00578	0.00561	0.00612
Nickel	0.000701	<0.00050	<0.0010	0.000500	<0.00050	<0.00050
Selenium	0.000285	0.000150	0.000511	0.000294	0.000239	0.000331
Zinc	0.02239	0.00312	0.0827	0.0282	0.0192	0.034

6.3.11 MW12-07

Groundwater well MW12-07 water quality results from 2018 are summarized in Table 6-18 and Table 6-19, and compared to historical data. Both zones (01 and 02) were sampled and analyzed during 2018. MW12-07-01 was discovered dry in May 2018 and therefore was not sampled in Q3 and Q4 of 2018.

Table 6-18: MW12-07-01 Water Quality Results Summary (2012 - 2018)

MW12-07-01	2012 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	7.98	7.38	8.38	8.09	7.92	8.28
TDS (mg/L)	921	599	1400	990	935	1050
Sulfate-dissolved (mg/L)	263.8	12.4	640	495	427	575
Nutrients (mg/L)						
Ammonia Nitrogen	0.43612	<0.0050	1.6	1.27400	0.974	1.91
Nitrate Nitrogen	5.583	0.044	53.5	0.792	0.2250	1.82
Nitrite Nitrogen	1.2191	<0.050	4.96	1.902	0.555	4.41
Dissolved Metals (mg/L)						
Silver	0.0000170	<0.000010	0.000037	0.0000102	<0.000010	0.000011
Aluminum	0.00855	0.0015	0.0346	0.0168	0.0026	0.0377
Arsenic	0.00101	0.00034	0.00271	0.00211	0.0008	0.00573
Cadmium	0.00005132	<0.0000050	0.000633	0.0000773	0.000006	0.000146
Chromium	0.0008	0.00015	0.0014	0.001100	0.00027	0.00216
Copper	0.005321	<0.00020	0.077	0.002368	<0.00020	0.00856
Lead	0.0001973	<0.000050	0.00104	0.0003640	<0.000050	0.000812
Molybdenum	0.006885	0.000252	0.0223	0.0031	0.00141	0.00708
Nickel	0.001182	<0.00050	0.0051	0.000895	<0.00050	0.0015
Selenium	0.004443	<0.00010	0.034700	0.00244	0.00188	0.00288
Zinc	0.02285	<0.0010	0.234	0.4802	0.0033	1.24

Table 6-19: MW12-07-02 Water Quality Results Summary (2012 – 2018)

MW12-07-02	2012 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	7.95	7.68	8.11	8.09	7.98	8.24
TDS (mg/L)	1093	748	1180	669	551	784
Sulfate-dissolved (mg/L)	662	283	756	368	298	454
Nutrients (mg/L)						
Ammonia Nitrogen	0.11176	<0.0050	0.61	0.01550	0.0081	0.0232
Nitrate Nitrogen	0.583	0.06	21.3	0.174	0.0800	0.368
Nitrite Nitrogen	0.447	0.1400	1.47	0.2779	0.0453	0.894
Dissolved Metals (mg/L)						
Silver	0.0000174	<0.000010	0.000023	0.0000307	<0.000010	0.000217
Aluminum	0.00686	0.0014	0.021	0.0067	0.0018	0.0215
Arsenic	0.00156	0.00024	0.00292	0.00119	0.00032	0.00592
Cadmium	0.00001659	<0.0000050	0.000269	0.0000408	<0.000015	0.000102
Chromium	0.000674	<0.00010	0.0011	0.000193	<0.00010	0.00071
Copper	0.000971	<0.00020	0.0217	0.002286	<0.00040	0.00494
Lead	0.0001579	<0.000050	0.00056	0.0000777	<0.000050	0.000213
Molybdenum	0.0182	0.0019	0.0334	0.0314	0.0279	0.0373
Nickel	0.000885	<0.00050	0.0017	0.000561	<0.00050	<0.0010
Selenium	0.000475	0.000055	0.014800	0.000728	0.000358	0.00145
Zinc	0.0103	0.0016	0.178	0.0966	0.028	0.375

6.3.12 MW17-08

This well was installed in July 2017 to monitor groundwater up-gradient of the Southwest Waste Dump and other mine activities. Four zones were sampled and analyzed in 2018, the results are summarized in Table 6-20 to 6-23 below alongside the 2017 results. Well 17-08 was installed to monitor the background water quality.

Table 6-20: MW17-08-01 Water Quality Results Summary (2017 - 2018)

MW17-08-01	2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.12	8.1	8.15	8.16	7.81	8.47
TDS (mg/L)	275	269	281	255.4	224	269
Sulfate-dissolved (mg/L)	42.4	41.7	43.1	37.8	36.9	39.1
Nutrients (mg/L)						
Ammonia Nitrogen	0.0062	<0.0050	0.0073	0.00536	<0.0050	0.0068
Nitrate Nitrogen	0.347	0.329	0.365	0.375	0.3670	0.387
Nitrite Nitrogen	0.0074	0.0012	0.0136	0.00186	<0.0010	0.0038
Dissolved Metals (mg/L)						
Silver	0.0000100	<0.000010	<0.000010	0.0000100	<0.000010	<0.000010
Aluminum	0.0022	0.0014	0.0029	0.0017	<0.0010	0.0028
Arsenic	0.00023	0.0002	0.00026	0.00177	0.00013	0.00523
Cadmium	0.0000516	0.0000396	0.0000635	0.0000769	0.0000294	0.000201
Chromium	0.00014	<0.00010	0.00019	0.000100	<0.00010	<0.00010
Copper	0.00064	0.00061	0.00068	0.00065	0.00033	0.00129
Lead	0.0000500	<0.000050	<0.000050	0.0000500	<0.000050	<0.000050
Molybdenum	0.00716	0.00525	0.00908	0.00861	0.0082	0.00876
Nickel	0.00068	<0.00050	0.00087	0.000500	<0.00050	<0.00050
Selenium	0.000912	0.000665	0.001160	0.000488	0.000399	0.000598
Zinc	0.0316	0.0297	0.0336	0.0379	0.03	0.0539

Table 6-21: MW17-08-02 Water Quality Results Summary (2017 - 2018)

MW17-08-02	2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.12	8.12	8.13	8.22	7.93	8.42
TDS (mg/L)	171	162	180	162.3	138	173
Sulfate-dissolved (mg/L)	11.6	11.4	11.7	11.9	11.8	12
Nutrients (mg/L)						
Ammonia Nitrogen	0.005	<0.0050	<0.0050	0.00500	<0.0050	<0.0050
Nitrate Nitrogen	0.681	0.678	0.684	0.68	0.6570	0.71
Nitrite Nitrogen	0.0028	<0.0010	0.0045	0.00122	<0.0010	0.0023
Dissolved Metals (mg/L)						
Silver	0.0000100	<0.000010	<0.000010	0.0000100	<0.000010	<0.000010
Aluminum	0.0032	0.0027	0.0038	0.0021	0.0019	0.0022
Arsenic	0.0003	0.00028	0.00033	0.00102	0.00019	0.00479
Cadmium	0.0000196	0.0000133	0.0000258	0.000027	0.0000114	0.0000458
Chromium	0.00046	<0.00010	0.00082	0.000100	<0.00010	<0.00010
Copper	0.00208	0.00175	0.0024	0.00242	0.00226	0.00271
Lead	0.0000500	<0.000050	<0.000050	0.0000500	<0.000050	<0.000050
Molybdenum	0.00354	0.00336	0.00372	0.00308	0.00299	0.00321
Nickel	0.0006	<0.00050	0.0007	0.000500	<0.00050	<0.00050
Selenium	0.001	0.000729	0.001270	0.000648	0.000514	0.00081
Zinc	0.019	0.0155	0.0224	0.0182	0.0084	0.0313

Table 6-22: MW17-08-03 Water Quality Results Summary (2017 - 2018)

MW17-08-03	2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.15	8.11	8.17	8.2	8.09	8.37
TDS (mg/L)	148.3	142	160	144.5	140	149
Sulfate-dissolved (mg/L)	5.4	5.3	5.7	5.2	5.08	5.43
Nutrients (mg/L)						
Ammonia Nitrogen	0.005	<0.0050	<0.0050	0.00500	<0.0050	<0.0050
Nitrate Nitrogen	0.822	0.806	0.851	0.781	0.7710	0.804
Nitrite Nitrogen	0.0027	<0.0010	0.0042	0.00165	<0.0010	0.0028
Dissolved Metals (mg/L)						
Silver	0.0000100	<0.000010	<0.000010	0.0000100	<0.000010	<0.000010
Aluminum	0.0043	0.0036	0.0048	0.0036	0.0031	0.0042
Arsenic	0.00018	0.00015	0.00023	0.00098	0.00016	0.00332
Cadmium	0.0000077	<0.0000050	0.0000131	0.0000214	0.0000066	0.0000369
Chromium	0.0001	<0.00010	<0.00010	0.000100	<0.00010	<0.00010
Copper	0.00064	0.00061	0.00069	0.0006	0.00044	0.00073
Lead	0.0000500	<0.000050	<0.000050	0.0000500	<0.000050	<0.000050
Molybdenum	0.00115	0.00114	0.00116	0.000971	0.000941	0.000994
Nickel	0.0005	<0.00050	<0.00050	0.000500	<0.00050	<0.00050
Selenium	0.000509	0.000372	0.000682	0.000419	0.000287	0.000605
Zinc	0.0117	0.0068	0.0209	0.0203	0.0128	0.0381

Table 6-23: MW17-08-04 Water Quality Results Summary (2017 - 2018)

MW17-08-04	2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean			Mean	Min	Max
pH	8.07			8.04	8.03	8.05
TDS (mg/L)	71.2			81.3	81.0	81.6
Sulfate-dissolved (mg/L)	<5.0			2.26	2.20	2.33
Nutrients (mg/L)						
Ammonia Nitrogen	<0.005			0.0184	0.0184	0.0184
Nitrate Nitrogen	0.618			0.598	0.594	0.603
Nitrite Nitrogen	0.0051			0.00150	<0.0010	0.0020
Dissolved Metals (mg/L)						
Silver	0.00001	<0.000010	<0.000010	0.0000100	<0.000010	<0.000010
Aluminum	0.0047	0.0038	0.0056	0.0036	0.0035	0.0037
Arsenic	0.0002	0.00013	0.00028	0.00251	0.00013	0.00489
Cadmium	0.000048	<0.0000050	0.000091	0.0000314	0.0000227	0.0000402
Chromium	0.00014	<0.00010	0.00017	0.000100	<0.00010	<0.00010
Copper	0.00046	0.00038	0.00053	0.00066	0.00036	0.00096
Lead	0.00005	<0.000050	<0.000050	0.0000500	<0.000050	<0.000050
Molybdenum	0.000607	0.0005	0.000714	0.000498	0.000433	0.000562
Nickel	0.00075	<0.00050	0.001	0.000640	<0.00050	0.00078
Selenium	0.000436	0.000213	0.000659	0.000233	0.000158	0.000308
Zinc	0.0708	0.0045	0.137	0.0226	0.0085	0.0367

6.3.13 MW17-09

This well was installed in July 2017 to monitor groundwater down-gradient of the Southwest Waste Dump. One zone was identified below an ice-rich layer, it was sampled and analyzed once in 2017. In 2018 the well was frozen in Q1 and Q2 and was found dry during the Q3 and Q4 sampling events, therefore no samples were collected in this well in 2018.

6.3.14 MW17-10

This well was installed in July 2017 to monitor groundwater down-gradient of the Main Waste Dump. All three ports were sampled in 2018, the results are summarized in Table 6-24 to 6-26 below alongside 2017 results.

Table 6-24: MW17-10-01 Water Quality Results Summary (2017 - 2018)

MW17-10-01	2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.1	8.1	8.10	8.15	8.07	8.19
TDS (mg/L)	212	191	233	229.6	217	245
Sulfate-dissolved (mg/L)	60.1	58.3	61.9	54.9	52.9	56.6
Nutrients (mg/L)						
Ammonia Nitrogen	0.0182	0.0088	0.0275	0.02182	<0.0050	0.0438
Nitrate Nitrogen	2.53	1.96	3.1	6.6	4.0000	8.45
Nitrite Nitrogen	0.0656	0.0484	0.0827	0.1045	0.0014	0.476
Dissolved Metals (mg/L)						
Silver	0.0000140	0.000013	0.000014	0.0000122	<0.000010	0.000017
Aluminum	0.0078	0.0071	0.0084	0.0052	0.0041	0.0062
Arsenic	0.00048	0.00031	0.00064	0.00073	0.00014	0.00244
Cadmium	0.0000556	0.0000229	0.0000884	0.0000624	<0.000015	0.000196
Chromium	0.0001	<0.00010	<0.00010	0.000100	<0.00010	<0.00010
Copper	0.00376	0.00321	0.0043	0.00425	0.00388	0.00448
Lead	0.0000500	<0.000050	<0.000050	0.0000500	<0.000050	<0.000050
Molybdenum	0.0375	0.0369	0.0381	0.0237	0.0193	0.029
Nickel	0.0136	0.0136	0.0137	0.010340	0.0089	0.0122
Selenium	0.001891	0.000882	0.002900	0.00102	0.000718	0.00197
Zinc	0.0298	0.0133	0.0463	0.0253	0.0205	0.0326

Table 6-25: MW17-10-02 Water Quality Results Summary (2017 - 2018)

MW17-10-02	2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.08	8.07	8.09	8.1	7.94	8.22
TDS (mg/L)	248.3	234	256	263.2	249	271
Sulfate-dissolved (mg/L)	25.2	24.8	25.9	24	23.7	24.4
Nutrients (mg/L)						
Ammonia Nitrogen	0.00517	<0.0050	0.0055	0.00506	<0.0050	0.0053
Nitrate Nitrogen	17	15.6	17.7	20.9	18.3000	22.5
Nitrite Nitrogen	0.0028	0.0016	0.0045	0.0021	0.0011	0.0037
Dissolved Metals (mg/L)						
Silver	0.0000100	<0.000010	<0.000010	0.0000100	<0.000010	<0.000010
Aluminum	0.0034	0.0026	0.0044	0.0028	0.0023	0.0038
Arsenic	0.00017	0.00015	0.00021	0.00146	0.00012	0.00654
Cadmium	0.000029	0.0000136	0.0000369	0.0000512	0.00001	0.000164
Chromium	0.0001	<0.00010	<0.00010	0.000100	<0.00010	<0.00010
Copper	0.00372	0.00343	0.00419	0.00261	0.00172	0.00524
Lead	0.0000500	<0.000050	<0.000050	0.0000500	<0.000050	<0.000050
Molybdenum	0.00928	0.0091	0.00942	0.00785	0.00753	0.00822
Nickel	0.00774	0.00629	0.0106	0.003180	0.00284	0.0036
Selenium	0.00137	0.001180	0.001530	0.0016	0.00134	0.00185
Zinc	0.0299	0.0163	0.037	0.0326	0.0201	0.0475

Table 6-26: MW17-10-03 Water Quality Results Summary (2017 - 2018)

MW17-10-03	2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.1	8.09	8.10	8.08	7.97	8.14
TDS (mg/L)	247.3	240	262	268.5	260	274
Sulfate-dissolved (mg/L)	23.3	23.2	23.3	22.6	22.3	23.2
Nutrients (mg/L)						
Ammonia Nitrogen	0.01043	<0.0050	0.0172	0.00500	<0.0050	<0.0050
Nitrate Nitrogen	18.2	17.4	19.9	22.9	20.5000	24.4
Nitrite Nitrogen	0.005	0.0036	0.0062	0.00262	<0.0010	0.0038
Dissolved Metals (mg/L)						
Silver	0.0000100	<0.000010	<0.000010	0.0000100	<0.000010	<0.000010
Aluminum	0.0033	0.0028	0.0039	0.0038	0.0021	0.0077
Arsenic	0.00013	0.00012	0.00014	0.001348	<0.00010	0.00502
Cadmium	0.0000257	0.0000092	0.0000561	0.000021	0.0000117	0.0000299
Chromium	0.0001	<0.00010	<0.00010	0.000100	<0.00010	<0.00010
Copper	0.00341	0.00295	0.00371	0.00191	0.00173	0.00216
Lead	0.0000500	<0.000050	<0.000050	0.0000500	<0.000050	<0.000050
Molybdenum	0.00934	0.00902	0.00966	0.0074	0.00675	0.00802
Nickel	0.00729	0.00592	0.00805	0.003730	0.00319	0.0042
Selenium	0.00128	0.001190	0.001450	0.0017	0.00148	0.00206
Zinc	0.0306	0.0174	0.0559	0.04	0.0303	0.0568

6.3.15 MW17-11

This well was installed in July 2017 to monitor groundwater down-gradient of the Minto North Pit. Ports 01, 02, 03 and 04 were sampled as per scheduled while port 05 was found frozen in Q1 and Q4, the results are summarized in Table 6-27 to 6-31 below.

Table 6-27: MW17-11-01 Water Quality Results Summary (2017 - 2018)

MW17-11-01	2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.18	8.08	8.27	8.24	8.2	8.27
TDS (mg/L)	177	171	183	188.6	185	191
Sulfate-dissolved (mg/L)	38.8	38.7	39	37.4	36	39.5
Nutrients (mg/L)						
Ammonia Nitrogen	0.00585	<0.0050	0.0067	0.00946	<0.0050	0.0202
Nitrate Nitrogen	0.2032	0.0674	0.339	0.00762	<0.0050	0.0133
Nitrite Nitrogen	0.0311	0.0187	0.0435	0.0087	0.001	0.0274
Dissolved Metals (mg/L)						
Silver	0.0000100	<0.000010	<0.000010	0.0000100	<0.000010	<0.000010
Aluminum	0.0162	0.0095	0.0229	0.0062	0.0054	0.0082
Arsenic	0.00066	0.00063	0.00068	0.00145	0.00095	0.0019
Cadmium	0.0000576	0.0000538	0.0000614	0.00015528	<0.0000050	0.000673
Chromium	0.000135	<0.00010	0.00017	0.000122	<0.00010	0.00021
Copper	0.00074	0.00052	0.00095	0.001052	<0.00020	0.00317
Lead	0.0000500	<0.000050	<0.000050	0.0000500	<0.000050	<0.000050
Molybdenum	0.0265	0.0257	0.0273	0.0195	0.0167	0.0225
Nickel	0.00111	0.00102	0.0012	0.000602	<0.00050	0.00101
Selenium	0.000366	0.000137	0.000596	0.0001462	<0.000050	0.000471
Zinc	0.017	0.0099	0.024	0.0225	0.0119	0.0429

Table 6-28: MW17-11-02 Water Quality Results Summary (2017 - 2018)

MW17-11-02	2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.21	8.1	8.27	8.17	8.08	8.28
TDS (mg/L)	188.7	178	196	195	192	199
Sulfate-dissolved (mg/L)	29.8	28.7	31.3	36.8	34.1	39.2
Nutrients (mg/L)						
Ammonia Nitrogen	0.005	<0.0050	<0.0050	0.00500	<0.0050	<0.0050
Nitrate Nitrogen	0.03083	<0.0050	0.0748	0.02144	<0.0050	0.0872
Nitrite Nitrogen	0.0031	0.0020	0.0053	0.00108	<0.0010	0.0013
Dissolved Metals (mg/L)						
Silver	0.0000100	<0.000010	<0.000010	0.0000100	<0.000010	<0.000010
Aluminum	0.0061	0.0047	0.007	0.0033	0.0021	0.005
Arsenic	0.00127	0.00067	0.00183	0.00071	0.00054	0.00126
Cadmium	0.0000203	0.0000073	0.0000348	0.00001862	<0.0000050	0.0000633
Chromium	0.0001	<0.00010	<0.00010	0.000100	<0.00010	<0.00010
Copper	0.000427	<0.00020	0.00061	0.000308	<0.00020	0.00065
Lead	0.0000633	<0.000050	0.000082	0.0000500	<0.000050	<0.000050
Molybdenum	0.0068	0.00628	0.00743	0.00616	0.00586	0.00659
Nickel	0.000713	<0.00050	0.00095	0.000598	<0.00050	0.00099
Selenium	0.001065	0.000202	0.002610	0.000078	<0.000050	0.000126
Zinc	0.0317	0.0136	0.0656	0.0169	0.0121	0.0267

Table 6-29: MW17-11-03 Water Quality Results Summary (2017 - 2018)

MW17-11-03	2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.25	8.18	8.32	8.21	8.19	8.24
TDS (mg/L)	188.5	183	194	170	160	181
Sulfate-dissolved (mg/L)	22.5	21.1	23.8	19.5	16.9	22.5
Nutrients (mg/L)						
Ammonia Nitrogen	0.005	<0.0050	<0.0050	0.00500	<0.0050	<0.0050
Nitrate Nitrogen	0.333	0.331	0.335	0.005	<0.0050	<0.0050
Nitrite Nitrogen	0.0712	0.0395	0.103	0.00132	<0.0010	0.0019
Dissolved Metals (mg/L)						
Silver	0.0000100	<0.000010	<0.000010	0.0000100	<0.000010	<0.000010
Aluminum	0.0057	0.0056	0.0057	0.0046	0.0038	0.0057
Arsenic	0.00034	0.00021	0.00046	0.0005	0.00041	0.00068
Cadmium	0.00000575	<0.0000050	0.0000065	0.0000108	<0.0000050	0.000019
Chromium	0.0001	<0.00010	<0.00010	0.000100	<0.00010	<0.00010
Copper	0.00035	0.00033	0.00036	0.000223	<0.00020	0.00029
Lead	0.0000500	<0.000050	<0.000050	0.0000500	<0.000050	<0.000050
Molybdenum	0.00702	0.00615	0.00789	0.00519	0.00406	0.00601
Nickel	0.00102	<0.00050	0.00154	0.000680	<0.00050	0.00107
Selenium	0.00033	0.000075	0.000586	0.0000765	<0.000050	0.000139
Zinc	0.0088	0.0063	0.0112	0.013	0.0094	0.0166

Table 6-30: MW17-11-04 Water Quality Results Summary (2017 - 2018)

MW17-11-04	2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.03	7.84	8.27	8.1	7.81	8.31
TDS (mg/L)	347	313	367	371	197	557
Sulfate-dissolved (mg/L)	7.5	6.3	8.1	22.3	18.5	29
Nutrients (mg/L)						
Ammonia Nitrogen	0.0175	0.0145	0.0202	0.03417	<0.0050	0.106
Nitrate Nitrogen	9.18	9.1	9.23	5.0936	0.0173	11.1
Nitrite Nitrogen	0.0264	0.0181	0.0316	0.003	0.002	0.0044
Dissolved Metals (mg/L)						
Silver	0.0000103	<0.000010	0.000011	0.0000200	<0.000010	0.000033
Aluminum	0.0036	0.0035	0.0038	0.0043	0.0030	0.0057
Arsenic	0.00015	0.0001	0.00024	0.00044	0.00014	0.00067
Cadmium	0.0000417	0.0000375	0.0000491	0.0000266	0.0000062	0.0000707
Chromium	0.0001	<0.00010	<0.00010	0.000100	<0.00010	<0.00010
Copper	0.00891	0.00674	0.01	0.00273	0.0008	0.0068
Lead	0.0000500	<0.000050	<0.000050	0.0000500	<0.000050	<0.000050
Molybdenum	0.00618	0.00407	0.0073	0.01166	0.00475	0.0198
Nickel	0.0025	0.00136	0.00309	0.003785	<0.00050	0.00823
Selenium	0.000303	0.000182	0.000502	0.000445	0.000133	0.000929
Zinc	0.0263	0.0168	0.0453	0.042	0.0137	0.0834

Table 6-31: MW17-11-05 Water Quality Results Summary (2017 - 2018)

MW17-11-05	2017 Summary Statistics	2018 Summary Statistics		
Parameters	Mean	Mean	Min	Max
pH	8.28	7.49	7.47	7.51
TDS (mg/L)	305	920	833	971
Sulfate-dissolved (mg/L)	4.7	16	13	17.8
Nutrients (mg/L)				
Ammonia Nitrogen	<0.0050	0.01500	0.0064	0.0334
Nitrate Nitrogen	9.23	24	20.3000	29
Nitrite Nitrogen	0.0045	0.0135	0.0089	0.0227
Dissolved Metals (mg/L)				
Silver	0.0000110	0.0000542	<0.000050	0.000063
Aluminum	0.0014	0.0031	0.0016	0.0053
Arsenic	0.0001	0.00044	0.00035	0.00054
Cadmium	0.0000083	0.0000517	0.000023	0.0000834
Chromium	0.0001	0.000200	<0.00010	<0.00050
Copper	0.00229	0.0049	0.00341	0.0093
Lead	0.00005	0.0001000	<0.000050	<0.00025
Molybdenum	0.00114	0.00675	0.00433	0.00952
Nickel	0.00067	0.006030	0.0053	0.00789
Selenium	0.000349	0.00129	0.00102	0.00155
Zinc	0.045	0.0812	0.0665	0.101

6.3.16 MW17-12

This well was installed in July 2017 to monitor groundwater down-gradient of the Dry Stack Tailing Storage Facility (DSTSF) and all other mine activities. All eight zones were sampled and analyzed in 2018, the results are summarized in Table 6-32 to 6-39 below alongside 2017 results.

Table 6-32: MW17-12-01 Water Quality Results Summary (2017 - 2018)

MW17-12-01	2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	7.8	7.68	7.93	7.97	7.68	8.11
TDS (mg/L)	2165	2160	2170	2090	2040	2160
Sulfate-dissolved (mg/L)	1390	1370	1410	1322.5	1300	1340
Nutrients (mg/L)						
Ammonia Nitrogen	0.005	<0.0050	<0.0050	0.00500	<0.0050	<0.0050
Nitrate Nitrogen	0.075	<0.050	<0.10	0.0875	<0.050	<0.10
Nitrite Nitrogen	0.017	0.0140	<0.020	0.0235	<0.010	0.044
Dissolved Metals (mg/L)						
Silver	0.0000100	<0.000010	<0.000010	0.0000275	<0.000020	<0.000050
Aluminum	0.0026	0.0023	0.0029	0.0059	0.0024	0.0157
Arsenic	0.00228	0.00223	0.00232	0.00295	0.00232	0.00425
Cadmium	0.0000107	0.0000087	0.0000127	0.0000405	<0.000010	0.000067
Chromium	0.0001	<0.00010	<0.00010	0.000275	<0.00020	<0.00050
Copper	0.0002	<0.00020	<0.00020	0.001	<0.00040	0.0028
Lead	0.0000500	<0.000050	<0.000050	0.0001380	<0.00010	<0.00025
Molybdenum	0.00718	0.00689	0.00748	0.0081	0.00792	0.00839
Nickel	0.000655	<0.00050	0.00081	0.001380	<0.0010	<0.0025
Selenium	0.000072	0.000060	0.000083	0.000155	<0.00010	<0.00025
Zinc	0.0358	0.0331	0.0385	0.0365	0.0164	0.0574

Table 6-33: MW17-12-02 Water Quality Results Summary (2017 - 2018)

MW17-12-02	2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	7.89	7.8	7.98	8.06	7.87	8.19
TDS (mg/L)	1810	1780	1840	1735	1670	1810
Sulfate-dissolved (mg/L)	1125	1110	1140	1062.5	1020	1100
Nutrients (mg/L)						
Ammonia Nitrogen	0.005	<0.0050	<0.0050	0.00500	<0.0050	<0.0050
Nitrate Nitrogen	0.075	<0.050	<0.10	0.0563	<0.025	<0.10
Nitrite Nitrogen	0.015	<0.010	<0.020	0.01125	<0.0050	<0.020
Dissolved Metals (mg/L)						
Silver	0.0000150	<0.000010	<0.000020	0.0000250	<0.000010	<0.000050
Aluminum	0.0023	0.0022	0.0023	0.0056	0.0023	0.0134
Arsenic	0.00185	0.00157	0.00213	0.00256	0.00199	0.00405
Cadmium	0.000008	0.000006	<0.000010	0.000018	<0.000010	<0.000025
Chromium	0.00015	<0.00010	<0.00020	0.000250	<0.00010	<0.00050
Copper	0.0003	<0.00020	<0.00040	0.0005	<0.00020	<0.0010
Lead	0.0000750	<0.000050	<0.00010	0.0001250	<0.000050	<0.00025
Molybdenum	0.00786	0.00732	0.0084	0.00791	0.00775	0.00827
Nickel	0.00099	0.00098	<0.0010	0.001250	<0.00050	<0.0025
Selenium	0.000075	<0.000050	<0.00010	0.000132	0.000076	<0.00025
Zinc	0.0224	0.0219	0.023	0.0332	0.0127	0.0468

Table 6-34: MW17-12-03 Water Quality Results Summary (2017 - 2018)

MW17-12-03	2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.04	7.87	8.21	8.12	7.85	8.34
TDS (mg/L)	551	541	561	537.5	522	559
Sulfate-dissolved (mg/L)	137.5	133	142	138.5	136	142
Nutrients (mg/L)						
Ammonia Nitrogen	0.005	<0.0050	<0.0050	0.00500	<0.0050	<0.0050
Nitrate Nitrogen	0.1481	0.0221	0.274	0.0202	0.0060	<0.025
Nitrite Nitrogen	0.007	<0.0050	0.0091	0.00415	0.0016	<0.0050
Dissolved Metals (mg/L)						
Silver	0.0000100	<0.000010	<0.000010	0.0000100	<0.000010	<0.000010
Aluminum	0.0026	0.0024	0.0027	0.0044	0.0019	0.0106
Arsenic	0.00114	0.00104	0.00123	0.00114	0.00097	0.00149
Cadmium	0.0000065	<0.0000050	0.000008	0.00000927	<0.0000050	0.0000136
Chromium	0.0001	<0.00010	<0.00010	0.000100	<0.00010	<0.00010
Copper	0.0002	<0.00020	<0.00020	0.000492	<0.00020	0.00137
Lead	0.0000500	<0.000050	<0.000050	0.0000500	<0.000050	<0.000050
Molybdenum	0.0061	0.00601	0.0062	0.00553	0.00521	0.00592
Nickel	0.00128	0.00069	0.00186	0.000735	<0.00050	0.00144
Selenium	0.00005	<0.000050	<0.000050	0.0000675	<0.000050	0.00012
Zinc	0.0218	0.0151	0.0286	0.0231	0.0103	0.048

Table 6-35: MW17-12-04 Water Quality Results Summary (2017 - 2018)

MW17-12-04	2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.08	7.97	8.19	8.18	7.86	8.46
TDS (mg/L)	474.5	469	480	435.2	423	450
Sulfate-dissolved (mg/L)	120.5	115	126	98.1	93.6	102
Nutrients (mg/L)						
Ammonia Nitrogen	0.005	<0.0050	<0.0050	0.00500	<0.0050	<0.0050
Nitrate Nitrogen	0.252	0.242	0.261	0.272	0.2220	0.335
Nitrite Nitrogen	0.0043	0.0036	<0.0050	0.003	<0.0010	<0.0050
Dissolved Metals (mg/L)						
Silver	0.0000100	<0.000010	<0.000010	0.0000125	<0.000010	0.000015
Aluminum	0.0032	0.0029	0.0035	0.0030	0.0023	0.0035
Arsenic	0.0004	0.00018	0.00061	0.00077	0.00021	0.00226
Cadmium	0.0000151	0.0000113	0.0000189	0.0000139	0.0000052	0.0000212
Chromium	0.0001	<0.00010	<0.00010	0.000100	<0.00010	<0.00010
Copper	0.0036	0.00347	0.00374	0.0017	0.00123	0.00217
Lead	0.0000500	<0.000050	<0.000050	0.0000500	<0.000050	<0.000050
Molybdenum	0.008	0.00711	0.0089	0.00579	0.00526	0.00641
Nickel	0.00188	0.00103	0.00272	0.000590	<0.00050	0.00086
Selenium	0.000622	0.000569	0.000674	0.000726	0.000607	0.000994
Zinc	0.0215	0.0173	0.0257	0.0455	0.0105	0.101

Table 6-36: MW17-12-05 Water Quality Results Summary (2017 - 2018)

MW17-12-05	2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.11	8.01	8.21	8.21	7.94	8.48
TDS (mg/L)	480	474	486	453.8	441	466
Sulfate-dissolved (mg/L)	111	102	120	90.2	87.5	93.1
Nutrients (mg/L)						
Ammonia Nitrogen	0.0055	<0.0050	0.006	0.00500	<0.0050	<0.0050
Nitrate Nitrogen	0.308	0.279	0.336	0.276	0.1990	0.415
Nitrite Nitrogen	0.0108	<0.0050	0.0165	0.004	<0.0010	<0.0050
Dissolved Metals (mg/L)						
Silver	0.0000100	<0.000010	<0.000010	0.0000100	<0.000010	<0.000010
Aluminum	0.0037	0.0037	0.0037	0.0079	0.0026	0.0177
Arsenic	0.00027	<0.00010	0.00044	0.000222	<0.00010	0.00047
Cadmium	0.000025	0.0000151	0.0000348	0.0000226	0.0000191	0.000029
Chromium	0.0001	<0.00010	<0.00010	0.000100	<0.00010	<0.00010
Copper	0.00123	0.00086	0.0016	0.00228	0.00098	0.00318
Lead	0.0000500	<0.000050	<0.000050	0.0000500	<0.000050	<0.000050
Molybdenum	0.0083	0.0078	0.0088	0.01466	0.00474	0.0207
Nickel	0.002	0.00136	0.00264	0.002880	0.00117	0.0043
Selenium	0.000575	0.000562	0.000588	0.000345	0.000255	0.000504
Zinc	0.0554	0.0372	0.0737	0.0254	0.013	0.043

Table 6-37: MW17-12-06 Water Quality Results Summary (2017 - 2018)

MW17-12-06	2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.18	8.1	8.27	8.22	7.94	8.48
TDS (mg/L)	442	422	462	455.5	443	466
Sulfate-dissolved (mg/L)	91.2	88.2	94.1	94.6	91.6	101
Nutrients (mg/L)						
Ammonia Nitrogen	0.0152	<0.0050	0.0253	0.00610	<0.0050	0.0094
Nitrate Nitrogen	0.0255	<0.0050	0.046	0.1539	0.0575	0.247
Nitrite Nitrogen	0.0032	0.0015	<0.0050	0.0118	<0.0050	0.0152
Dissolved Metals (mg/L)						
Silver	0.0000100	<0.000010	<0.000010	0.0000100	<0.000010	<0.000010
Aluminum	0.0038	0.0028	0.0047	0.0051	0.0024	0.0093
Arsenic	0.000225	<0.00010	0.00035	0.000272	<0.00010	0.00058
Cadmium	0.0000312	0.0000223	<0.000040	0.0000364	<0.000025	0.0000598
Chromium	0.0001	<0.00010	<0.00010	0.000100	<0.00010	<0.00010
Copper	0.0007	0.00062	0.00077	0.00211	0.00115	0.00296
Lead	0.0000500	<0.000050	<0.000050	0.0000515	<0.000050	0.000056
Molybdenum	0.0528	0.0448	0.0607	0.0266	0.0216	0.033
Nickel	0.00312	0.00268	0.00357	0.003930	0.00326	0.00457
Selenium	0.000538	0.000532	0.000544	0.000429	0.000197	0.00085
Zinc	0.0176	0.0135	0.0218	0.142	0.011	0.524

Table 6-38: MW17-12-07 Water Quality Results Summary (2017 - 2018)

MW17-12-07	2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.12	8.02	8.23	8.16	7.96	8.42
TDS (mg/L)	318.5	304	333	329	316	343
Sulfate-dissolved (mg/L)	62.1	60.9	63.3	62.9	60.6	67.4
Nutrients (mg/L)						
Ammonia Nitrogen	0.005	<0.0050	<0.0050	0.00500	<0.0050	<0.0050
Nitrate Nitrogen	0.984	0.97	0.997	0.799	0.7390	0.928
Nitrite Nitrogen	0.0016	<0.0010	0.0021	0.00162	<0.0010	0.0027
Dissolved Metals (mg/L)						
Silver	0.0000100	<0.000010	<0.000010	0.0000100	<0.000010	<0.000010
Aluminum	0.0028	0.0027	0.003	0.0055	0.0023	0.0135
Arsenic	0.000195	<0.00010	0.00029	0.00029	0.0001	0.00048
Cadmium	0.0000059	<0.0000050	0.0000068	0.00001747	<0.0000050	0.0000379
Chromium	0.0001	<0.00010	<0.00010	0.000100	<0.00010	<0.00010
Copper	0.00164	0.00122	0.00207	0.00091	0.00078	0.00127
Lead	0.0000500	<0.000050	<0.000050	0.0000500	<0.000050	<0.000050
Molybdenum	0.00883	0.00801	0.00966	0.00658	0.00626	0.00695
Nickel	0.00059	<0.00050	0.00068	0.000512	<0.00050	0.00057
Selenium	0.000338	0.000332	0.000345	0.00033	0.000219	0.000809
Zinc	0.0156	0.0131	0.018	0.0651	0.0108	0.281

Table 6-39: MW17-12-08 Water Quality Results Summary (2017 - 2018)

MW17-12-08	2017 Summary Statistics			2018 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.13	8.05	8.27	8.28	8.08	8.52
TDS (mg/L)	328.7	321	337	358	327	477
Sulfate-dissolved (mg/L)	62	60.8	62.7	67.6	61.2	95.4
Nutrients (mg/L)						
Ammonia Nitrogen	0.0054	<0.0050	0.0061	0.00500	<0.0050	<0.0050
Nitrate Nitrogen	0.948	0.936	0.963	0.716	0.1000	0.928
Nitrite Nitrogen	0.004	<0.0010	0.0058	0.00338	<0.0010	0.0124
Dissolved Metals (mg/L)						
Silver	0.0000100	<0.000010	<0.000010	0.0000102	<0.000010	0.000011
Aluminum	0.0045	0.0024	0.006	0.0057	0.0020	0.0113
Arsenic	0.000187	<0.00010	0.00025	0.000232	<0.00010	0.00069
Cadmium	0.0000085	0.0000075	0.0000103	0.00001285	<0.0000050	<0.000025
Chromium	0.0001	<0.00010	<0.00010	0.000100	<0.00010	<0.00010
Copper	0.00145	0.00141	0.00151	0.00189	0.00082	0.00494
Lead	0.0000500	<0.000050	<0.000050	0.0000500	<0.000050	<0.000050
Molybdenum	0.0127	0.011	0.0137	0.01172	0.00787	0.0279
Nickel	0.002497	<0.00050	0.00351	0.001147	<0.00050	0.00438
Selenium	0.000343	0.000340	0.000347	0.000248	0.000224	0.000286
Zinc	0.0179	0.0157	0.0213	0.0263	0.0099	0.0628

6.4 Vibrating Wire Piezometers

There are currently 20 operating vibrating wire piezometers installed on site as listed in Table 6-40. There were no changes to the operational status of any piezometers in 2018. Summaries of data collected from each piezometer are provided in the following sections.

Table 6-40: Vibrating Wire Piezometer Summary

Vibrating Wire Piezometer	Location	Operational Status
DSP-5	DSTSF	Operational
DSP-6	DSTSF	Operational
DSP-7	DSTSF	Operational
DSP-8	DSTSF	Operational
DSP-9	DSTSF	Inoperative (2016)
DSP-10	DSTSF	Operational
SDP-2	Southwest Dump	2A - Inoperative (2017)
SDP-3	Southwest Dump	Operational
SDP-4	Southwest Dump	Operational
WDP-2	Water Storage Pond Dam	Operational
WDP-3A	Water Storage Pond Dam	Operational
WDP-3	Water Storage Pond Dam	Operational
WDP-4	Water Storage Pond Dam	Operational
WDP-5	Water Storage Pond Dam	Operational
WDP-6	Water Storage Pond Dam	Operational
WDP-7	Water Storage Pond Dam	Operational
WDP-8	Water Storage Pond Dam	Operational
WDP-9	Water Storage Pond Dam	Operational
WDP-10	Water Storage Pond Dam	Operational
WDP-11	Water Storage Pond Dam	Operational
WDP-12	Water Storage Pond Dam	Operational
WDP-13	Water Storage Pond Dam	Operational

6.4.1.1 DSTSF Piezometers

Data collected from DSTSF piezometers are presented in Figure 6-2 to 6-5. Sensor DSP-6A is reading negative pressures and has not been included in the figure. The DSTSF piezometer data are collected quarterly.

Pore water pressures in DSP-5A and DSP-5B have been gradually increasing since installation in 2013. Analysis carried out by SRK Consulting in 2015 to consider the increasing pressures indicated high FOS values ($FOS > 2$) even without consideration of the constructed MVFE2. DSP-7 and DSP-8 water pressures have been gradually increasing since installation in late 2015. Review of the data by SRK consulting in 2018 identified no stability concern. DSP-10 water pressures increased significantly upon installation, and the trend has gradually been increasing since March 2016. Review of DSP-10 data by SRK Consulting in 2018 identified no stability concern. The MVFE2 slope near DSP-10 continues to be monitored by two survey hubs (MV1 and MV2) that indicate no signs of instability.

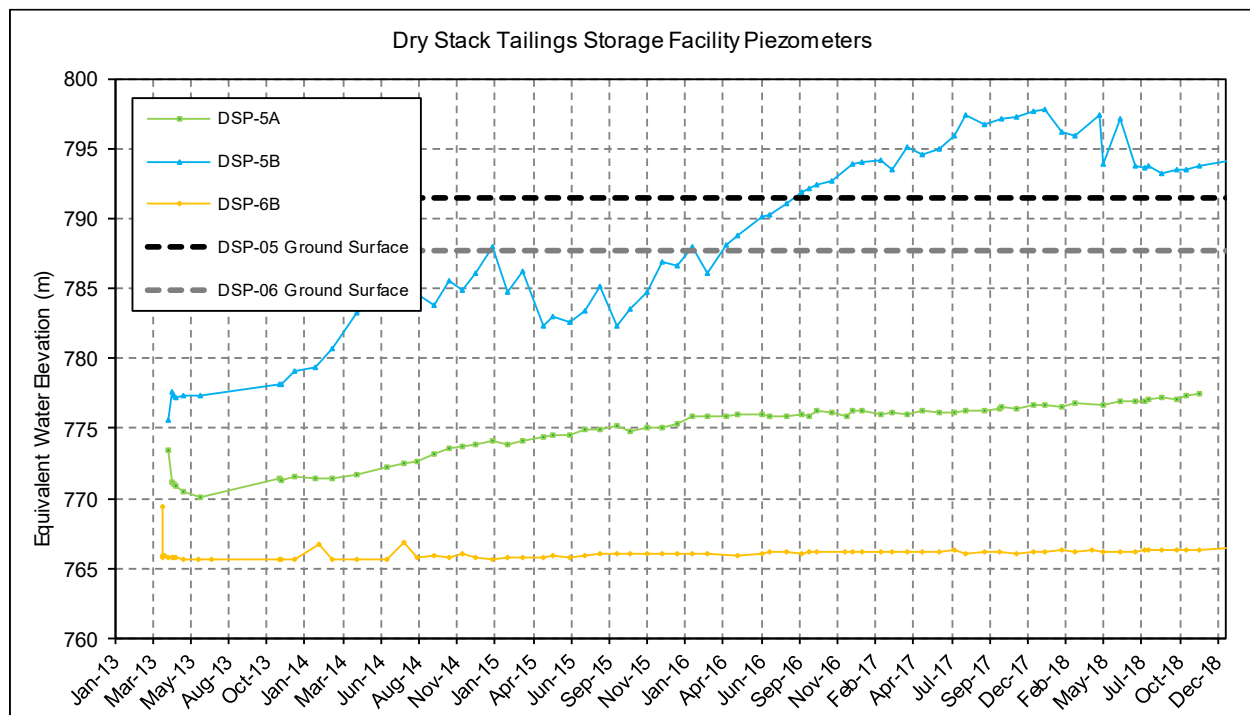


Figure 6-2: DSTSF Piezometer Data – DSP-05 and DSP-06 (2013-2018)

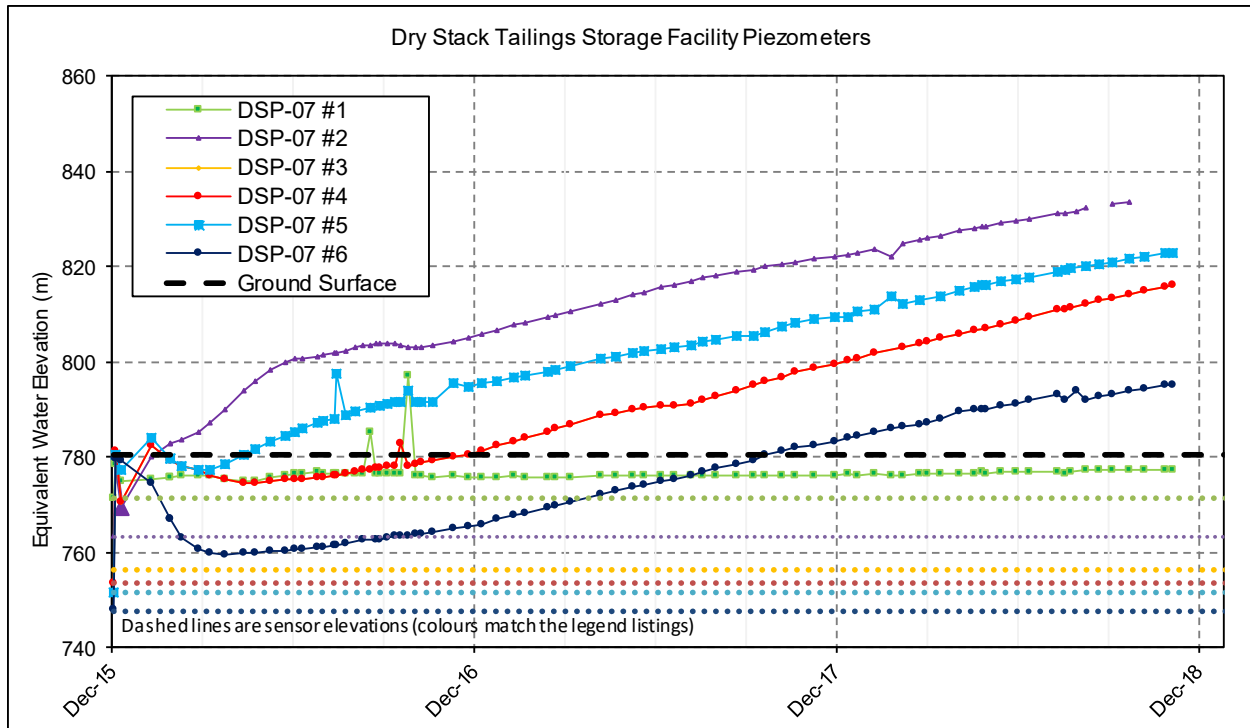


Figure 6-3: DSTSF Piezometer Data – DSP-07 (2015-2018)

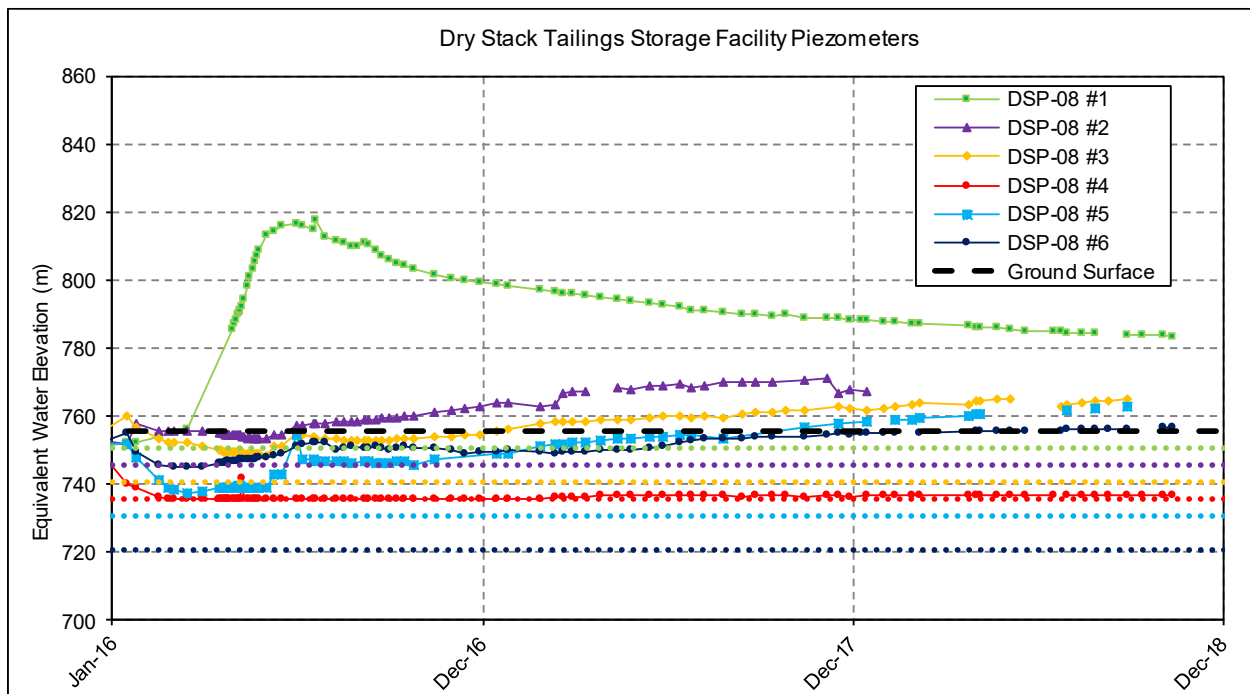


Figure 6-4: DSTSF Piezometer Data – DSP-08 (2015-2018)

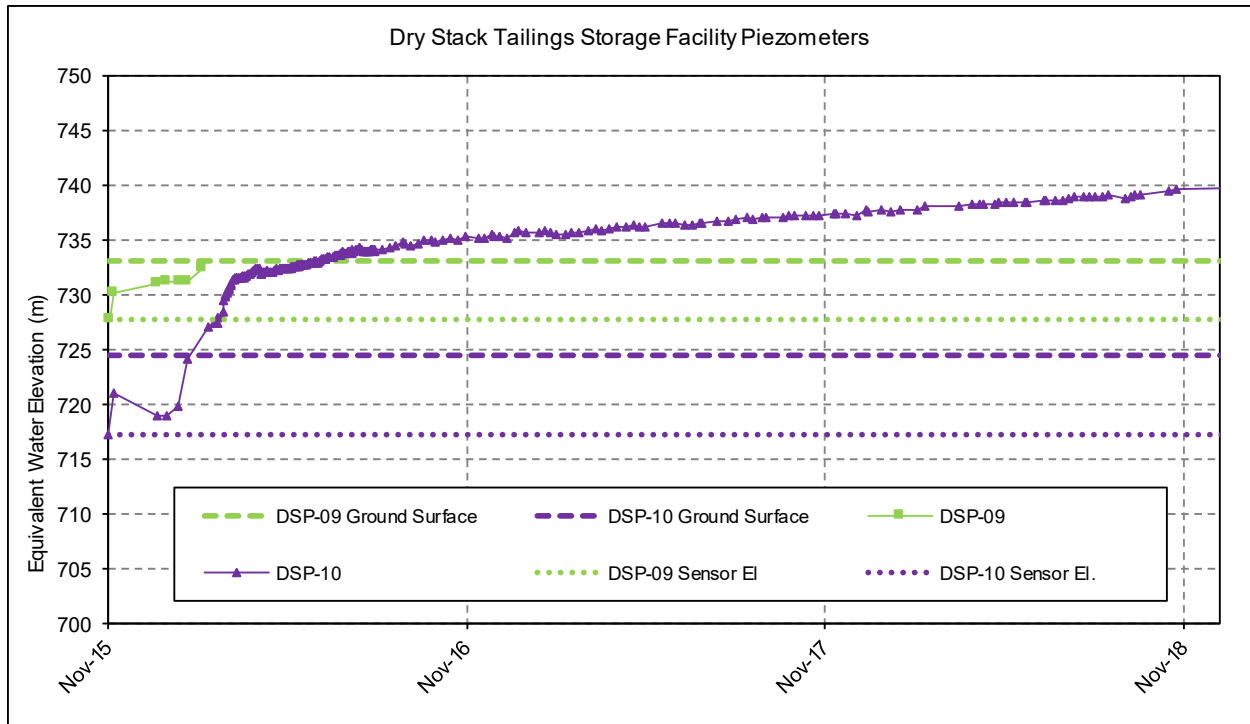


Figure 6-5: DSTSF Piezometer Data – DSP-09 and DSP-10 (2015-2018)

6.4.1.2 Southwest Dump Piezometers

Data collected from the Southwest Dump piezometers are presented in Figure 6-6. Sensors SDP-3A and SDP-3B are reading negative pressures and have not been included in the figure. The data collection frequency was reduced from monthly to quarterly in November 2018. The data indicate stable conditions with some seasonal changes in pore pressure in 2018.

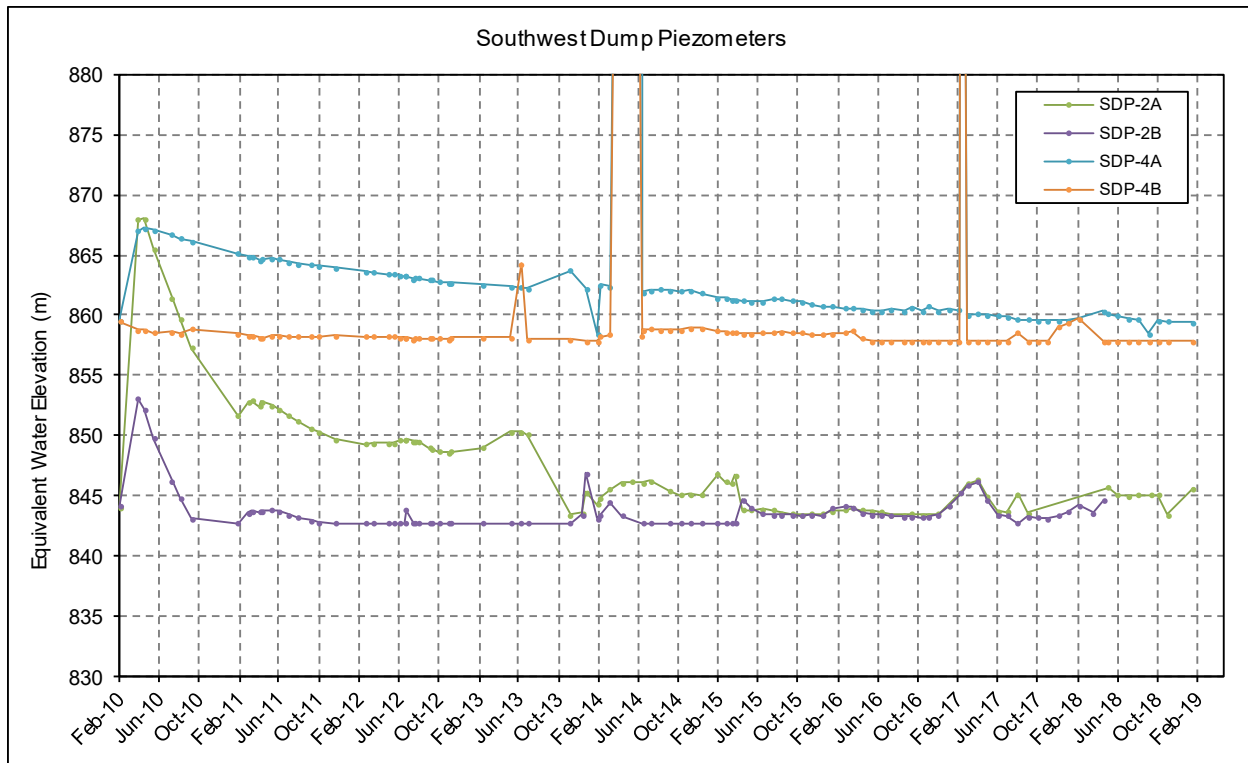


Figure 6-6: Southwest Dump Piezometer Data (2010-2018)

6.4.1.3 Water Storage Pond Dam Piezometers

Data collected from WSP Dam piezometers are presented in Figure 6-7. WDP-2, WDP-3, WDP-5, and WDP-11 are reading negative pressures and have not been included in the figure. Readings are collected monthly. Pressures in 2018 generally followed the trend of the water level in the water storage pond as in previous years.

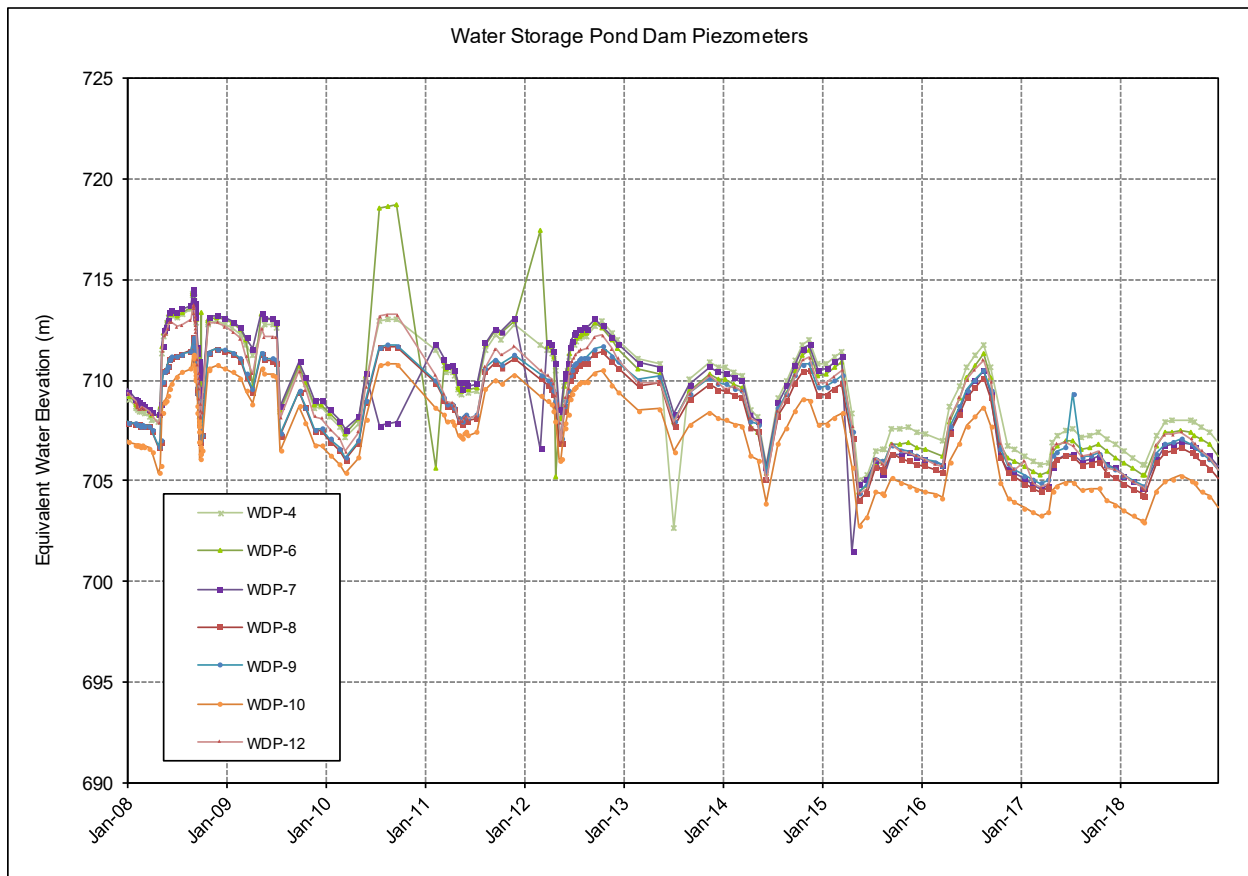


Figure 6-7: WSP Dam Piezometer Data (2008-2018)

6.4.2 Ground Temperature Cables

There are currently 22 operating ground temperature cables, or thermistors, installed on site as listed in Table 6-41. There were no changes to the operational status of any of the existing thermistors in 2018. Summaries of data collected from each thermistor are contained in the following sections.

Table 6-41: Thermistor Summary (2018)

Thermistor	Location	Operational Status
A2T-1	DSTSF	Operational
DST-10	DSTSF	Operational
DST-11	DSTSF	Operational
DST-13	DSTSF	Operational
DST-14	DSTSF	Operational
DST-15	DSTSF	Operational
MW-11-02	Ridgetop	Operational
MW-11-03	Ridgetop	Operational
SDT-1	Southwest Dump	Operational
SDT-2	Southwest Dump	Operational
SDT-3	Southwest Dump	Operational
SDT-4	Southwest Dump	Operational
WDT – 1	Water Storage Pond Dam	Operational
WDT – 2	Water Storage Pond Dam	Operational
WDT – 3	Water Storage Pond Dam	Operational
WDT – 4	Water Storage Pond Dam	Operational
WDT – 5	Water Storage Pond Dam	Operational
WDT – 6	Water Storage Pond Dam	Operational
WDT – 7	Water Storage Pond Dam	Operational
WDT – 8	Water Storage Pond Dam	Operational

6.4.2.1 DSTSF Thermistors

Data collected from DSTSF thermistors are presented in 6-8 through Figure 6-13. Data are collected quarterly. No major changes to ground temperatures at the DSTSF were observed in 2018.

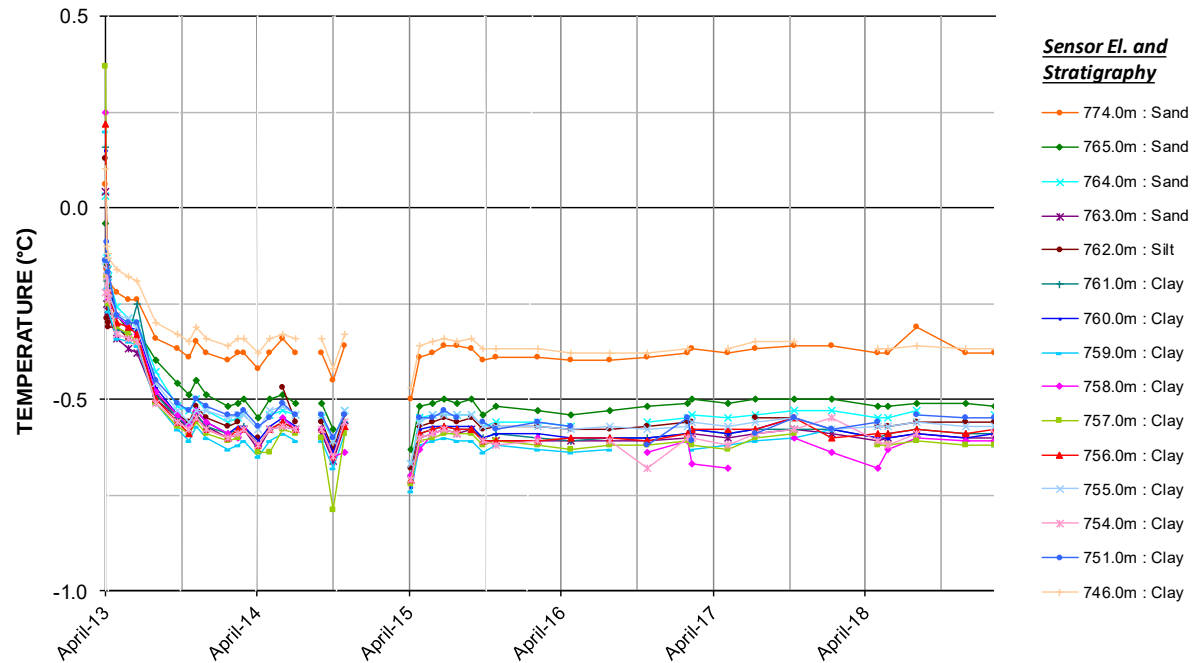


Figure 6-8: Thermistor DST-10 (2013-2018)

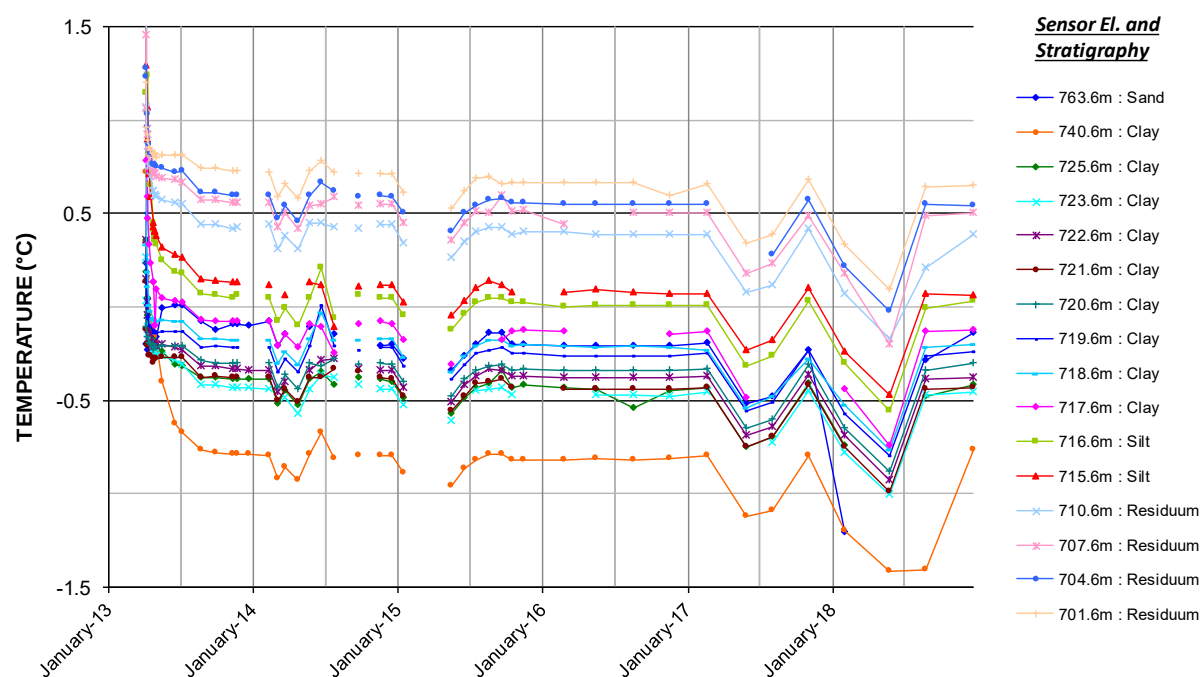


Figure 6-9: Thermistor DST-11 (2013-2018)

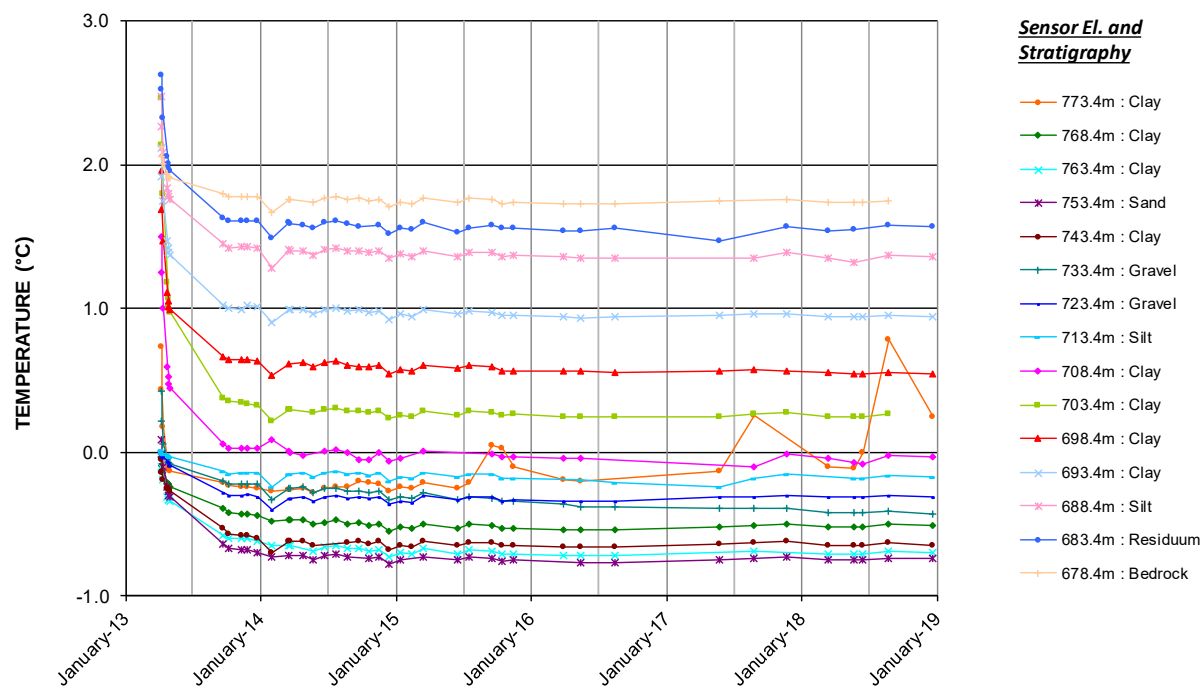


Figure 6-10: Thermistor DST-13 (2013-2018)

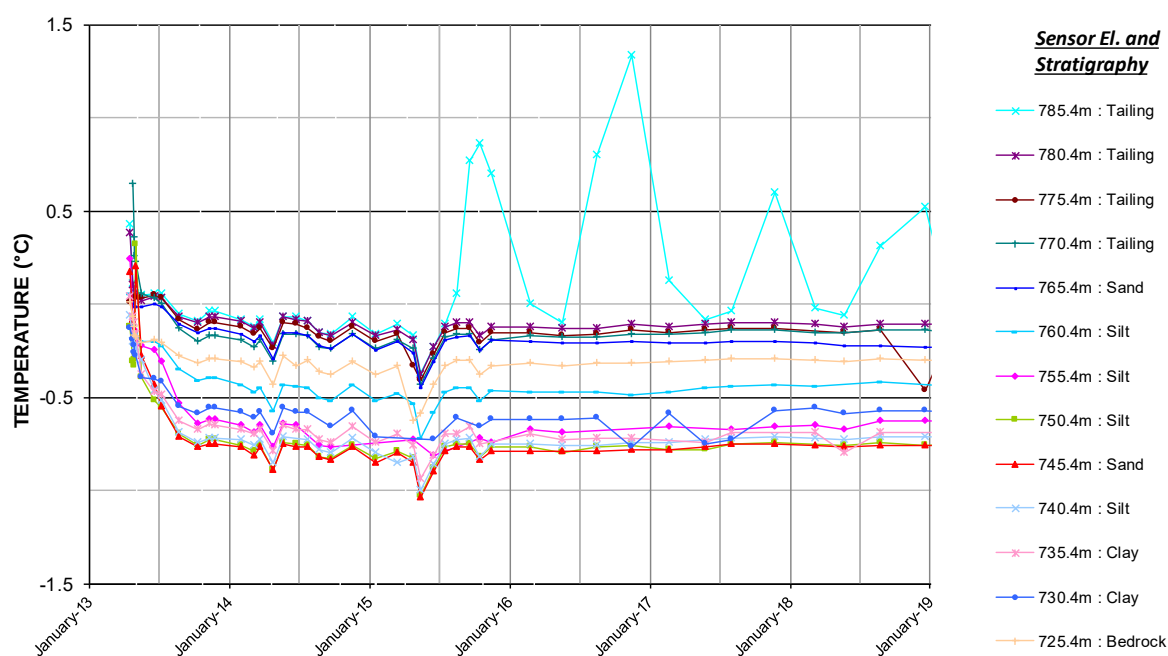


Figure 6-11: Thermistor DST-14 (2015-2018)

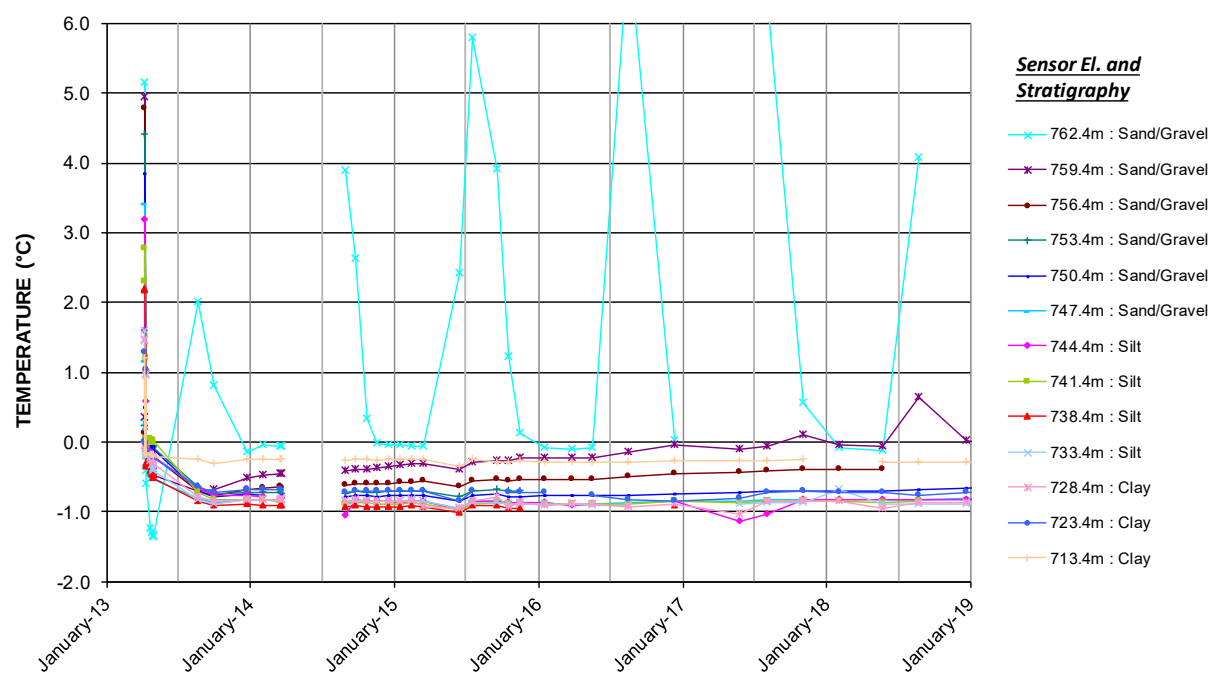


Figure 6-12: Thermistor DST-15 (2013-2018)

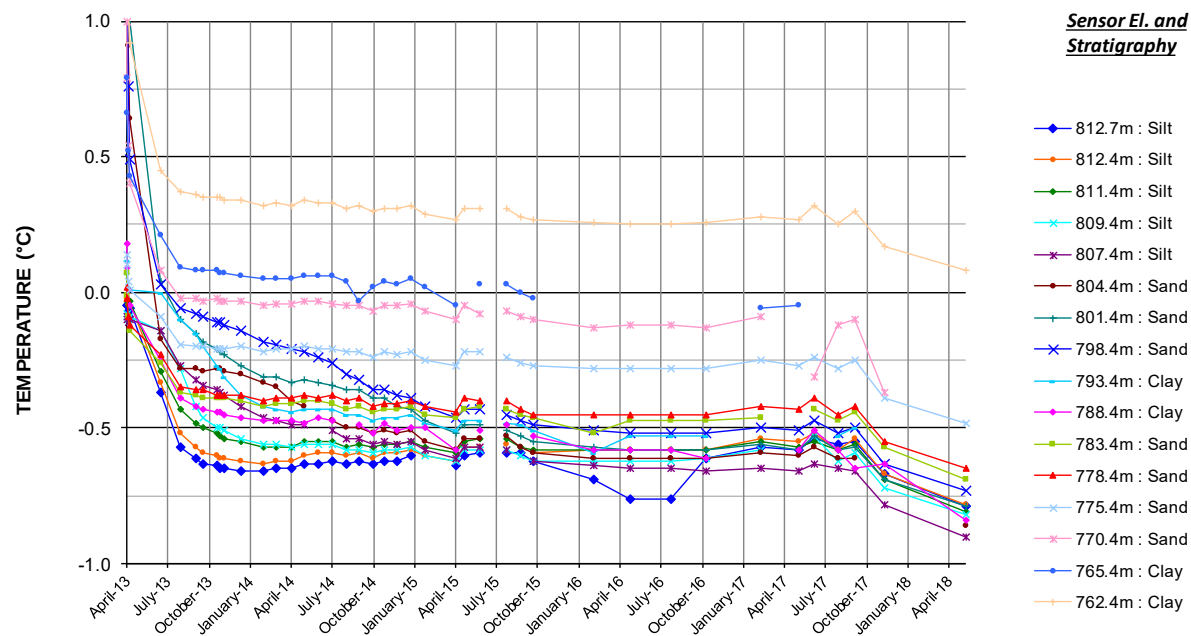


Figure 6-13: Thermistor AT2-1 (2013-2018)

6.4.2.2 Southwest Dump Thermistors

Data collected from SWD thermistors are presented in Figure 6-14 through Figure 6-17. Data are collected quarterly. No major changes to ground temperatures at the SWD were observed in 2018.

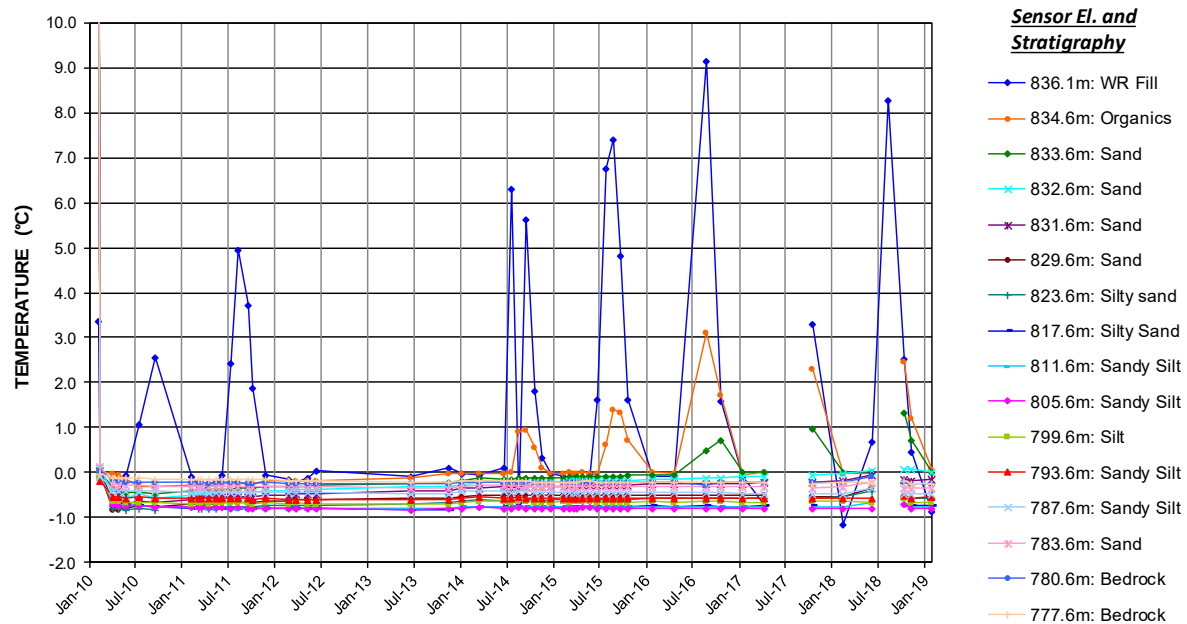


Figure 6-14: Thermistor SDT-1 (2010-2018)

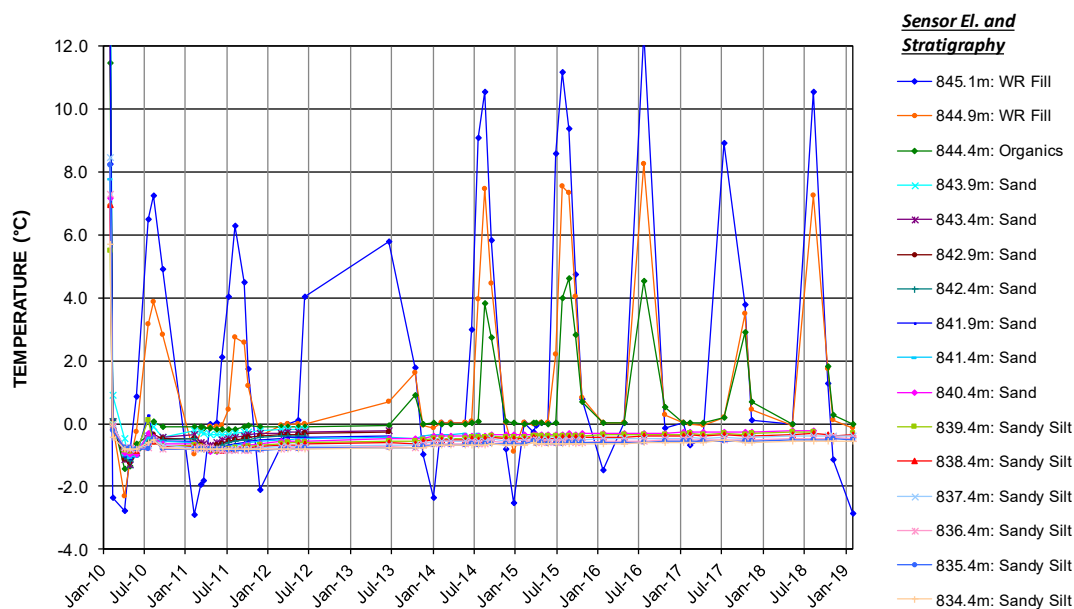


Figure 6-15: Thermistor SDT-2 (2010-2018)

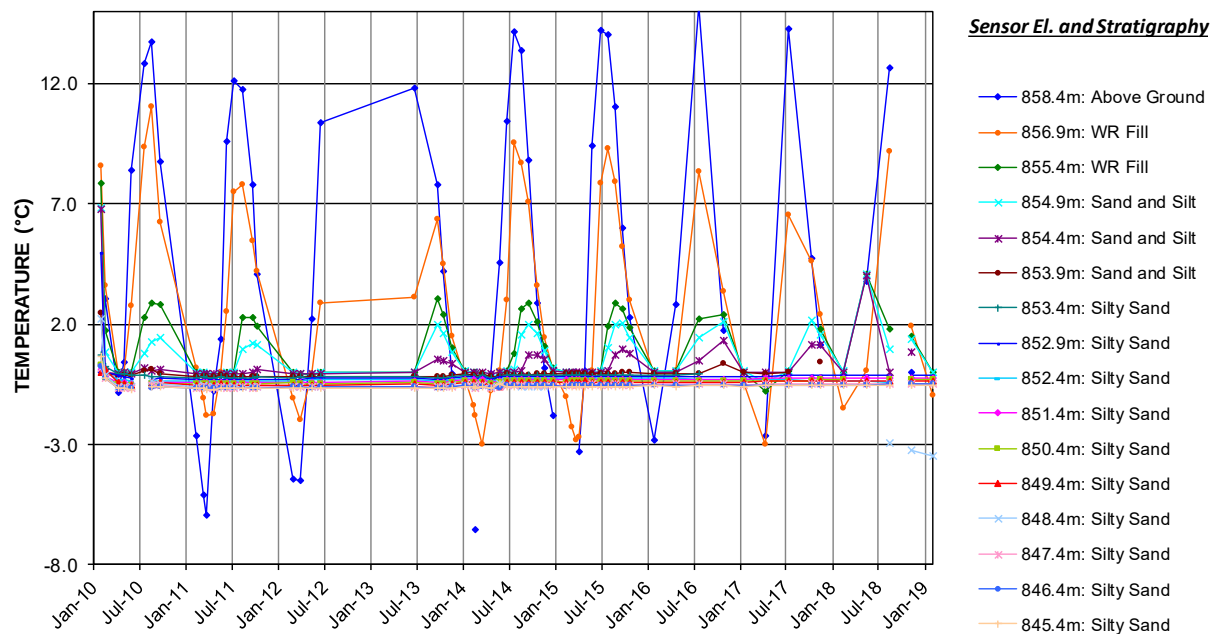


Figure 6-16: Thermistor SDT-3 (2010-2018)

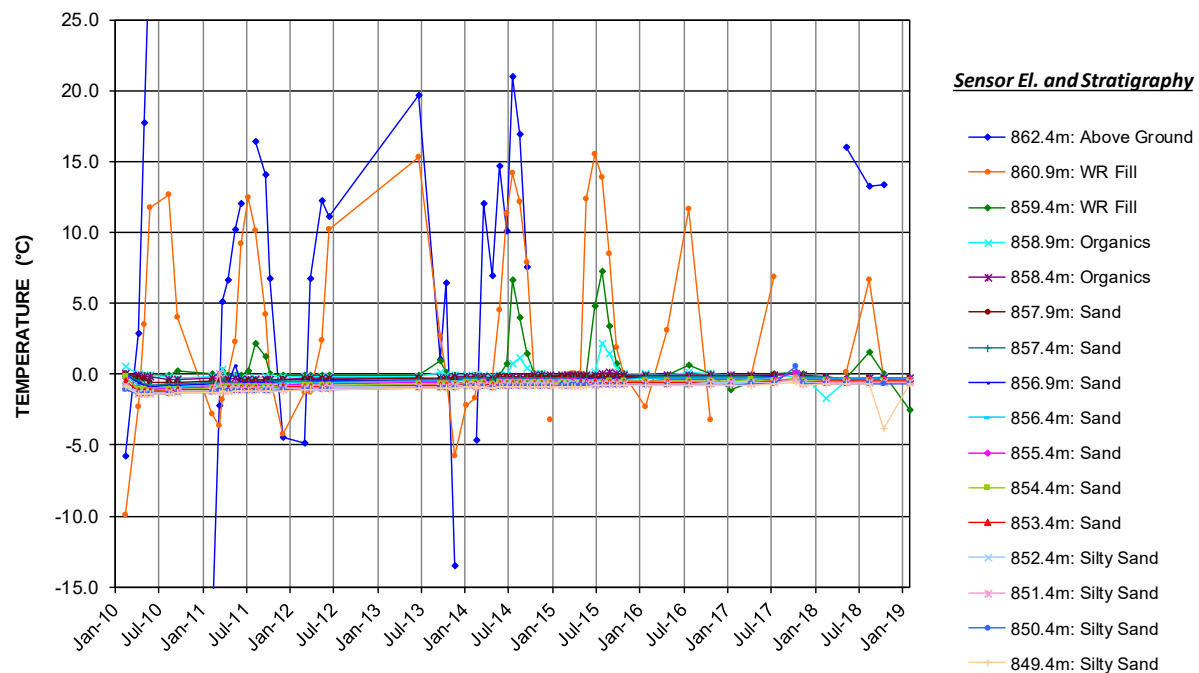


Figure 6-17: Thermistor SDT-4 (2010-2018)

6.4.2.3 Water Storage Pond Dam Thermistors

Data are collected monthly from all water retention dam thermistors. All thermistors continue to show temperatures well above zero since installation.

6.5 Lysimeters

As part of the site progressive reclamation efforts, soil covers were constructed over the waste rock dumps and the DSTSF with objectives that include reducing infiltration to the extent practical using locally available materials, and ensuring a stable landform that will promote establishment of natural vegetation endemic to the area. The closure cover soils are to consist of sandy loam with a minimum cover thickness of 0.5 m, and a minimum fines content of 10% (SRK 2016). The cover infiltration is an important input to the site-wide water and load balance model and the prediction of downstream water quality, and therefore, measurement of infiltration rates through the cover will allow for refinements to the model and improved estimates of future water quality.

As part of Clause 64 of the water license QZ14-031, an updated groundwater monitoring program is required that includes a minimum of one lysimeter in each waste rock pile.

Minto Explorations Ltd. installed four lysimeters in different waste facilities between October 11 and 18, 2017:

- LYS17-01 – Installed in the Main Waste Dump
- LYS17-02 – Installed in the Southwest Waste Dump
- LYS17-04 – Installed in the Mill Valley Fill Extension, and
- LYS17-05 – Installed in the Dry Stack Tailings Storage Facility

These installations have been operational and were monitored throughout 2018. It is anticipated that the installations will require a year of operation to reach equilibrium, therefore we will continue to monitor the lysimeters throughout 2019. Data presentation, analysis, and interpretation of cover performance will be completed at the end of 2019.

7 Seepage Water Quality Monitoring Program

Minto Mine implements a Seepage Monitoring Plan (SMP) to assess acid rock drainage and metal leaching conditions from several sources, including: pit wall seepage, ore stockpile areas, overburden dumps, waste rock dumps, DSTSF, Mill Valley Fill Extension 1 and 2, the mill area and other seepage locations.

Seepage monitoring conducted in 2018 was carried out in accordance with the EMSRP. The EMSRP states that seepage surveys will be conducted twice a year, during spring runoff and in early fall, by walking the toe of each waste dump, stockpile or other areas of interest. The survey route for each seepage monitoring event are recorded using the tracking function of a GPS. A map showing the 2018 survey routes and monitoring locations can be found in Figure 7-1.

WUL QZ14-031 identifies a Surface Water Surveillance Program which requires regular monitoring of seepage at several permanent seepage water quality stations. These stations include: W8 (Destroyed in 2017), W8A, W17, (W36, W37 – destroyed in 2016), and W62. Prior to WUL QZ14-031, Minto operated under WUL QZ96-006 which included seepage monitoring sites W32, W38, W39 and W40 in the Surface Water Surveillance Program. The water quality results for these permanent seepage quality stations are additionally reported to the Yukon Water Board (YWB) monthly. Other seepage sites that have been located have been recorded by GPS to ensure continued monitoring. These additional sites are visited during the spring and fall and, if water is present, a sample is collected. Substantial variability in flow presence and/or volume has been observed at many seepage sites. All lab results for 2018 spring and fall seepage monitoring programs are provided in Appendix D.

Seepage site locations are marked by GPS and data is stored in the Minto Mine Water Quality Database, along with results from WUL sampling stations. Minto will continue to monitor these seepage areas and monitor the site workings for seeps on a semi-annual basis.

Observations from the 2018 Seepage Monitoring Program indicate that many seepage sites identified are seasonally variable. It has also been observed that weather patterns have an impact, where snow melt or rain contribute to observable flows that are absent during warm, dry weather. Analysis of seepage results and water quality analysis assists in improving understanding of water chemistry, load, and water balance issuing from waste dumps, overburden dumps, ore stockpiles, and tailings facilities.

Constituents of concern, namely dissolved copper, dissolved cadmium, dissolved iron, dissolved selenium, ammonia, nitrate, and nitrite have been graphed below for each site sampled. In the event of results below the detection limit, the limit is plotted and the results are presented with a 0.5 factor. In cases where a graph's trend is skewed due to visual outliers (i.e. data points that are larger than the mean by an order of magnitude), a second graph with outliers removed is provided and labelled as "Reduced Concentration."

Per current EMSRP, field data and observations including coordinates, weather, field measurements (pH, conductivity and temperature), a sketch of the location, water conditions and colour of sediment and number of filters used. The original field sheets are presented with the pictures that were obtained at each site in Appendix D.



7.1 Mill Valley Fill

The first phase of the Mill Valley Fill (MVF) was completed in 2012 and vertical culverts were installed at both W8 and W8A to enable water quality monitoring at these locations. Obtaining water samples at W8 has been sporadic since the installation of the vertical culvert. The last time this station produced water was in late 2013. The second phase of the Mill Valley Fill Extension was completed in early 2016. Additional extensions were added to the vertical culverts of W8 and W8A to preserve the sampling stations. In fall 2017, W8 culvert was covered during reclamation operations and could no longer be accessed. Water quality results for W8 and W8A are outlined in Figure 7-2 through 7-10 and include 2018 results as well as historic data for dissolved copper, dissolved cadmium, dissolved iron, dissolved selenium, and nutrient levels for ammonia, nitrite, and nitrate.

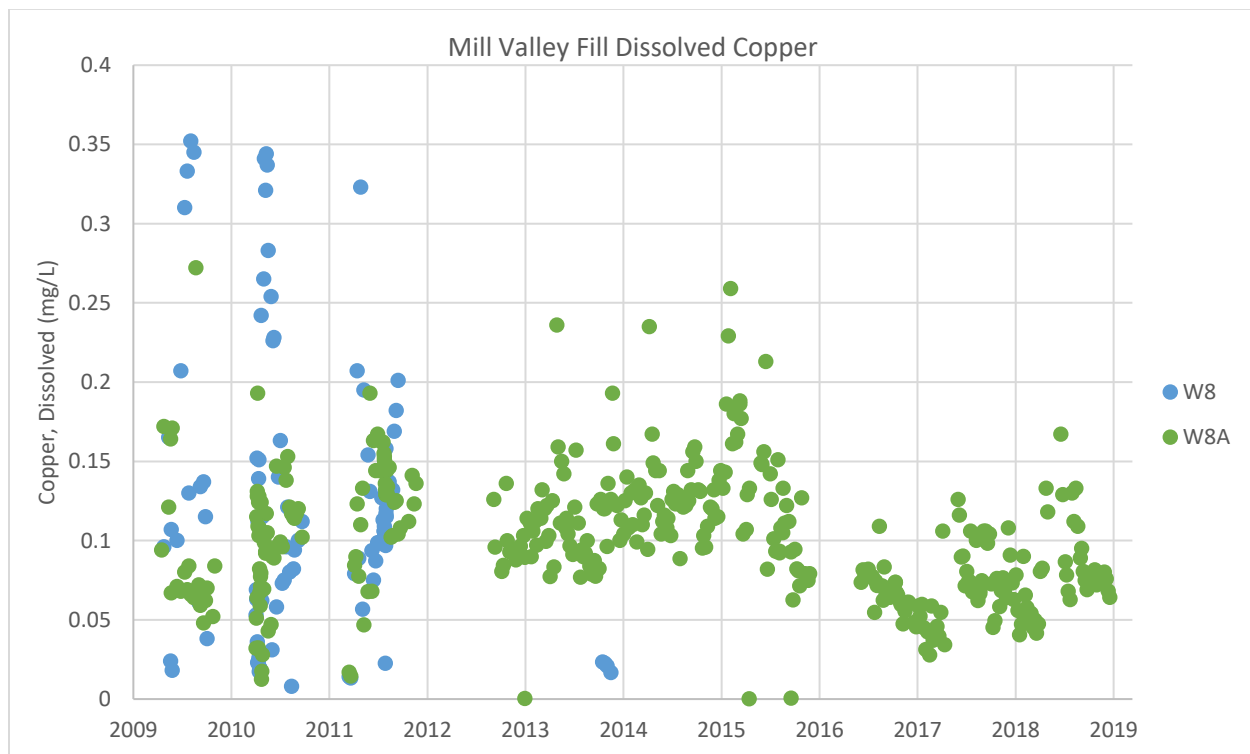


Figure 7-2: Mill Valley Fill Dissolved Copper

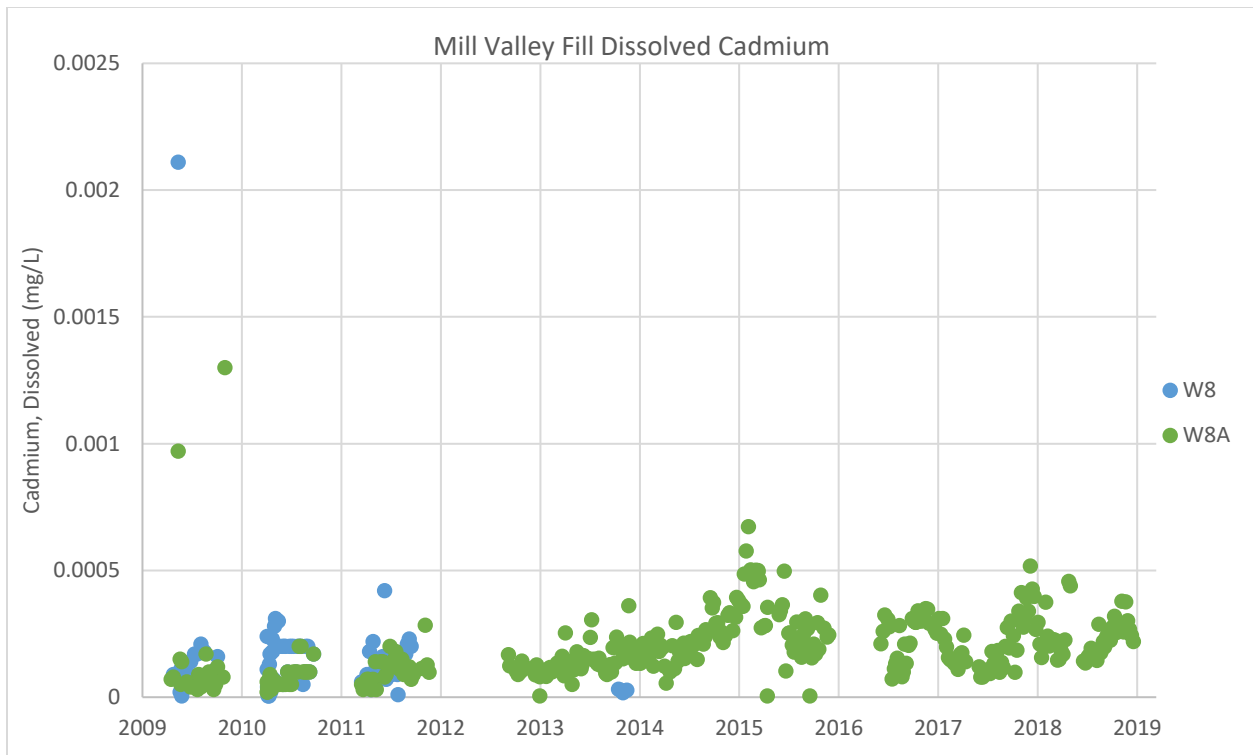


Figure 7-3: Mill Valley Fill Dissolved Cadmium

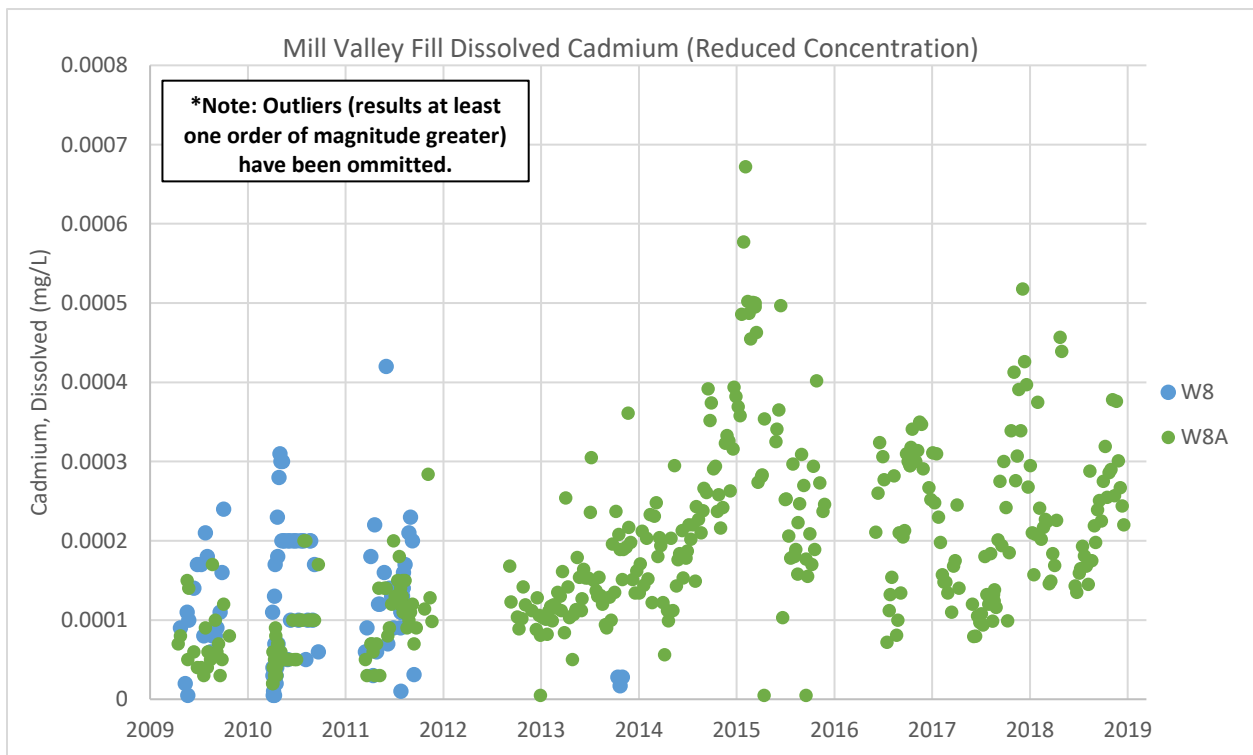


Figure 7-4: Mill Valley Fill Dissolved Cadmium (Reduced Concentration)

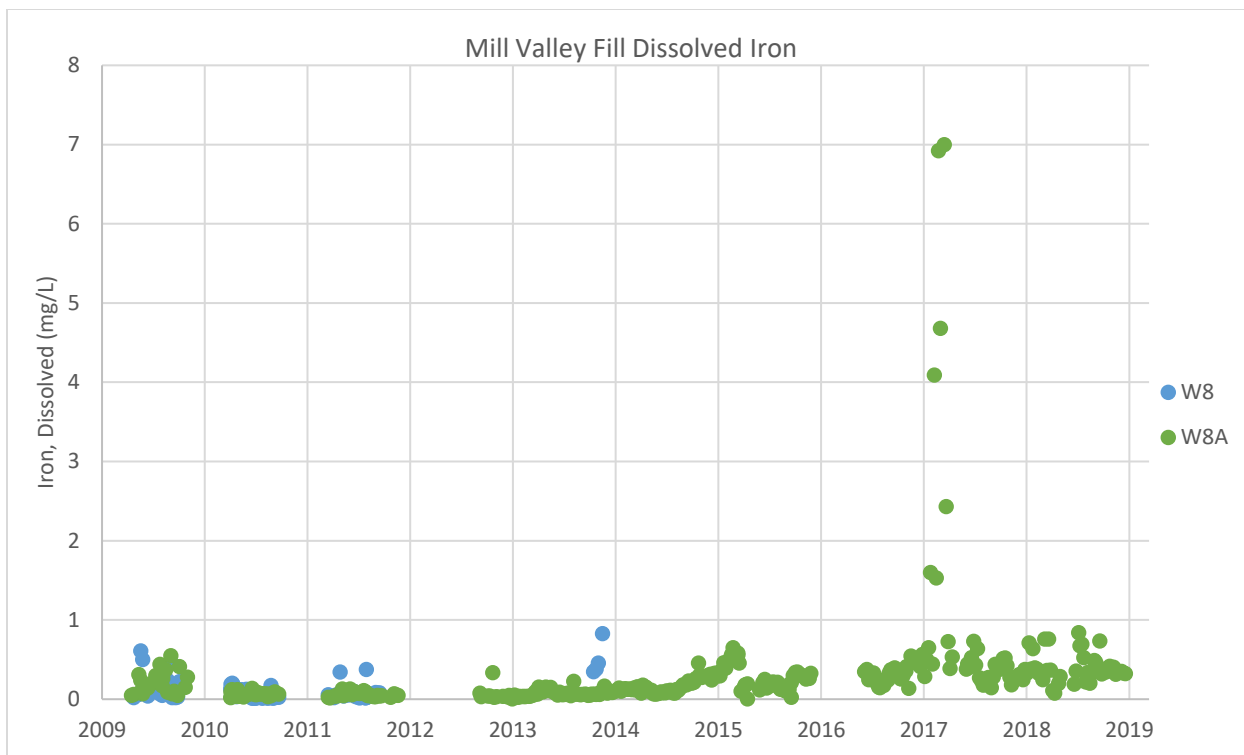


Figure 7-5: Mill Valley Fill Dissolved Iron

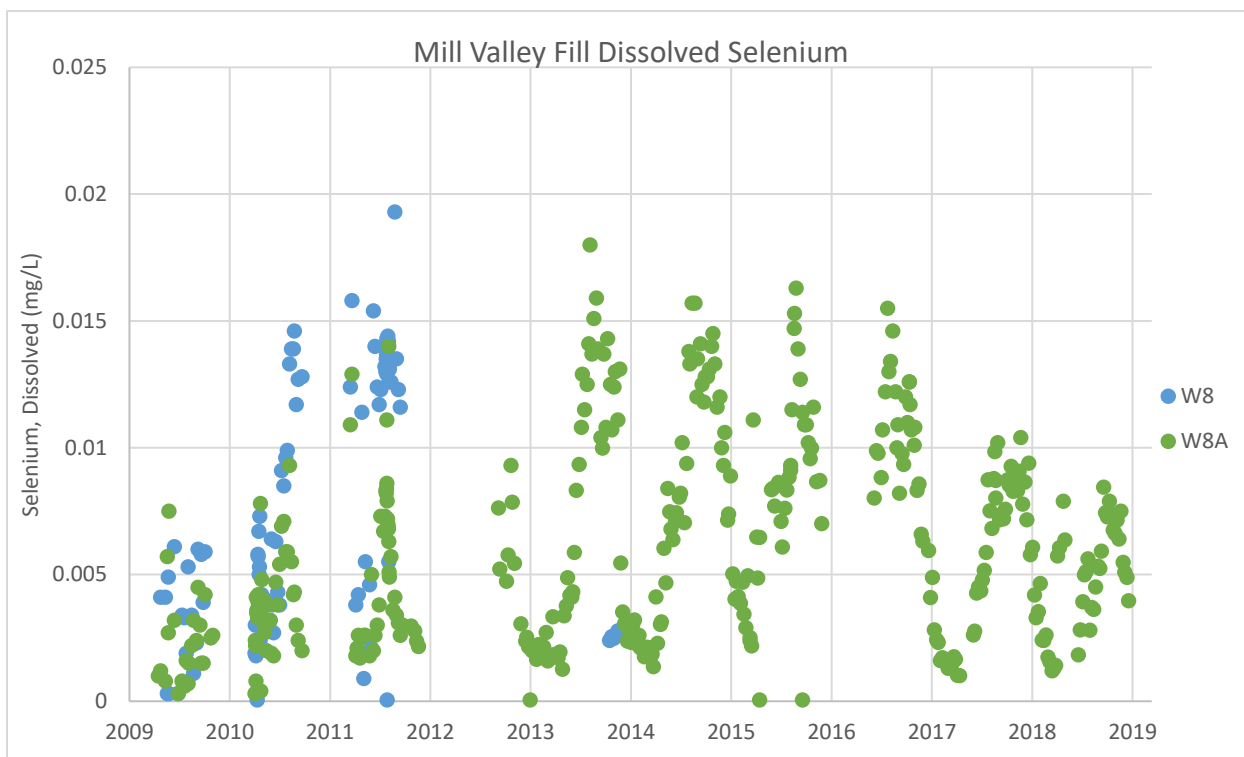


Figure 7-6: Mill Valley Fill Dissolved Selenium

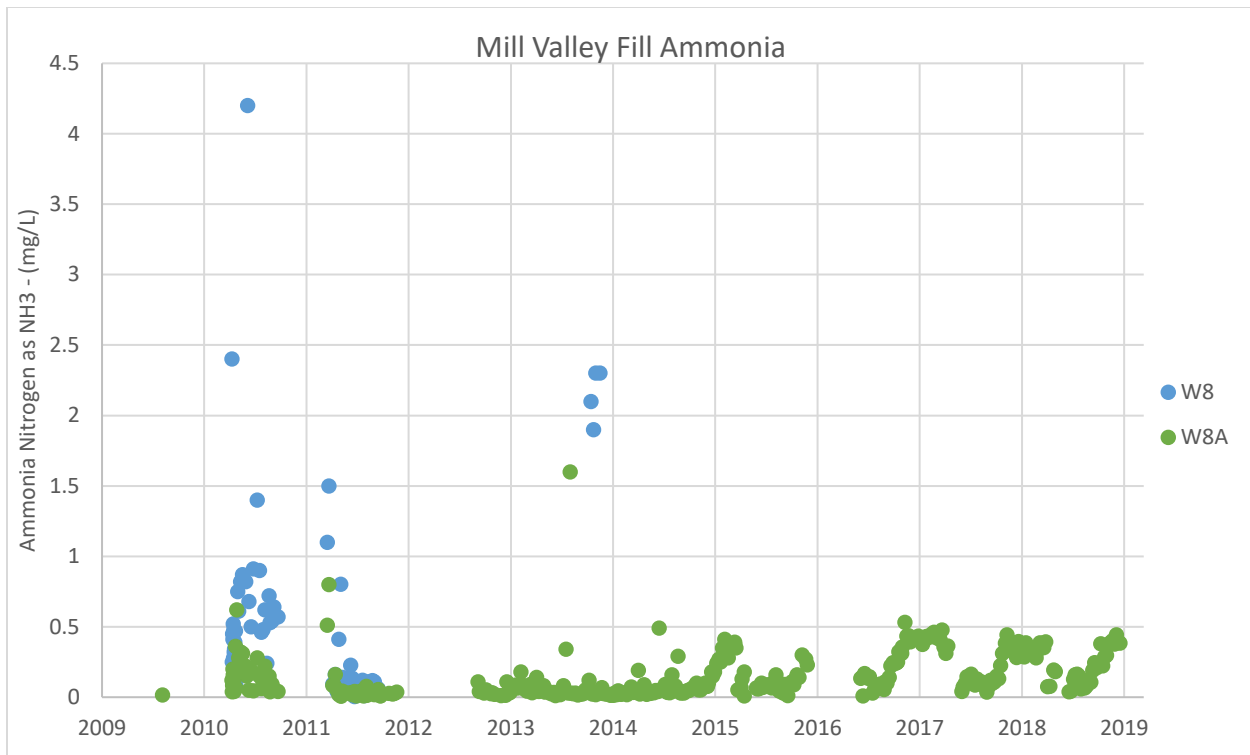


Figure 7-7: Mill Valley Fill Ammonia

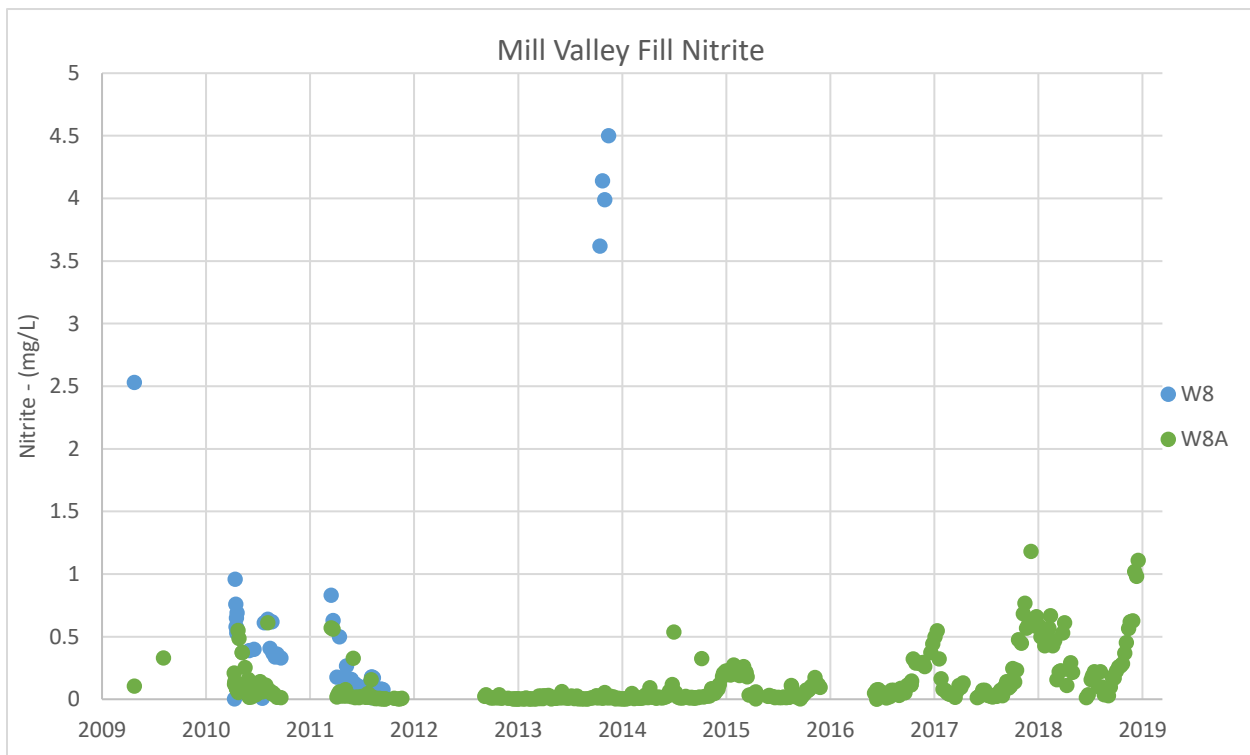


Figure 7-8: Mill Valley Fill Nitrite

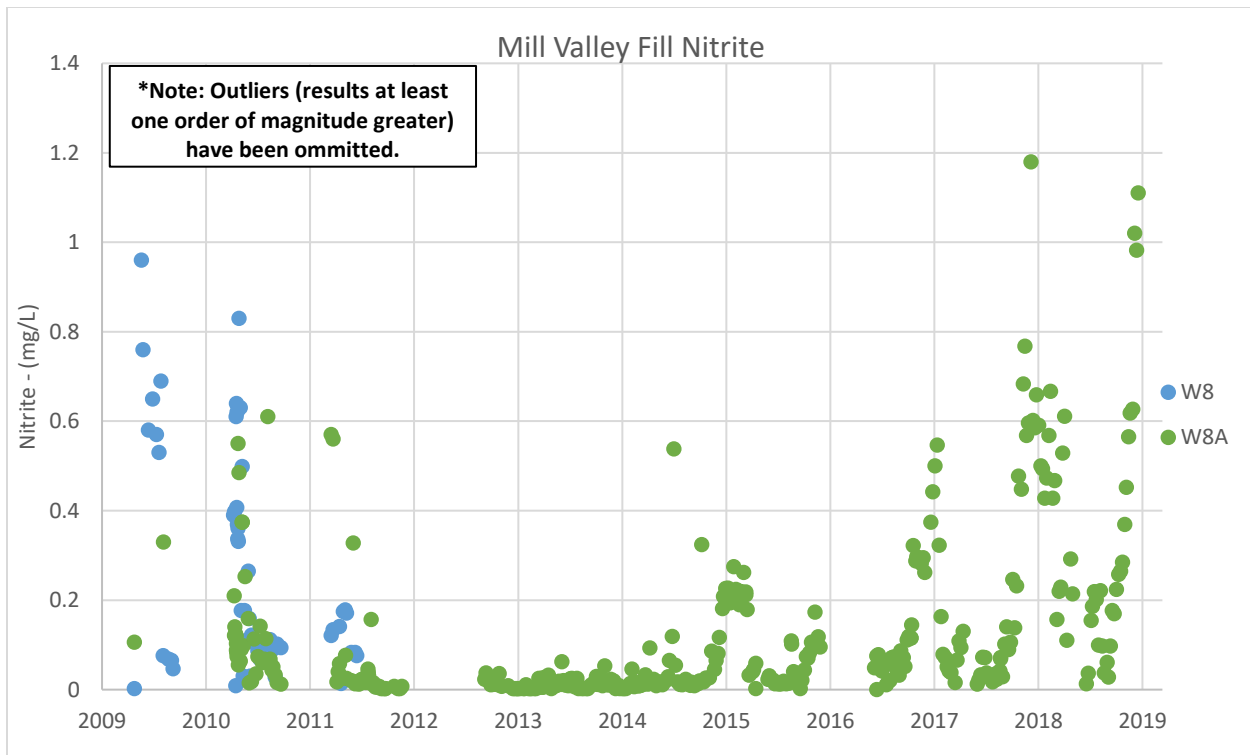


Figure 7-9: Mill Valley Fill Nitrite (Reduced Concentration)

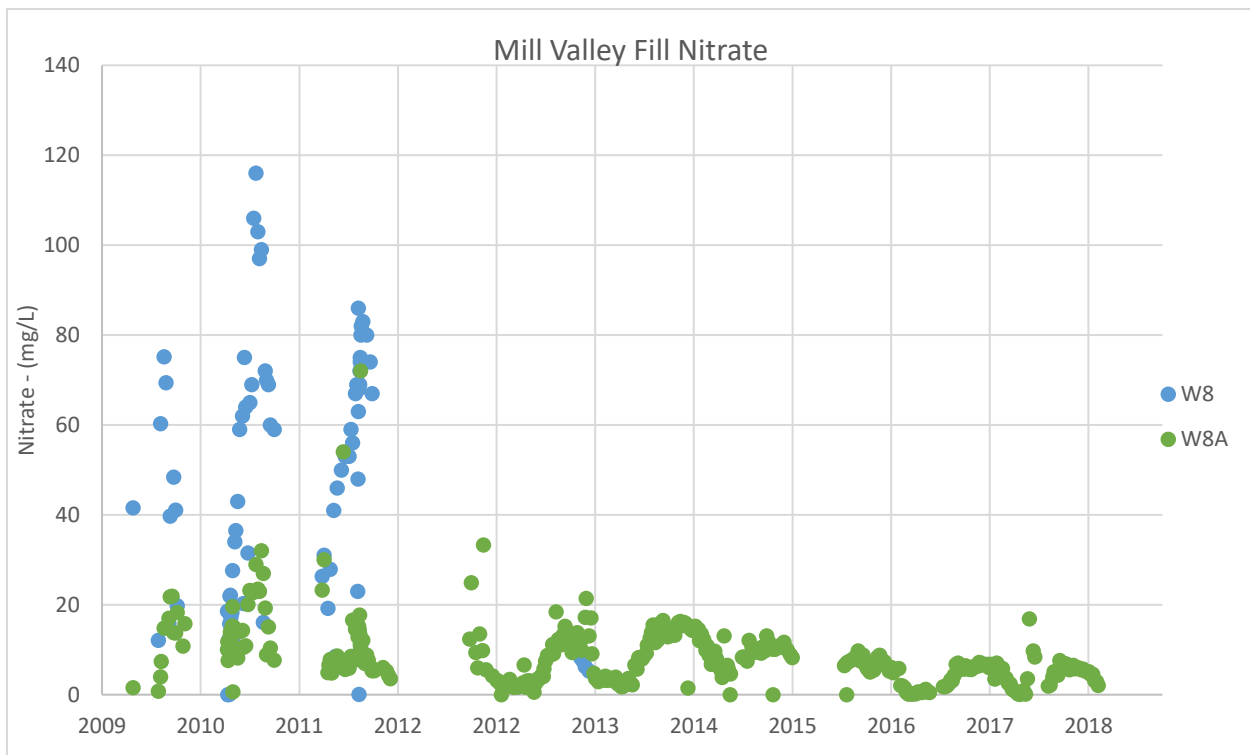


Figure 7-10: Mill Valley Fill Nitrate

7.2 Southwest Dump

Seepage was collected at stations SS13 and SS31 in the spring survey and at sites SS54, SS56, SS57, SS30, SS43, SS31, SS51 and SS44 during the fall survey, as well as a newly identified seep labelled SS65. Additionally, W32 was sampled during the spring. The ice-rich overburden dump was surveyed, and in the spring SS39 was the only identified seep, while in the fall samples SS48, SS49, SS50 and a new seep labelled SS64 were sampled.

Samples are taken within $\pm 5\text{m}$ of the original GPS point. If there is no seepage within the 5m buffer, the site is considered dry during that sampling session.

Water quality results from the 2018 survey program for W38 and W39, as well as W32 and W40 historical data, are presented in Figure 7-11 to 7-19. Historical data and 2018 seepage water quality results for SS1, SS13, SS21, SS22, SS28, SS29, SS30, SS31, SS39, SS43, SS44, SS48, SS49, SS50, SS51, SS52, SS54, SS556 and SS57 are summarized in Figure 7-20 to Figure 7-40. Data was separated between the north (SS1, SS21, SS28, SS29, SS54 and SS56), the south end of the southwest dump (SS13, SS22, SS30, SS31, SS43, SS44, SS51, SS52, and SS57) and the ice rich overburden dump seep (SS48, SS49 and SS63). The figures include water quality results for dissolved copper, dissolved cadmium, dissolved iron, dissolved selenium, and nutrient levels for ammonia, nitrite, and nitrate.

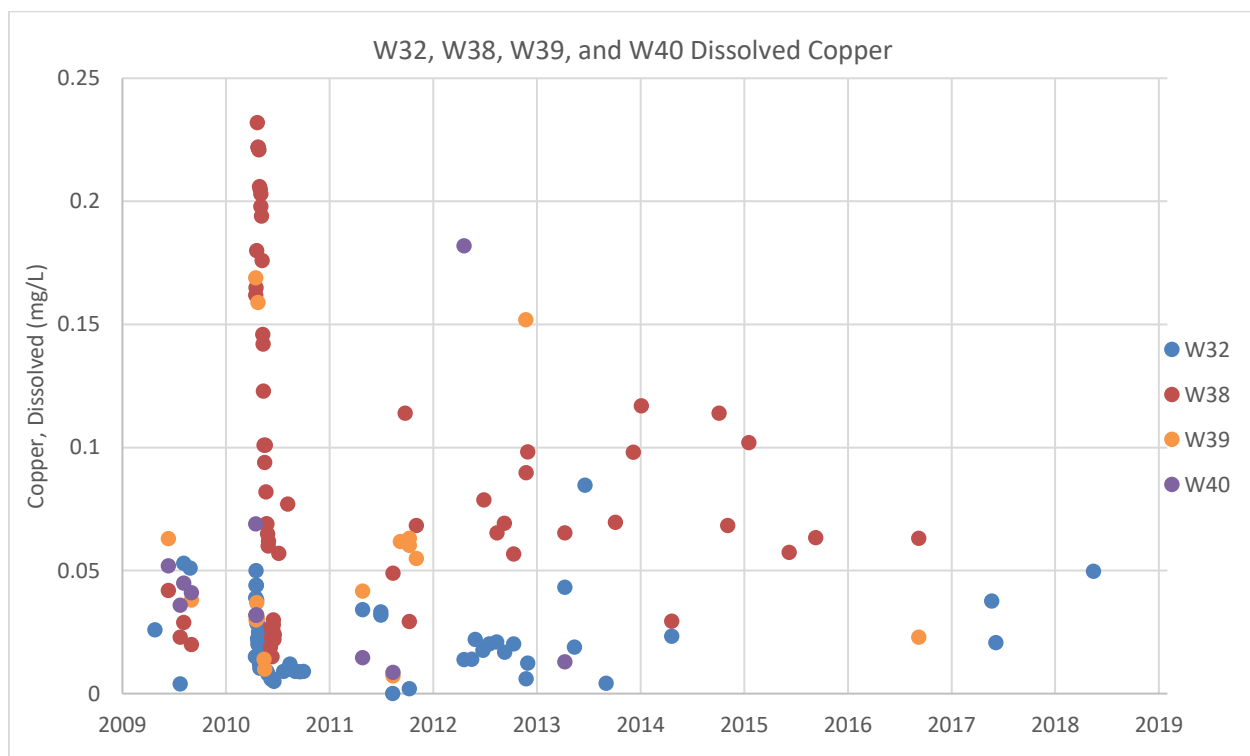


Figure 7-11: W32, W38, W39, and W40 Dissolved Copper

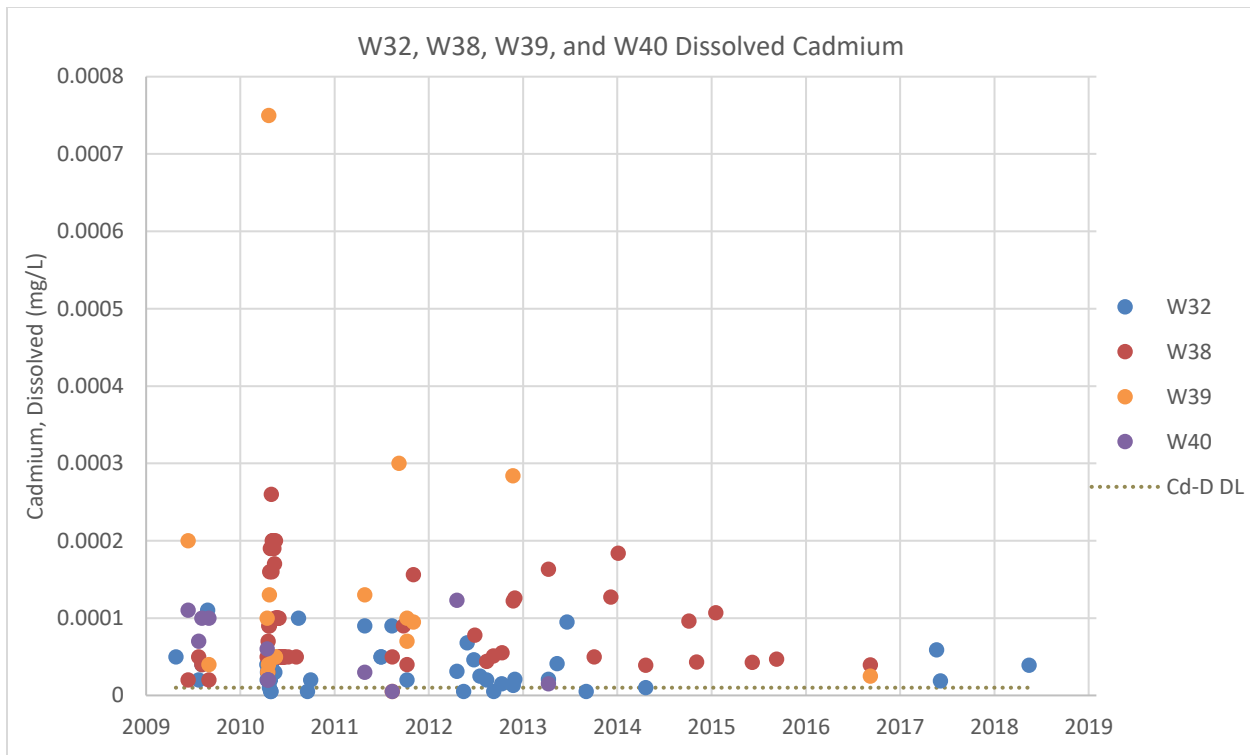


Figure 7-12: W32, W38, W39, and W40 Dissolved Cadmium

DL is Analytical Detection Limit

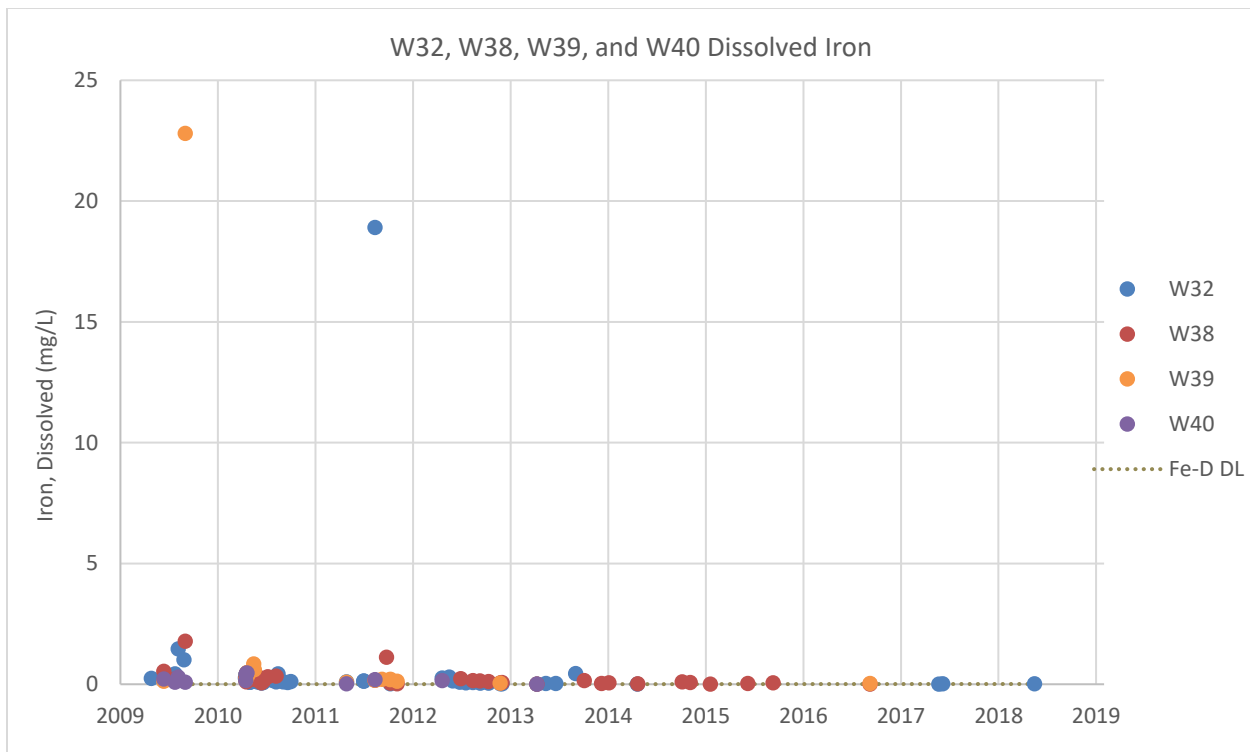


Figure 7-13: W32, W38, W39, and W40 Dissolved Iron

DL is Analytical Detection Limit

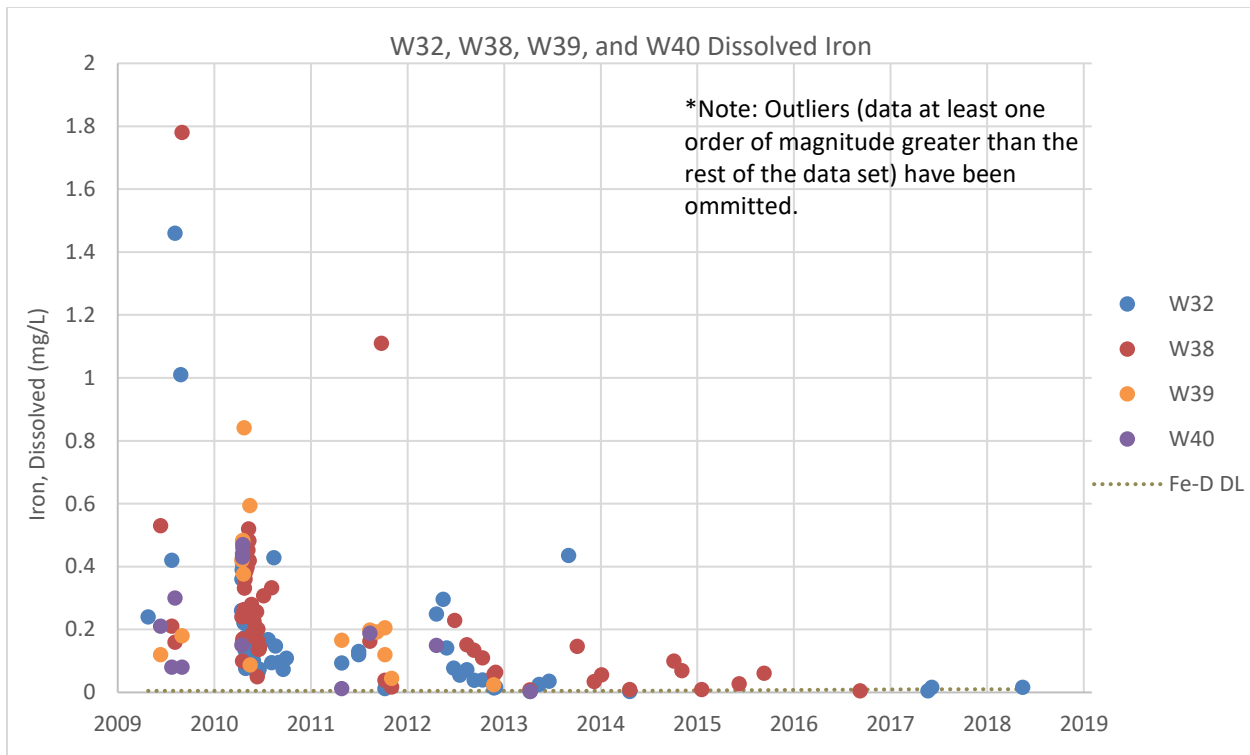


Figure 7-14: W32, W38, W39, and W40 Dissolved Iron (Reduced Concentration)

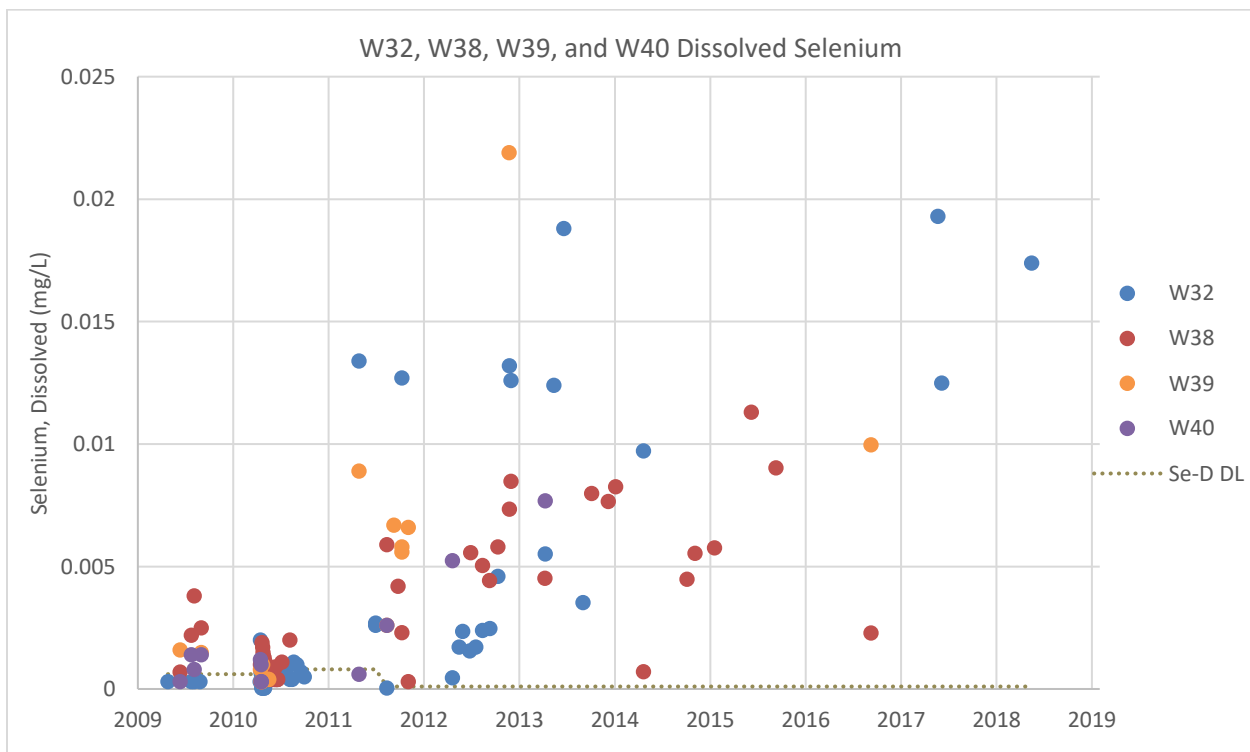


Figure 7-15: W32, W38, W39, and W40 Dissolved Selenium

DL is Analytical Detection Limit

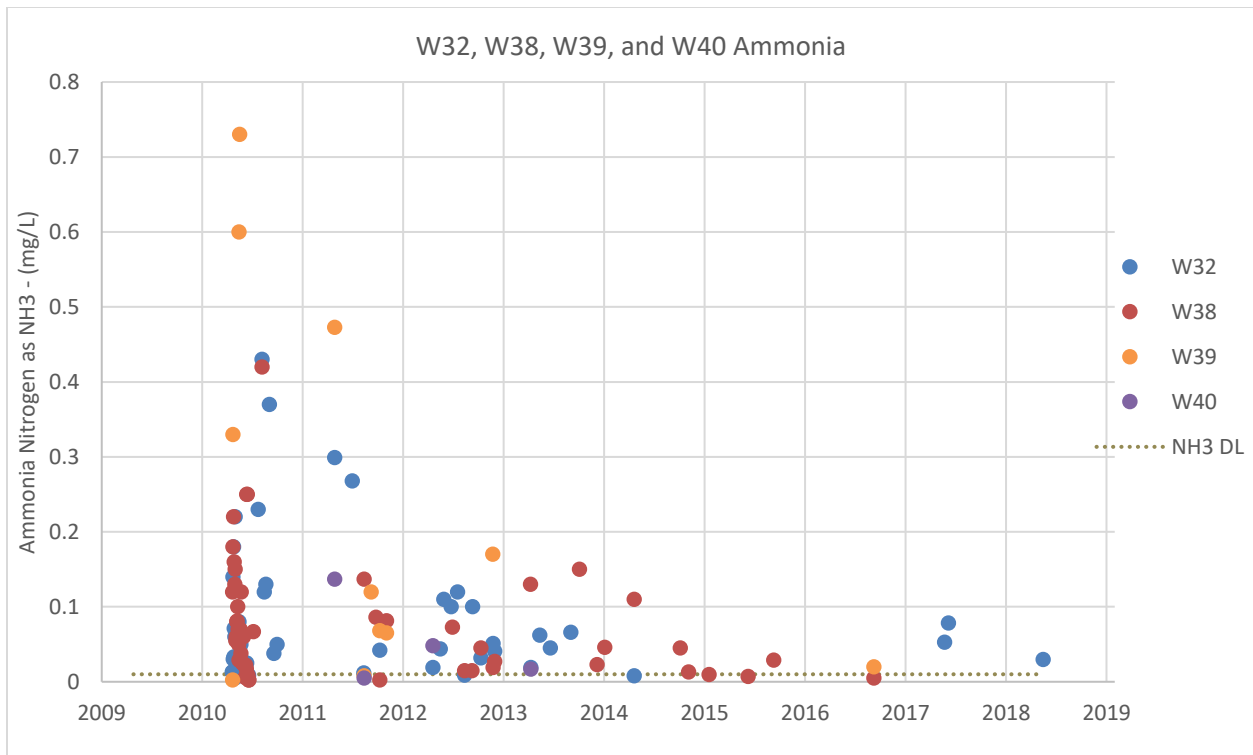


Figure 7-16: W32, W38, W39, and W40 Ammonia

DL is Analytical Detection Limit

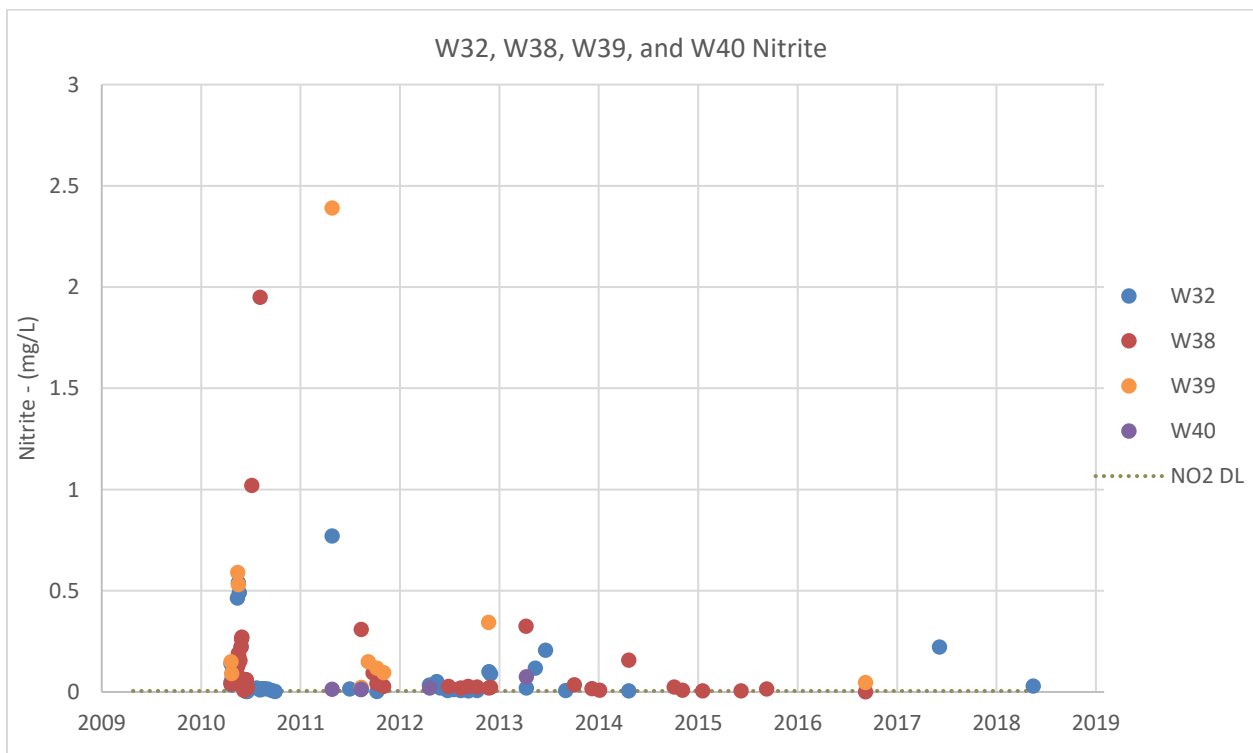


Figure 7-17: W32, W38, W39, and W40 Nitrite

DL is Analytical Detection Limit

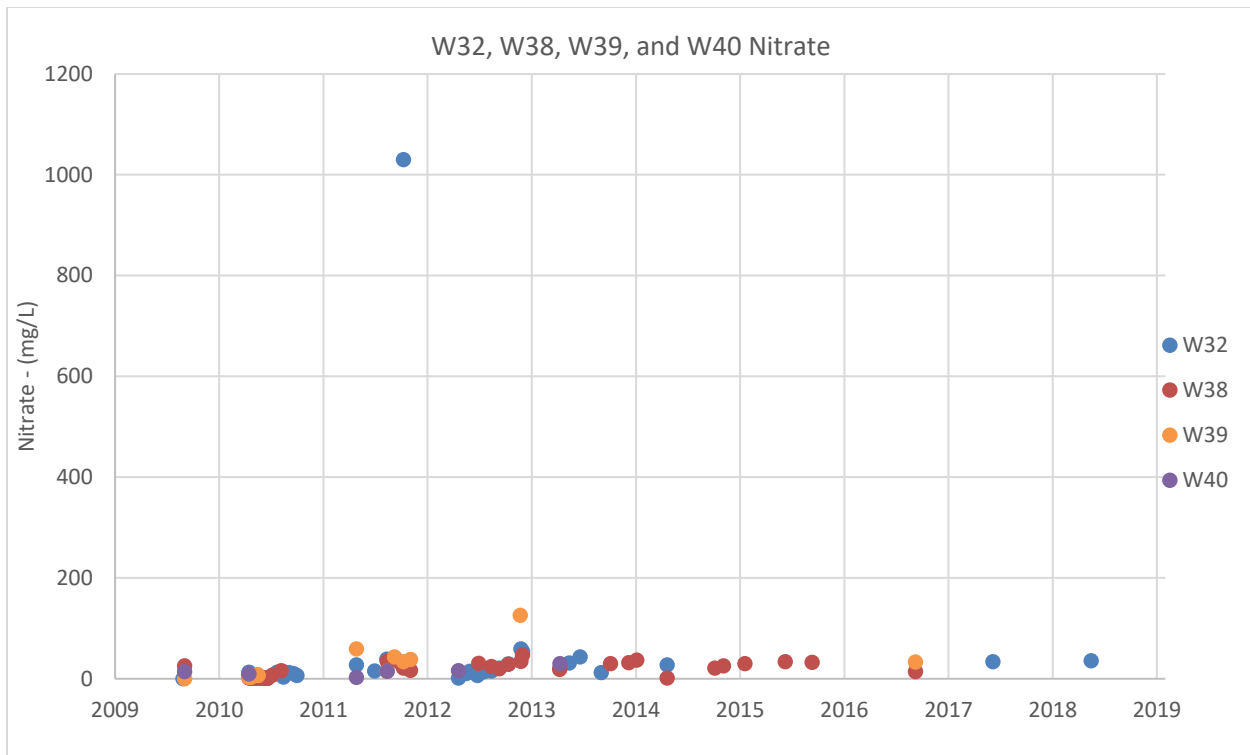


Figure 7-18: W32, W38, W39, and W40 Nitrate

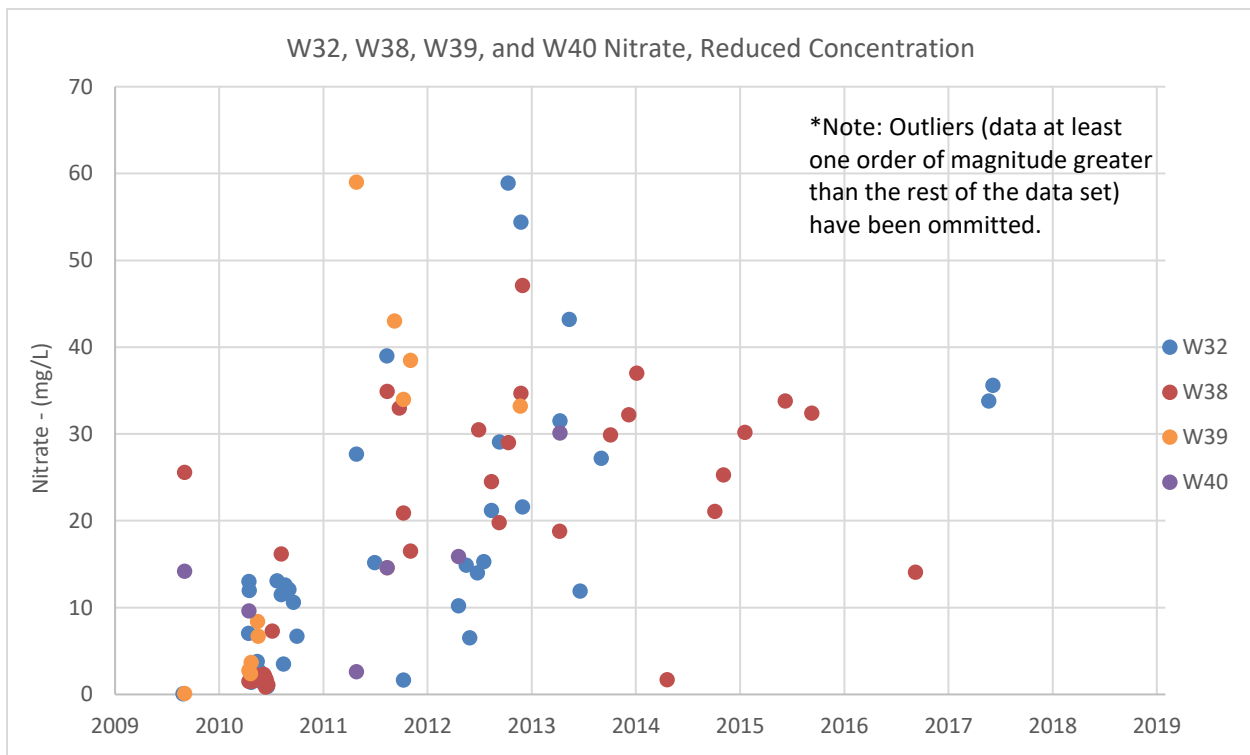


Figure 7-19: W32, W38, W39, and W40 Nitrate, Reduced Concentration

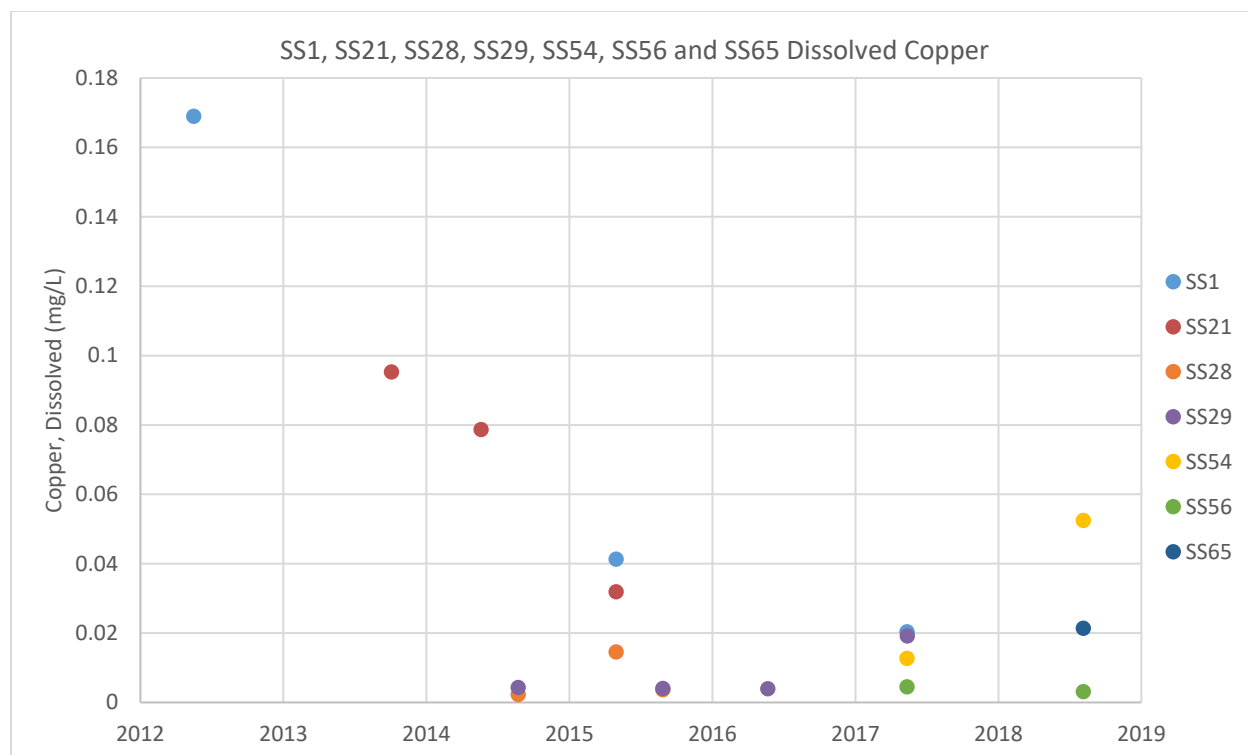


Figure 7-20: SS1, SS21, SS28, SS29, SS54, SS56 and SS65 Dissolved Copper

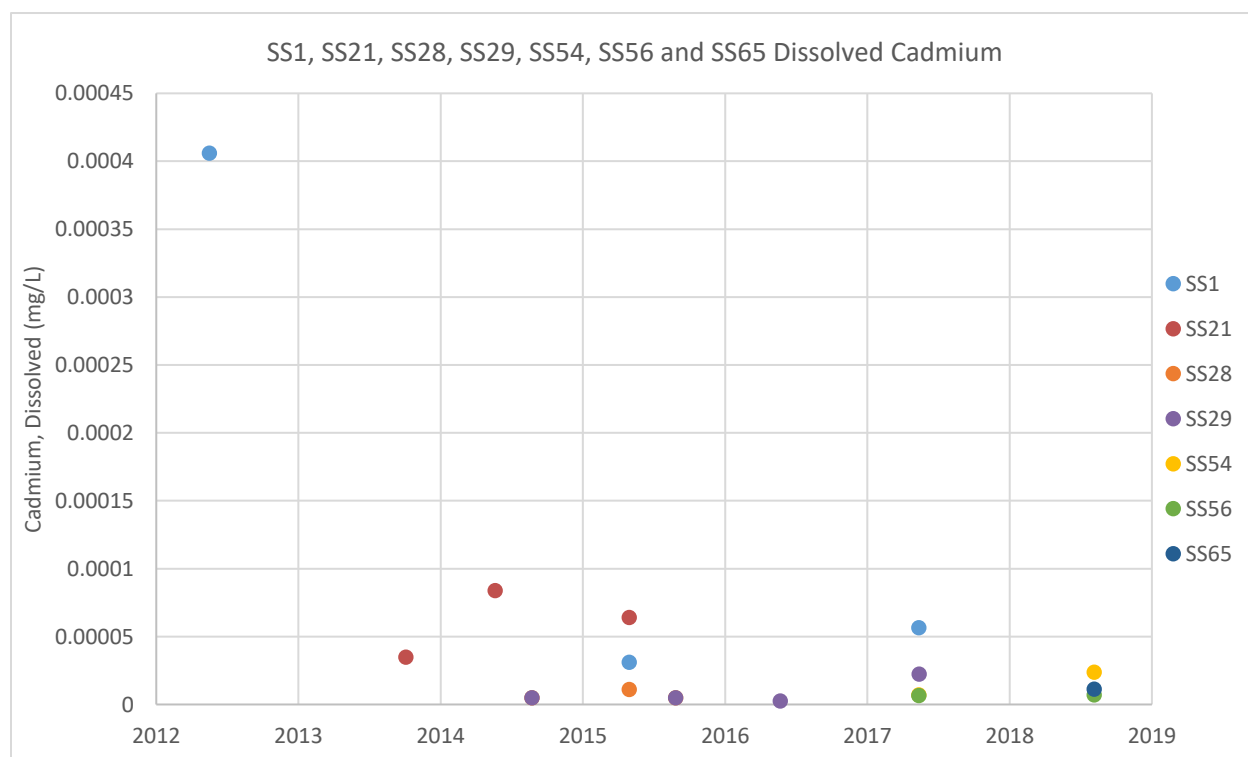


Figure 7-21: SS1, SS21, SS28, SS29, SS54, SS56 and SS65 Dissolved Cadmium

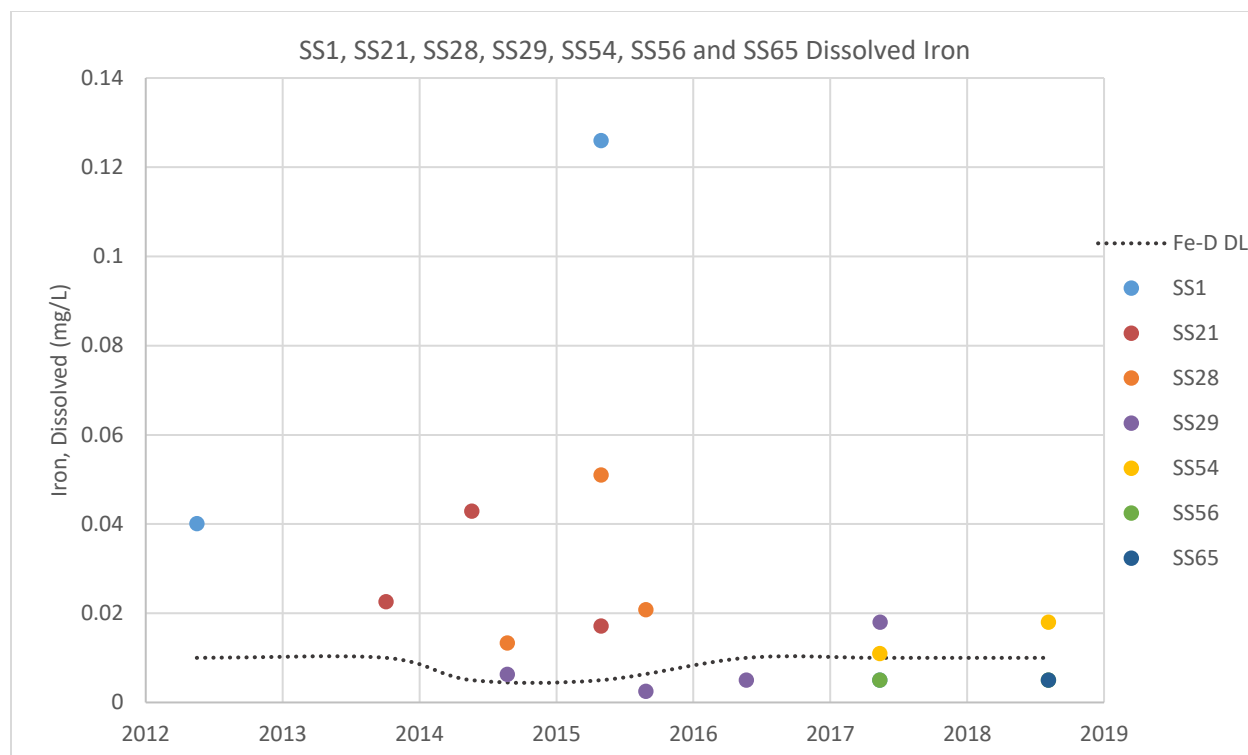


Figure 7-22: SS1, SS21, SS28, SS29, SS54, SS56 and SS65 Dissolved Iron

DL is Analytical Detection Limit

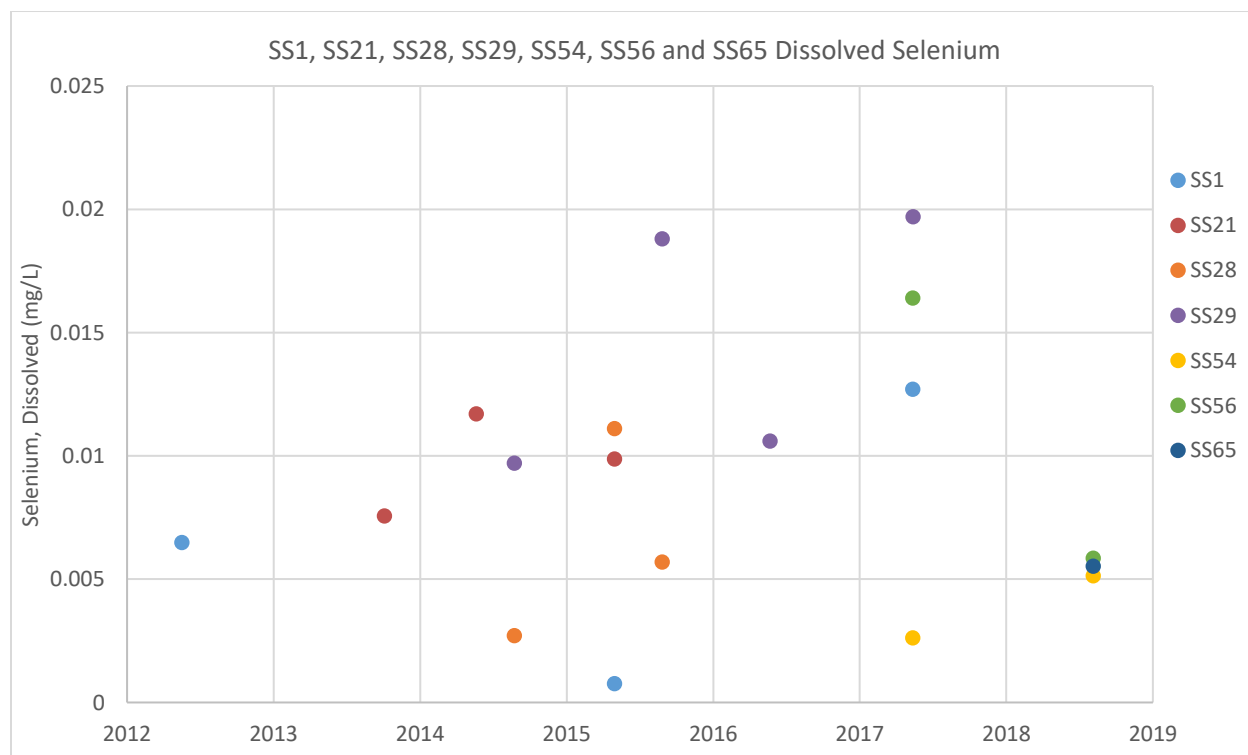


Figure 7-23: SS1, SS21, SS28, SS29, SS54, SS56 and SS65 Dissolved Selenium

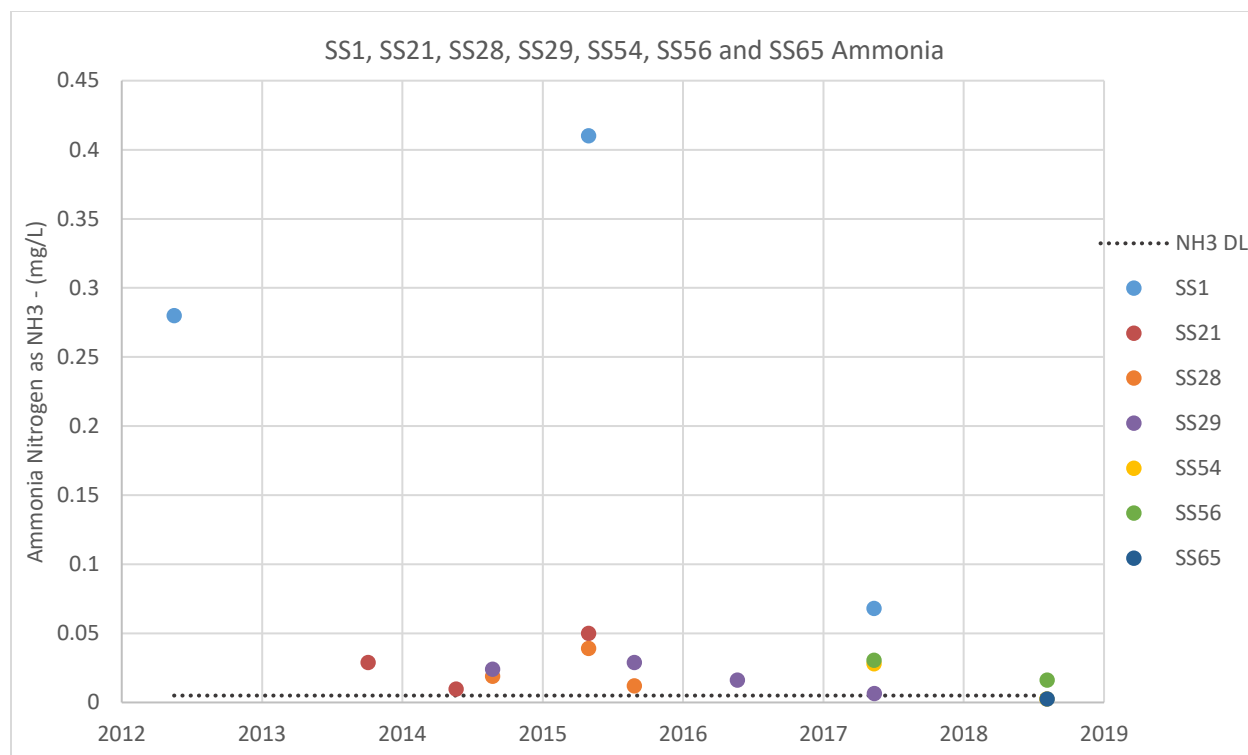


Figure 7-24: SS1, SS21, SS28, SS29, SS54, SS56 and SS65 Ammonia

DL is Analytical Detection Limit

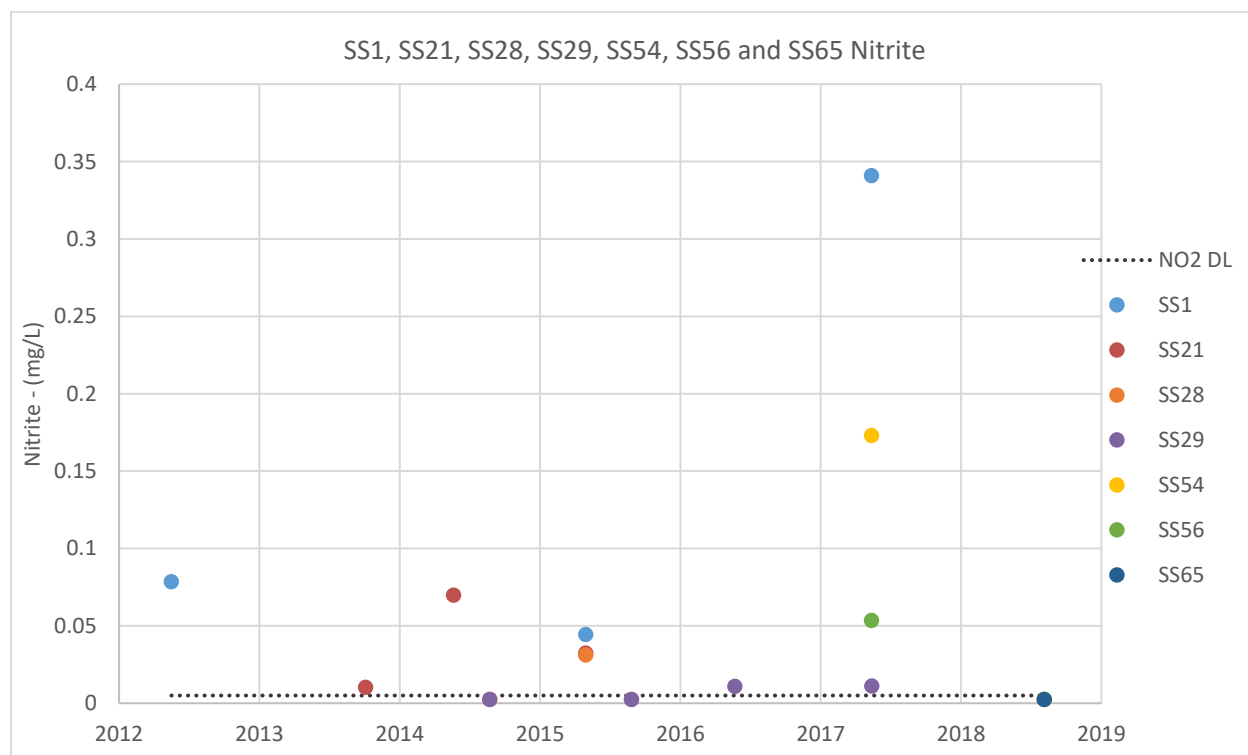


Figure 7-25: SS1, SS21, SS28, SS29, SS54, SS56 and SS65 Nitrite

DL is Analytical Detection Limit

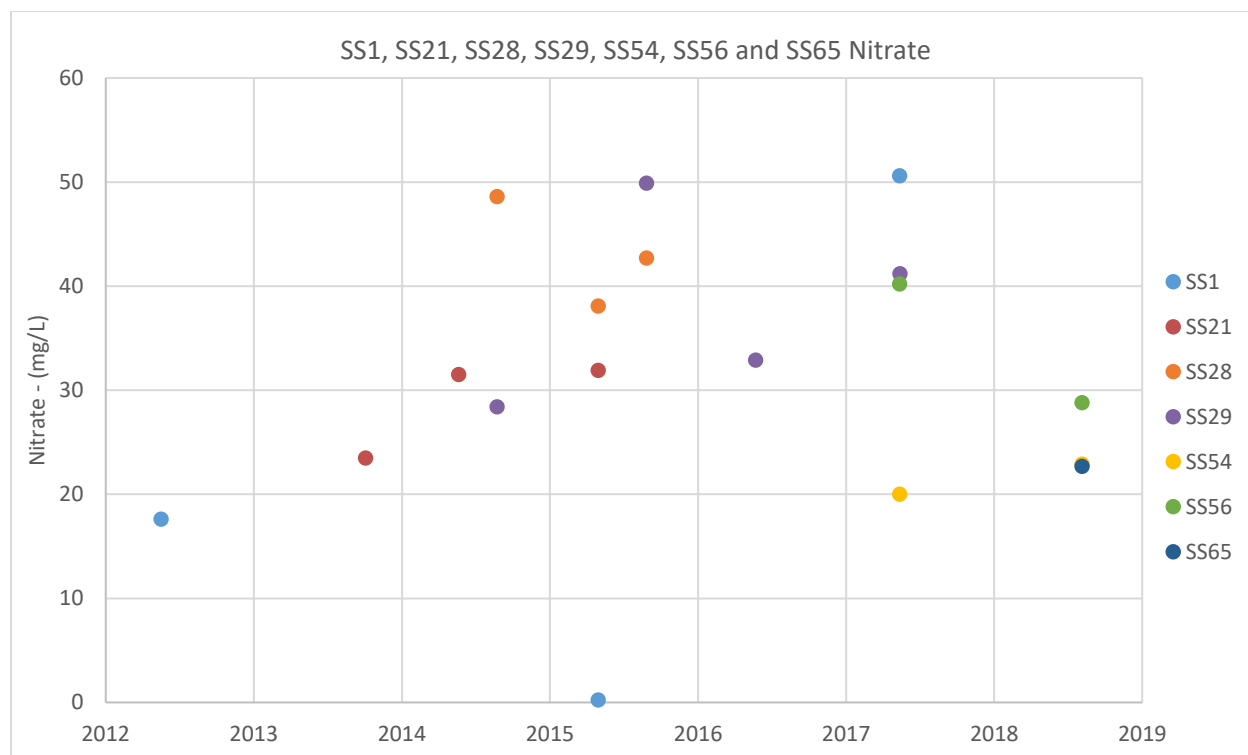


Figure 7-26: SS1, SS21, SS28, SS29, SS54, SS56 and SS65 Nitrate

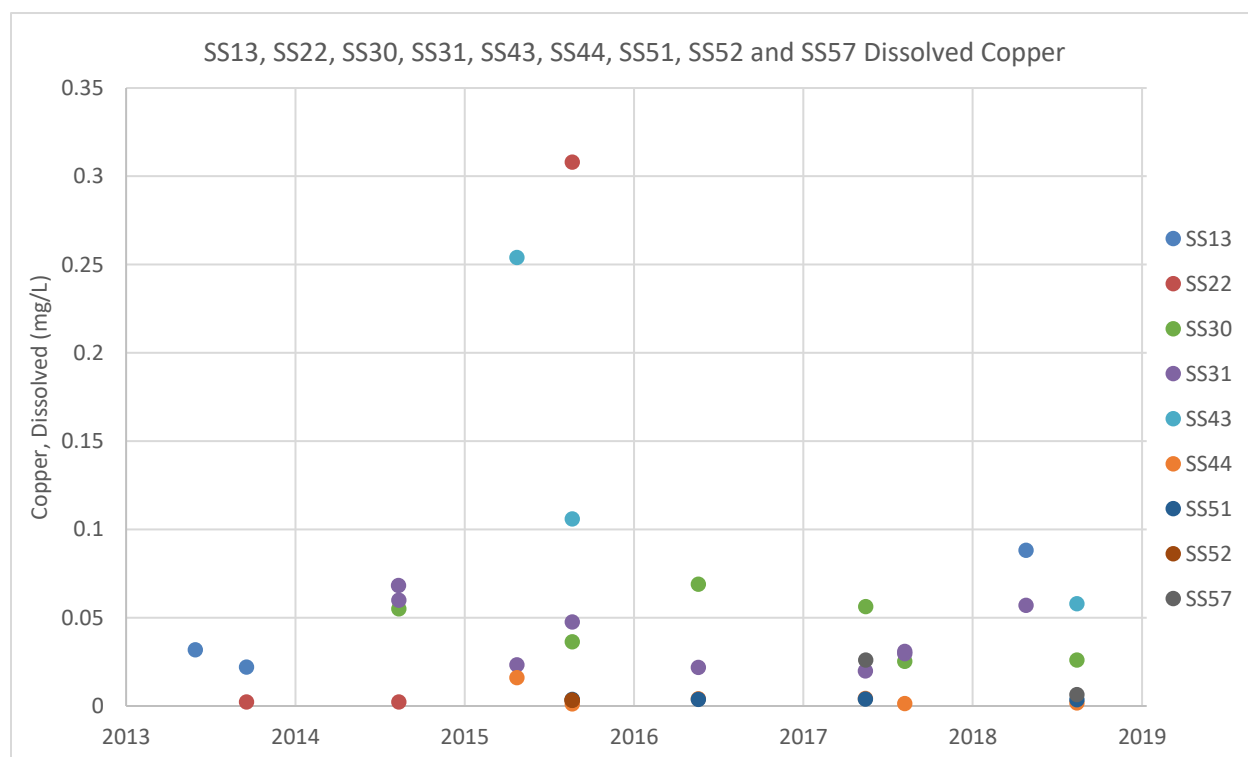


Figure 7-27: SS13, SS22, SS30, SS31, SS43, SS44, SS51, SS52 and SS57 Dissolved Copper

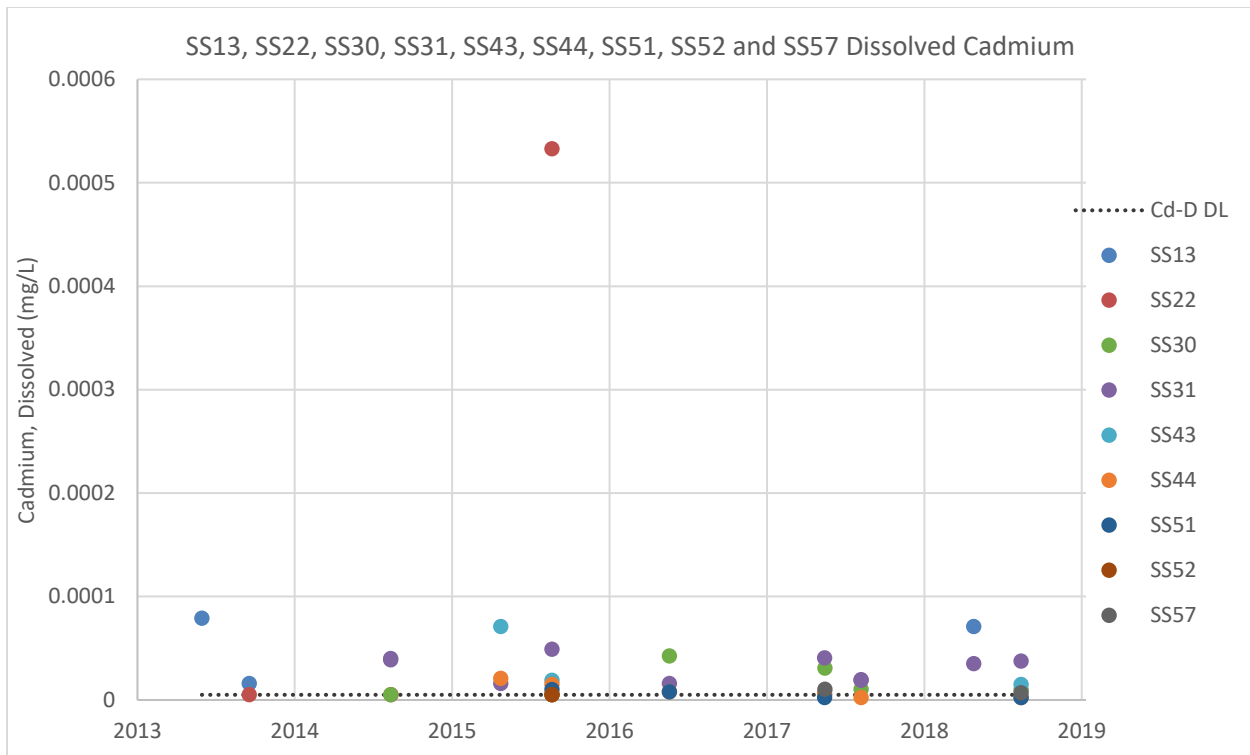


Figure 7-28: SS13, SS22, SS30, SS31, SS43, SS44, SS51, SS52 and SS57 Dissolved Cadmium
DL is Analytical Detection Limit

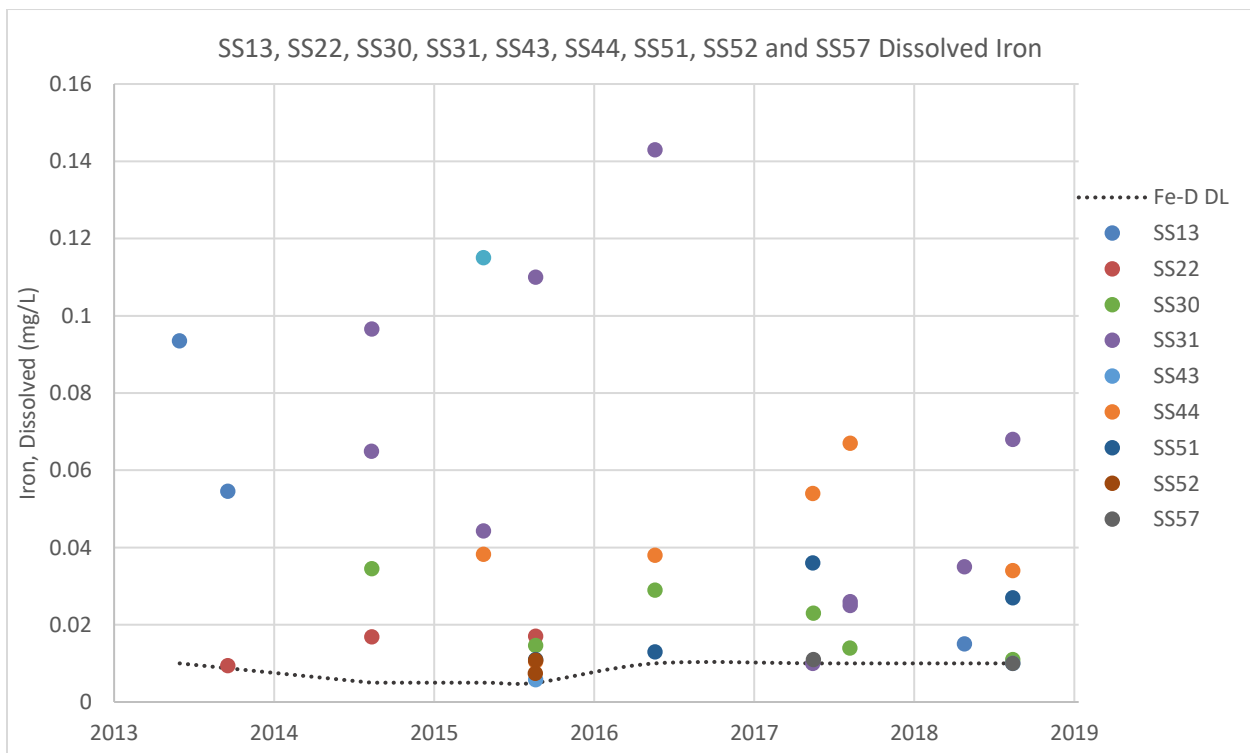


Figure 7-29: SS13, SS22, SS30, SS31, SS43, SS44, SS51, SS52 and SS57 Dissolved Iron
DL is Analytical Detection Limit

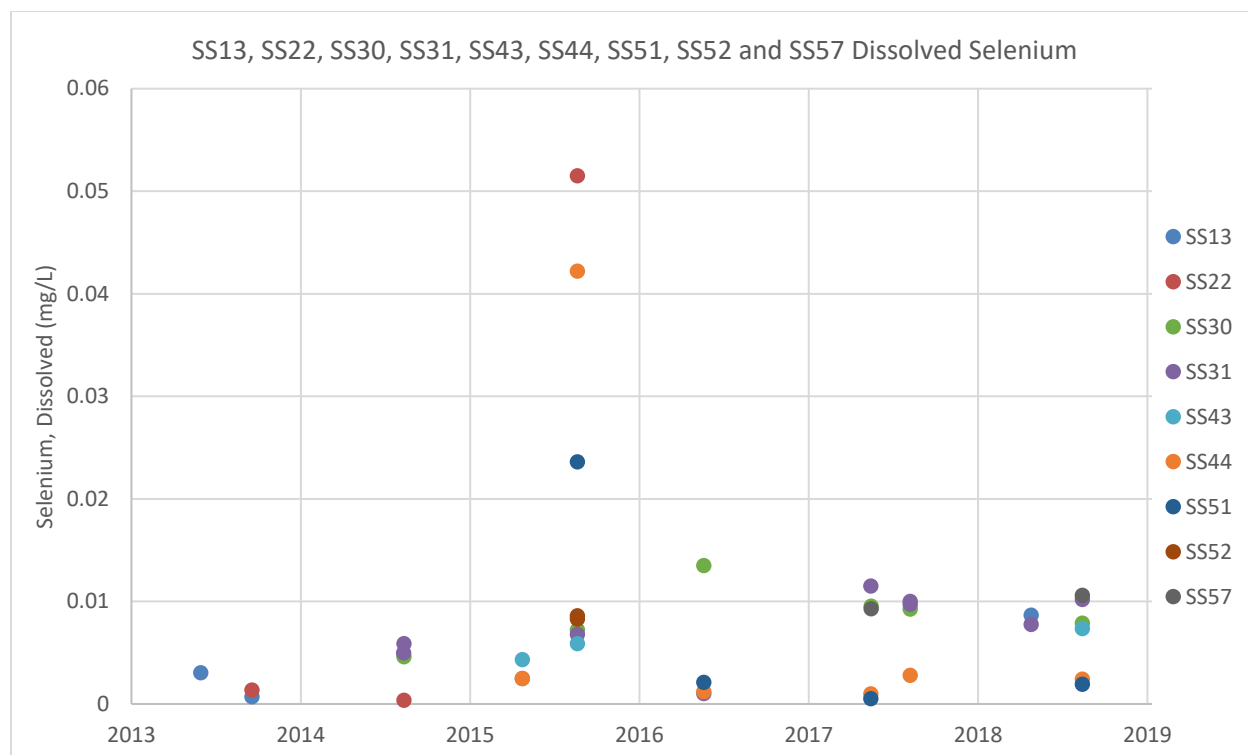


Figure 7-30: SS13, SS22, SS30, SS31, SS43, SS44, SS51, SS52 and SS57 Dissolved Selenium

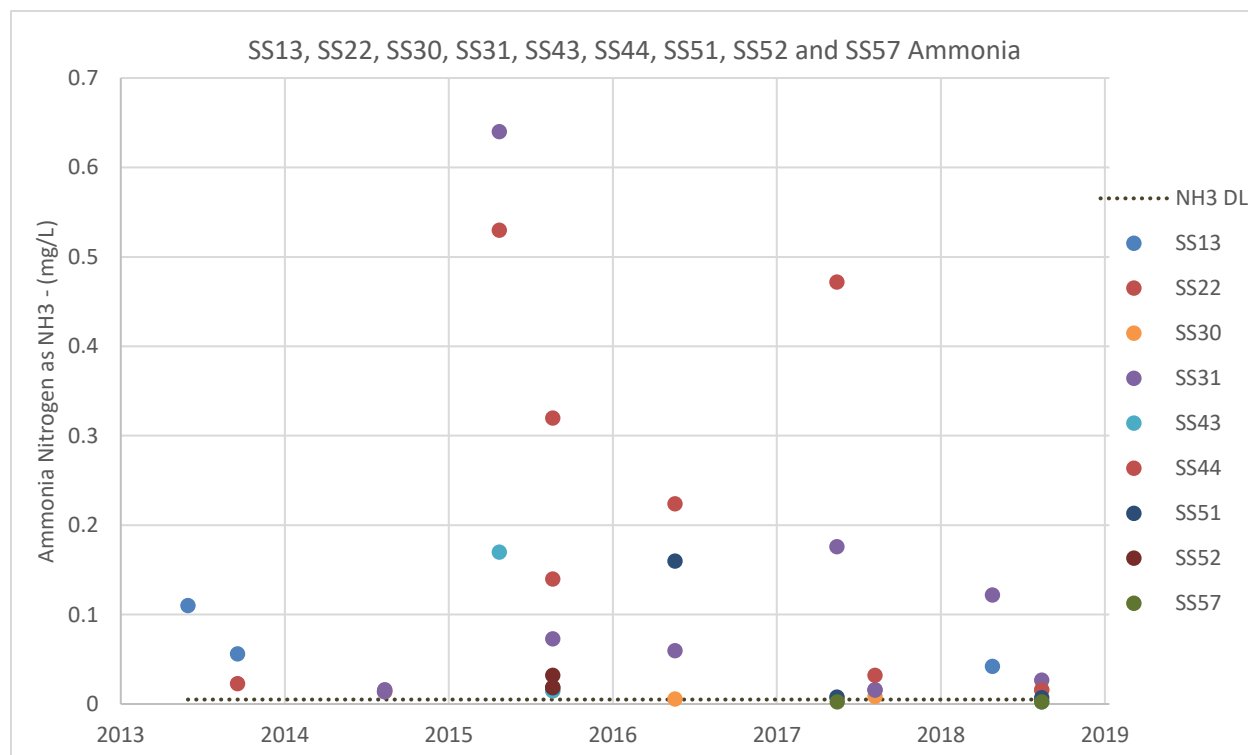


Figure 7-31: SS13, SS22, SS30, SS31, SS43, SS44, SS51, SS52 and SS57 Ammonia

DL is Analytical Detection Limit

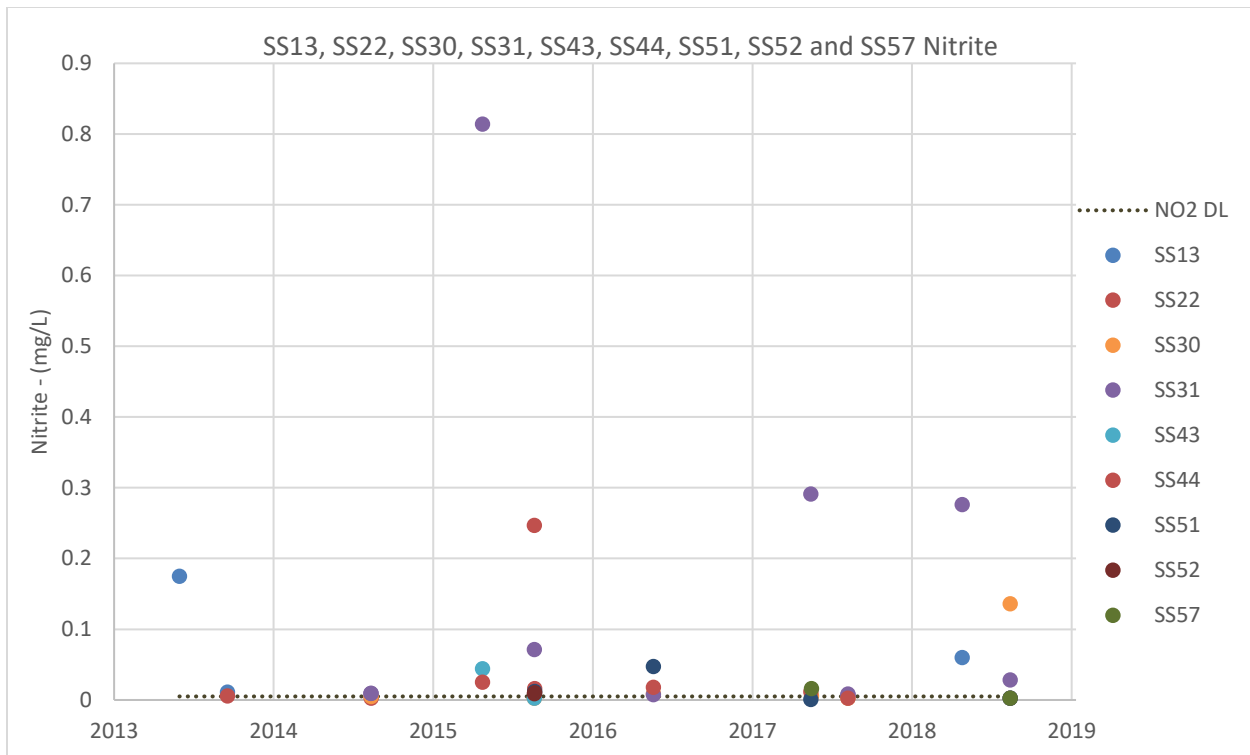


Figure 7-32: SS13, SS22, SS30, SS31, SS43, SS44, SS51, SS52 and SS57 Nitrite
DL is Analytical Detection Limit

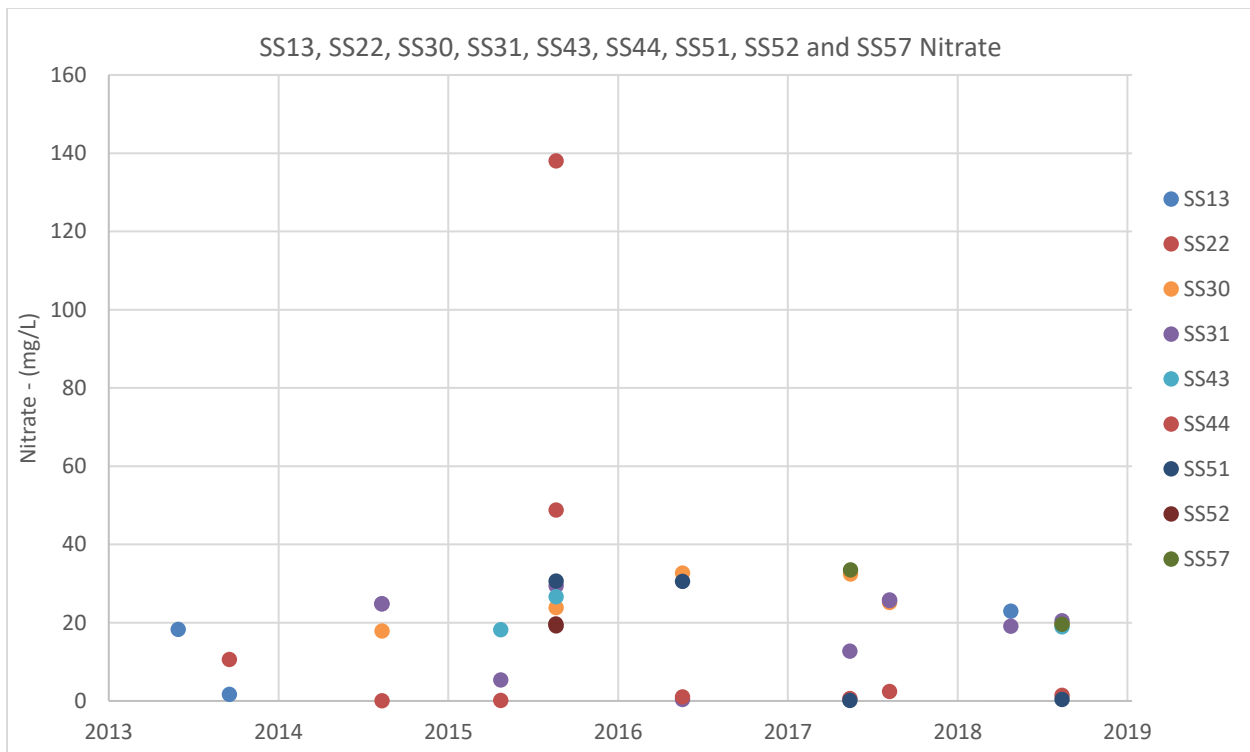


Figure 7-33: SS13, SS22, SS30, SS31, SS43, SS44, SS51, SS52 and SS57 Nitrate

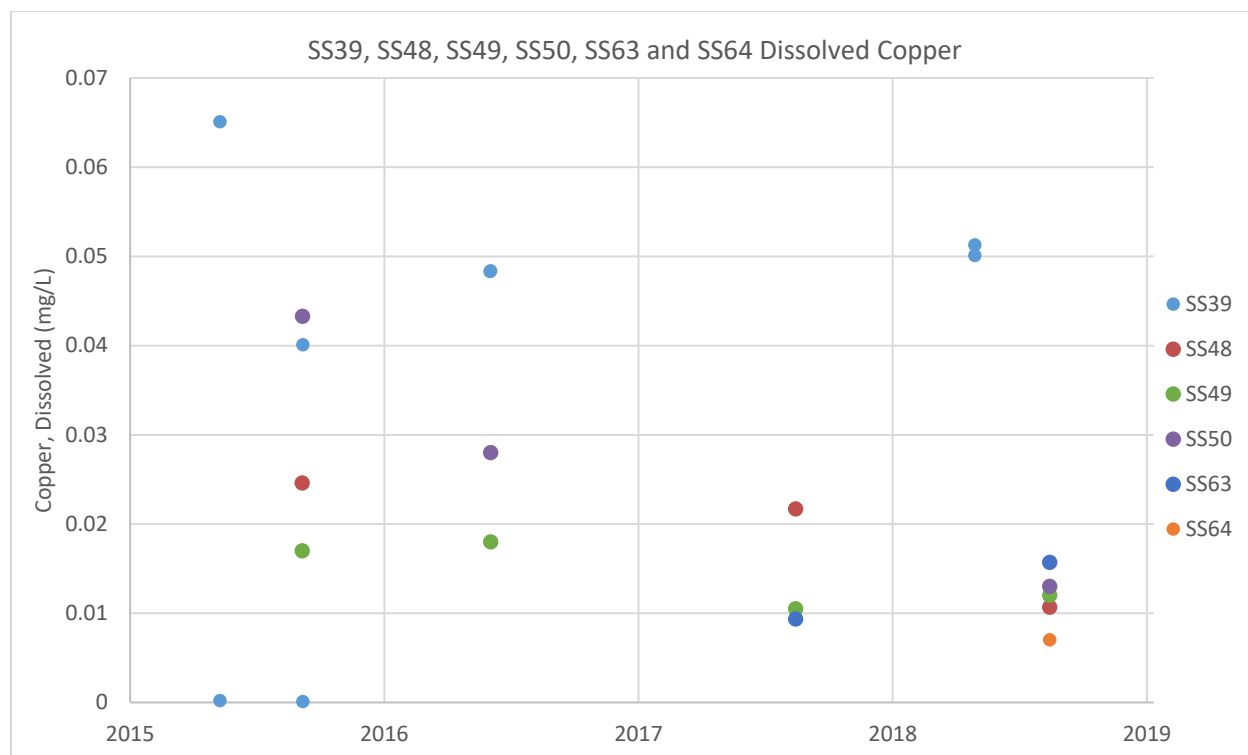


Figure 7-34: SS39, SS48, SS49, SS50, SS63 and SS64 Dissolved Copper

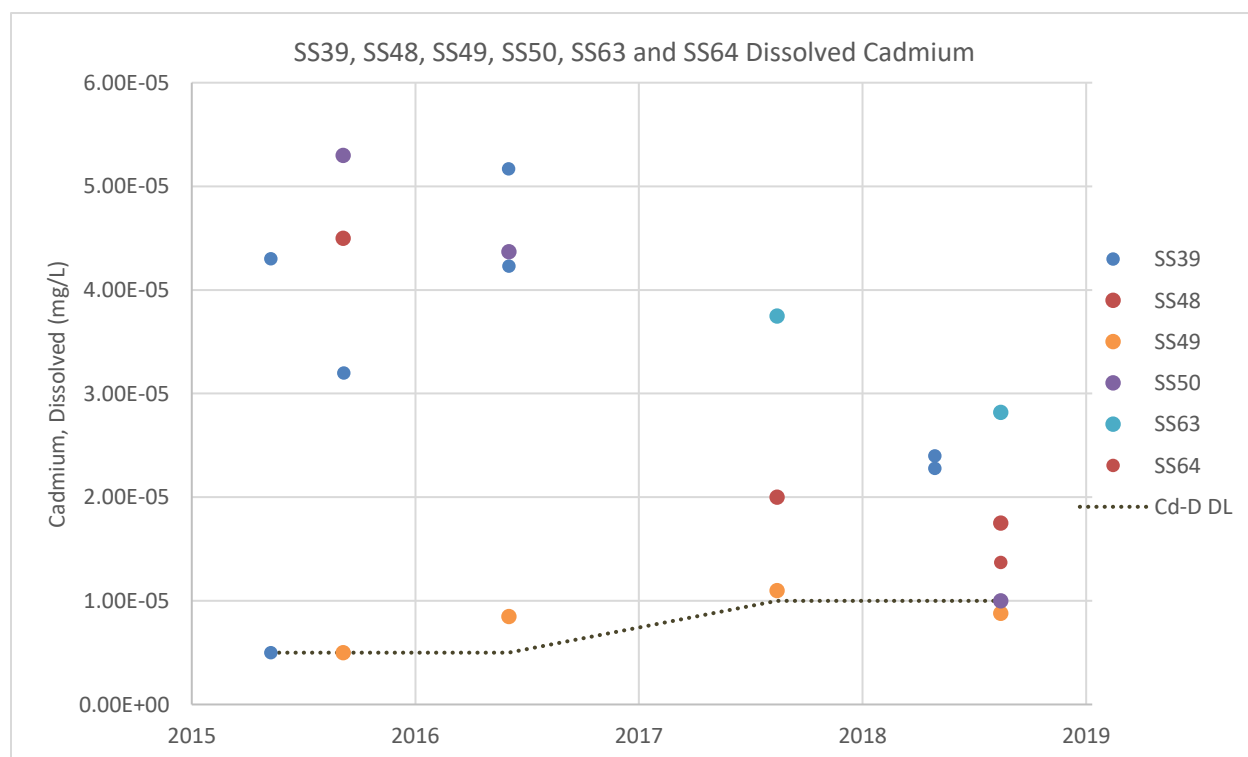


Figure 7-35: SS39, SS48, SS49, SS50, SS63 and SS64 Dissolved Cadmium

DL is Analytical Detection Limit

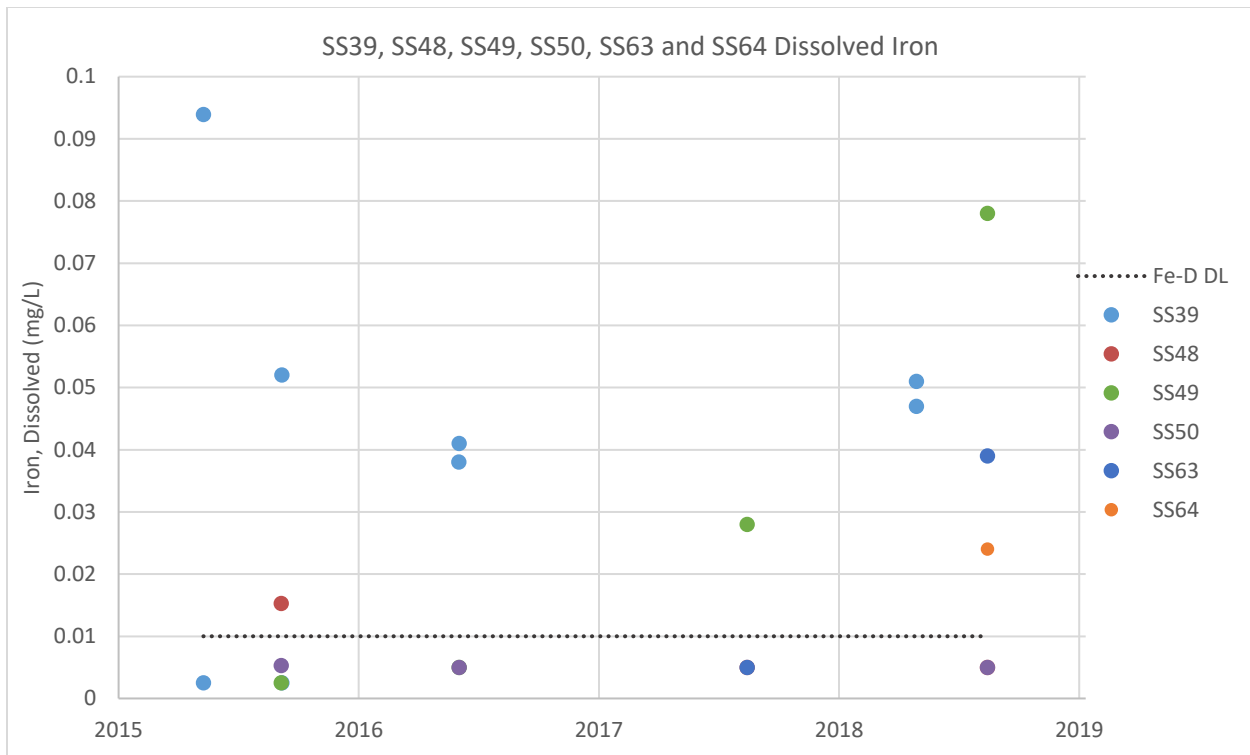


Figure 7-36: SS39, SS48, SS49, SS50, SS63 and SS64 Dissolved Iron

DL is Analytical Detection Limit

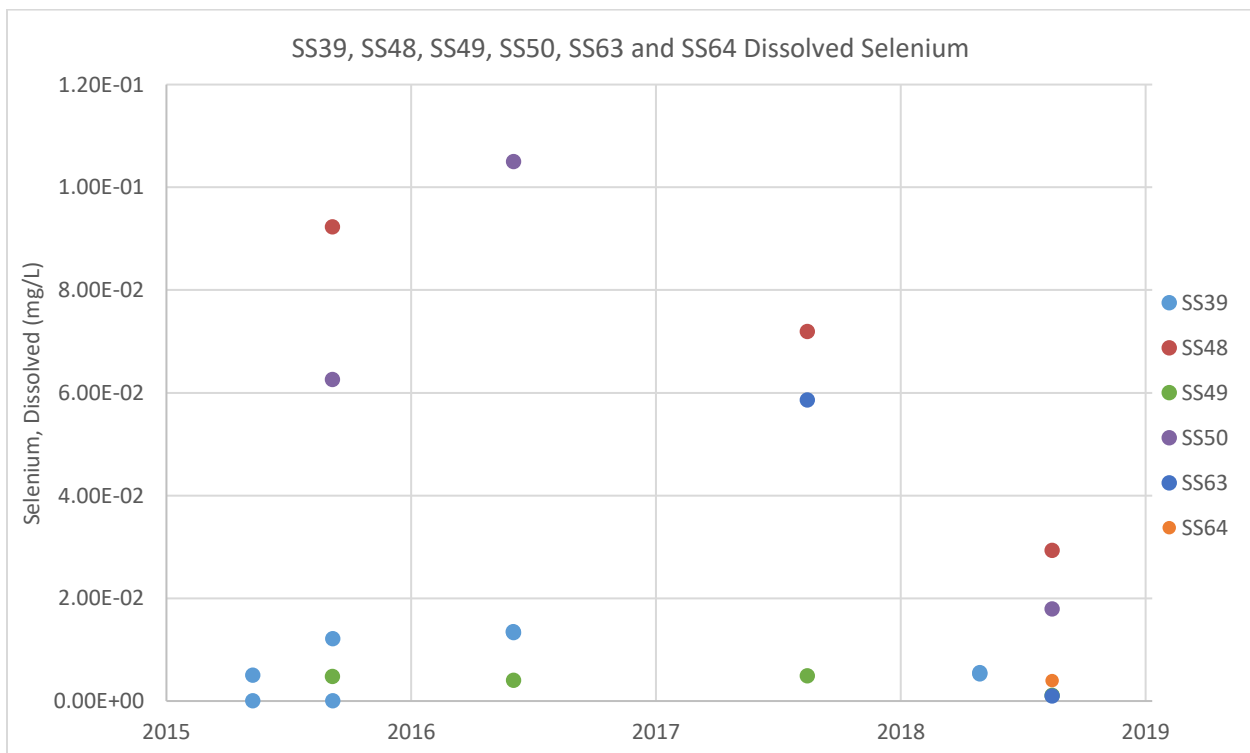


Figure 7-37: S SS39, SS48, SS49, SS50, SS63 and SS64 Dissolved Selenium

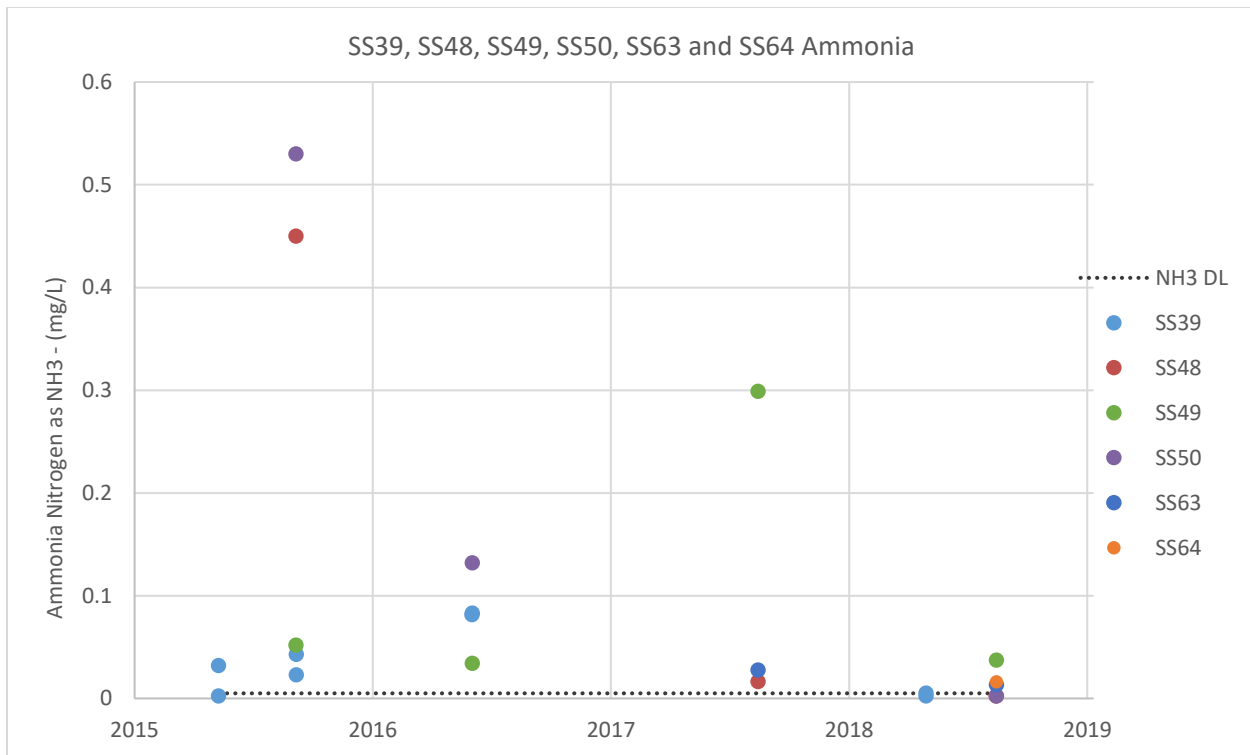


Figure 7-38: SS39, SS48, SS49, SS50, SS63 and SS64 Dissolved Ammonia

DL is Analytical Detection Limit

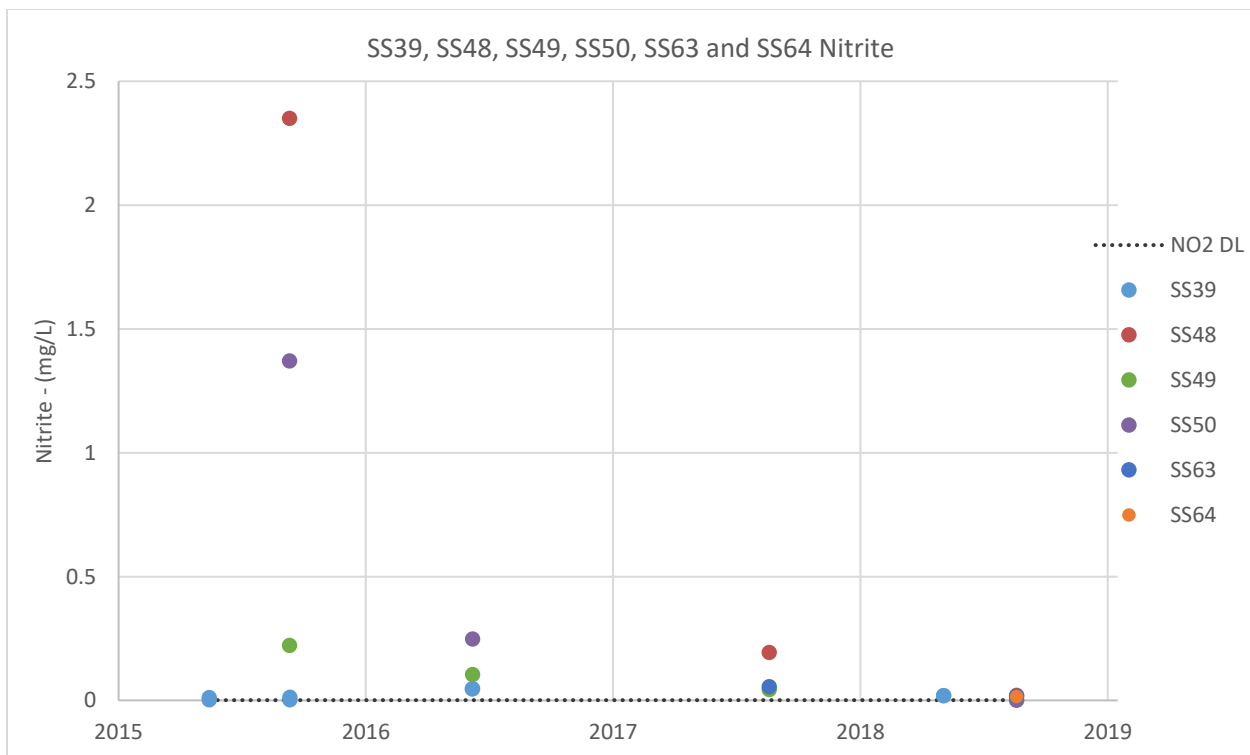


Figure 7-39: SS39, SS48, SS49, SS50, SS63 and SS64 Dissolved Nitrite

DL is Analytical Detection Limit

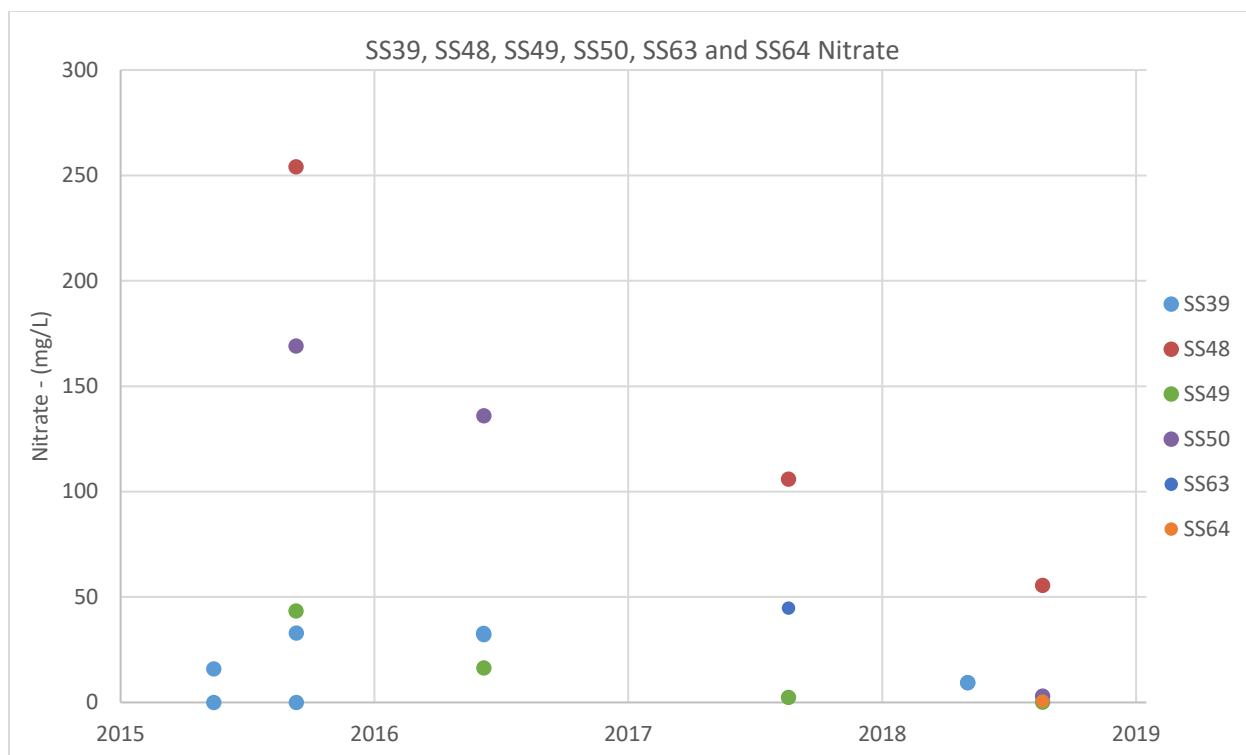


Figure 7-40: SS39, SS48, SS49, SS50, SS63 and SS64 Dissolved Nitrate

7.3 Minto Creek Detention Structure (MCDS)

The Mill Valley Fill Extension Stage 2 (MVFE2) collection sump (W62) was constructed during the period of November 9, 2015 to February 7, 2016 as a replacement for the Minto Creek Detention Structure (W37) used prior to 2016. W37 was decommissioned and buried in February 2016 as part of the MVFE2 construction. W62 is approximately 30m downslope from W37 and collects runoff and seepage from the Dry Stack Tailing Storage Facility and the Mill Valley Fill.

Water collected at W62 is pumped to the Main Pit. Water quality results for W37 (historical) and W62 are outlined in Figure 7-41 through Figure 7-47 and include results for dissolved copper, dissolved cadmium, dissolved iron, dissolved selenium, and nutrient levels for ammonia, nitrite, and nitrate.

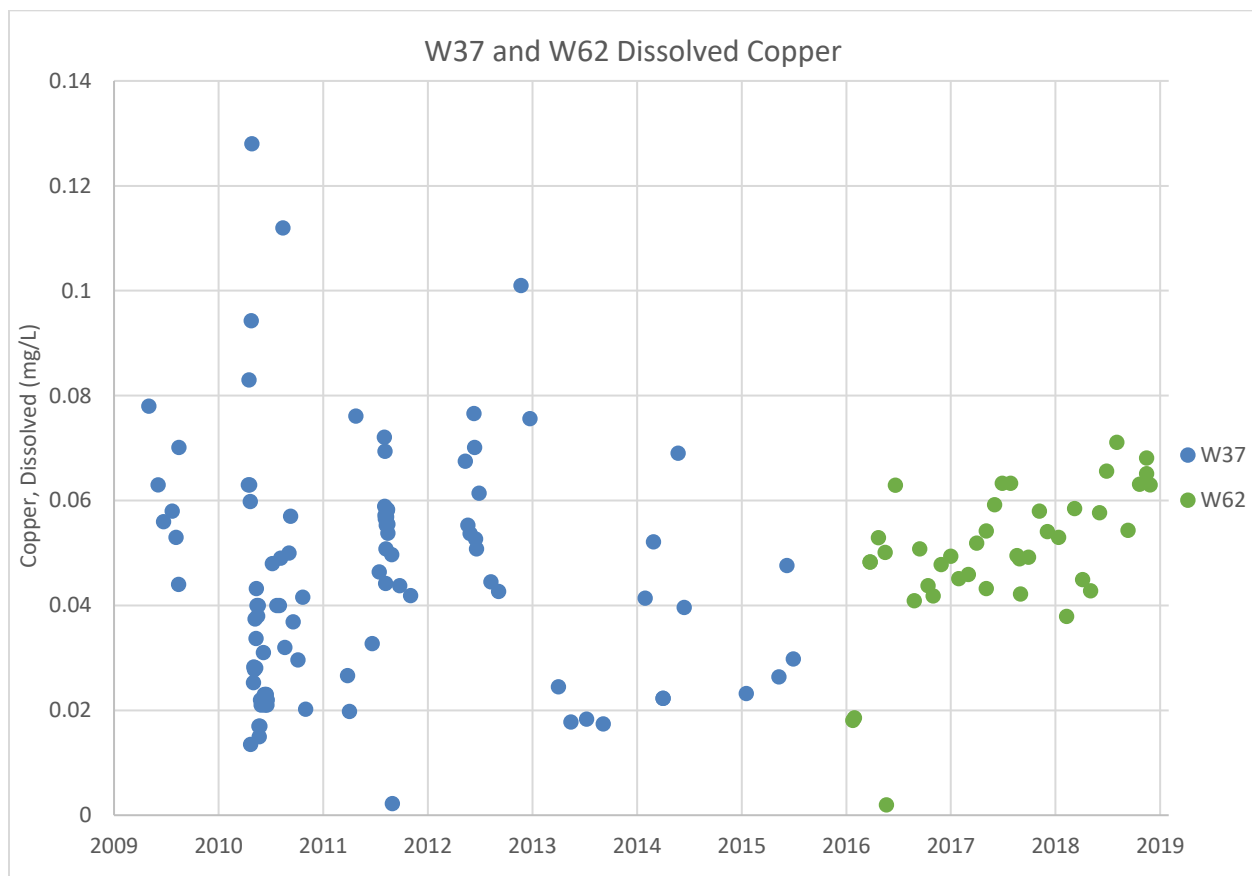


Figure 7-41: W37 and W62 Dissolved Copper

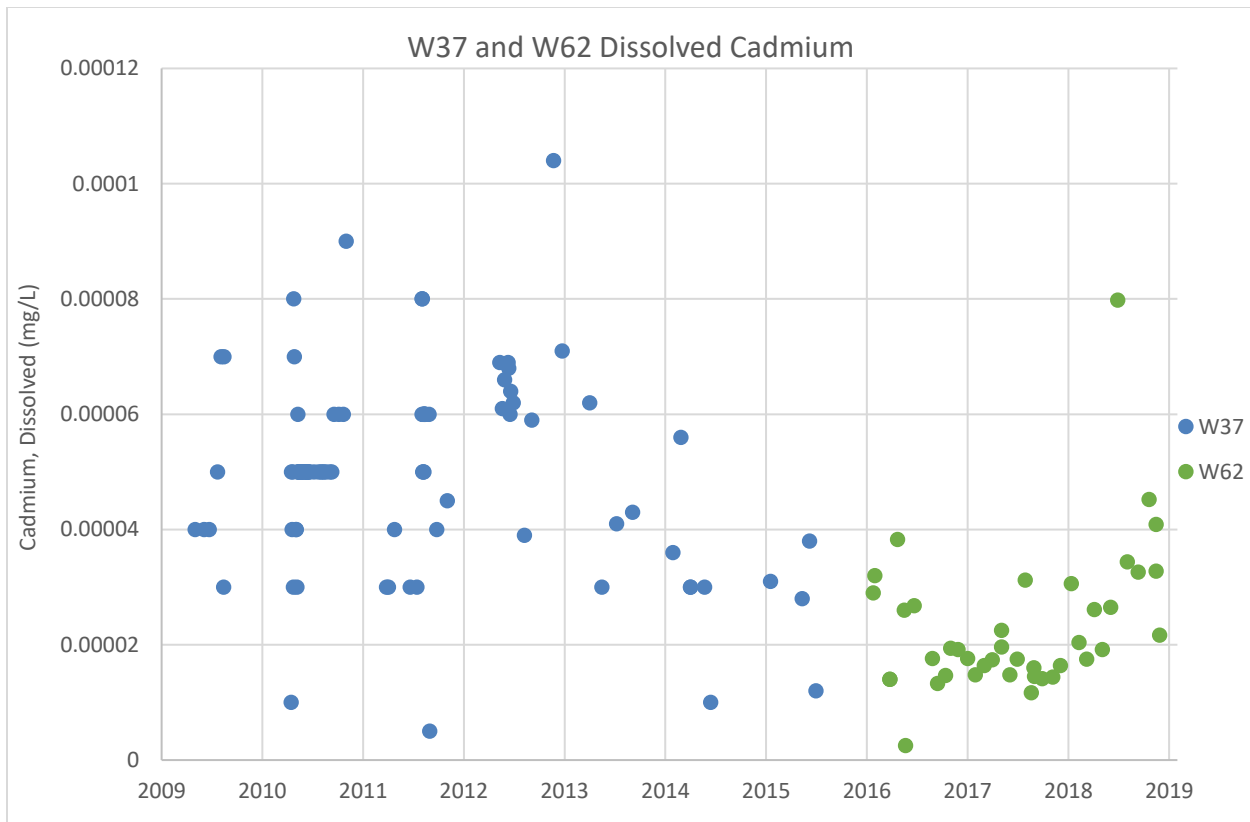


Figure 7-42: W37 and W62 Dissolved Cadmium

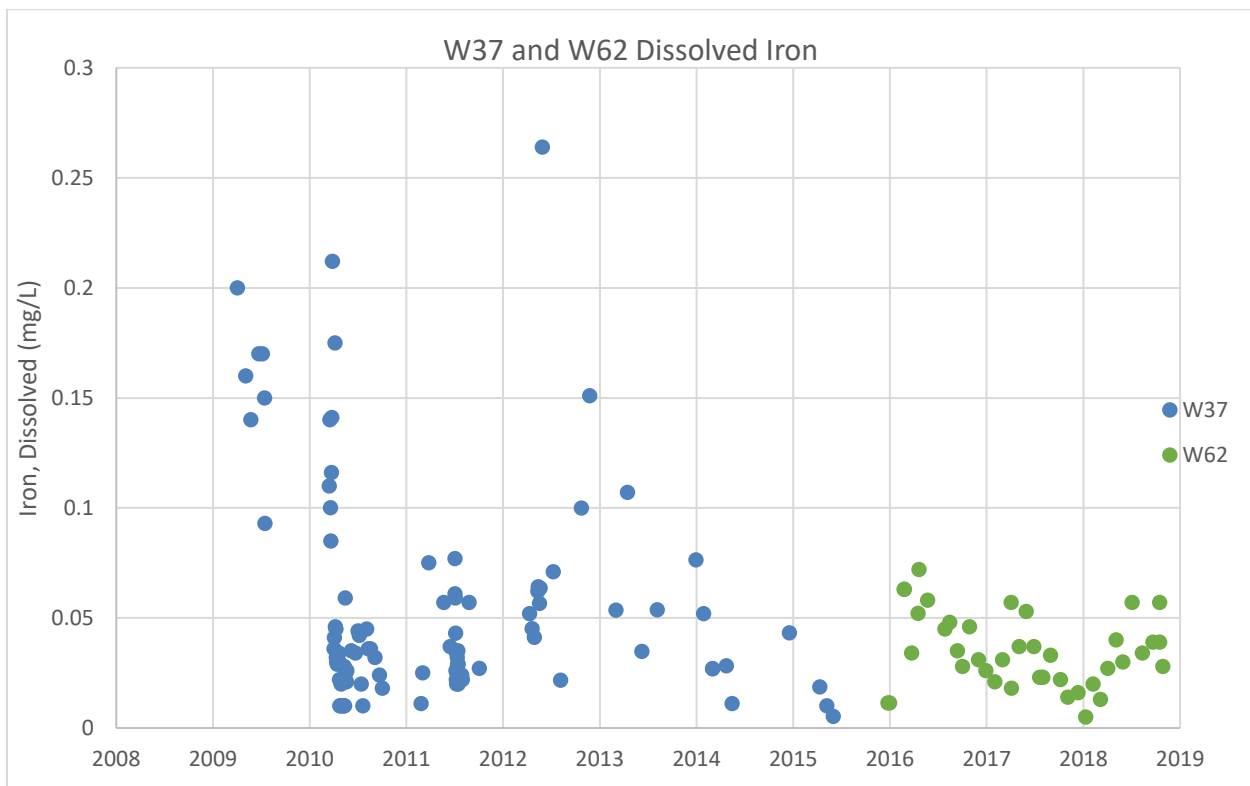


Figure 7-43: W37 and W62 Dissolved Iron

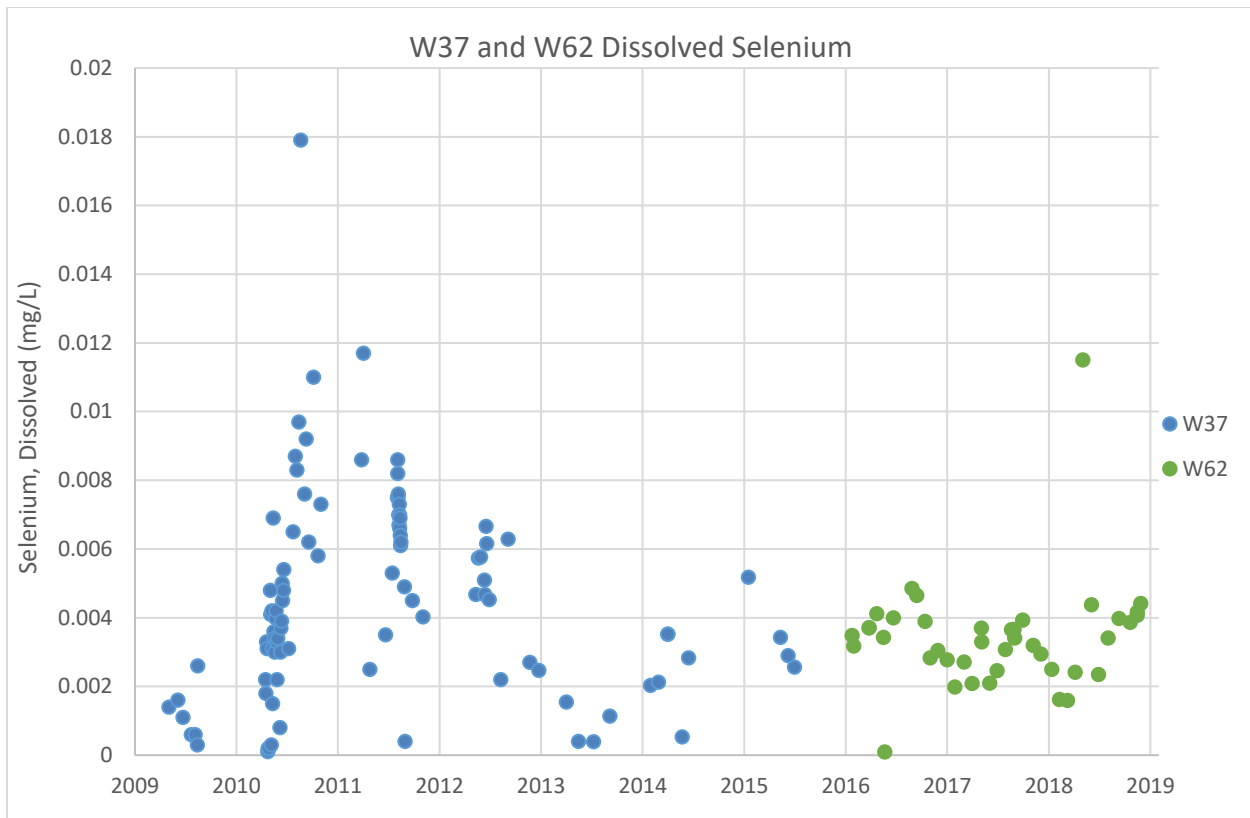


Figure 7-44: W37 and W62 Dissolved Selenium

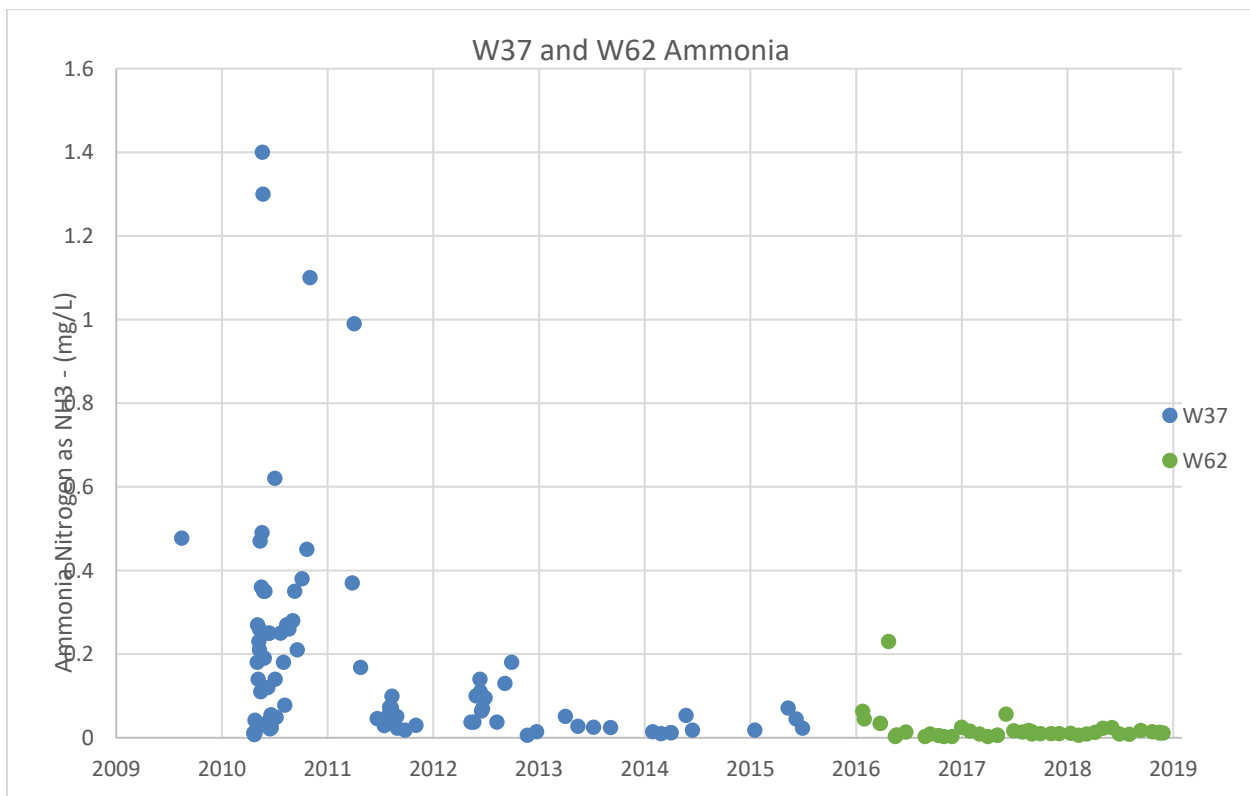


Figure 7-45: W37 and W62 Ammonia

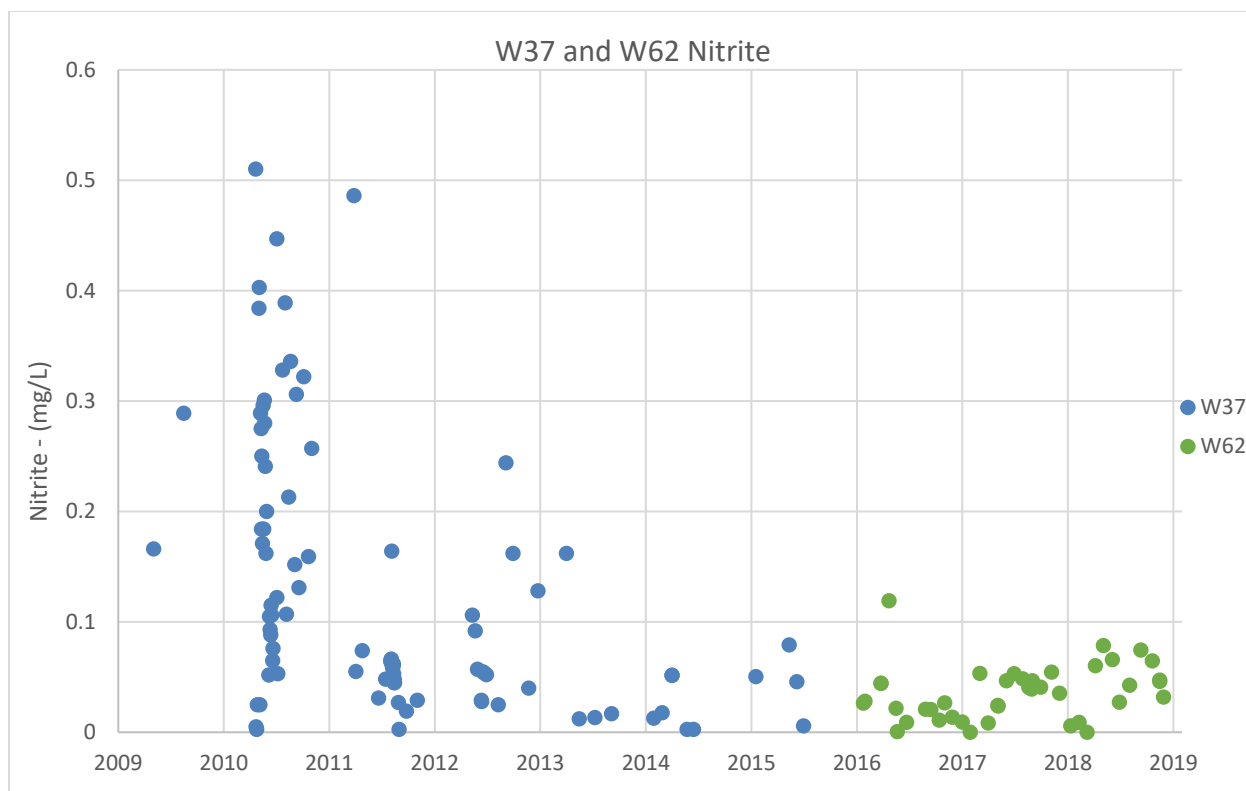


Figure 7-46: W37 and W62 Nitrite

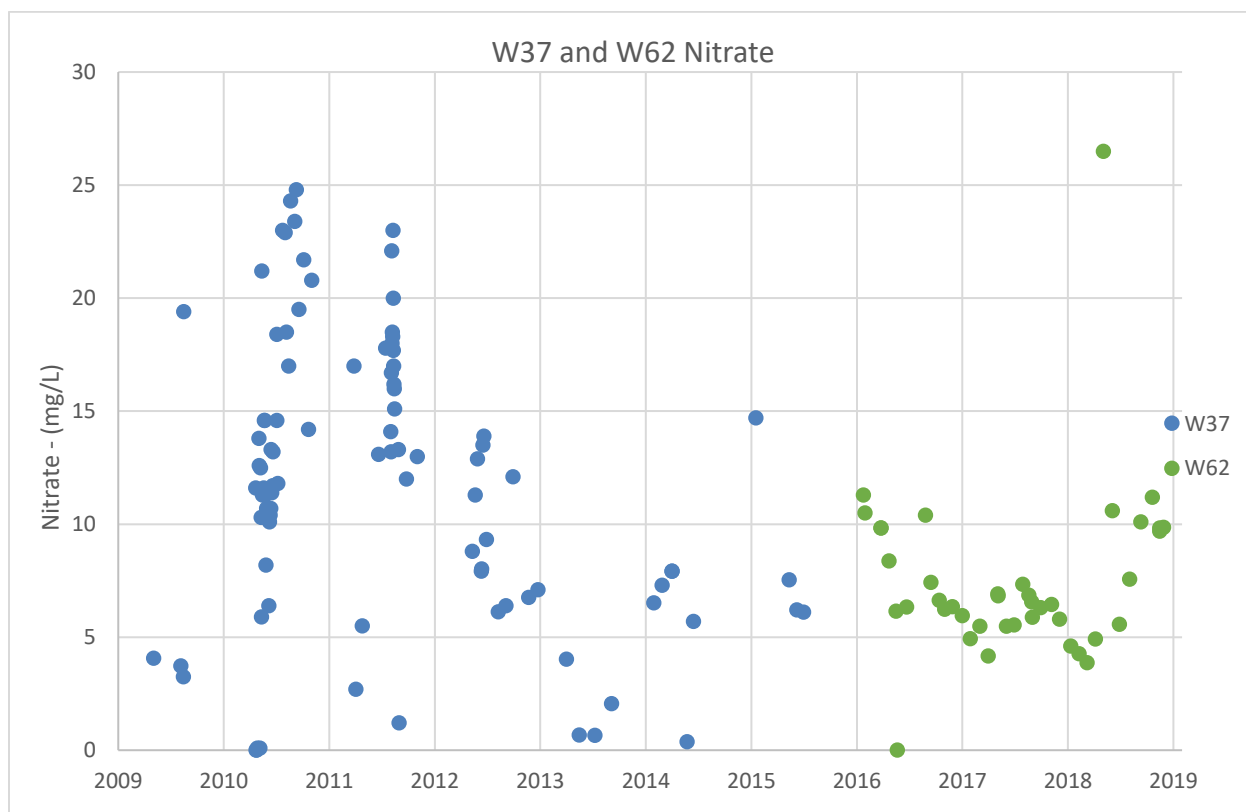


Figure 7-47: W37 and W62 Nitrate

7.4 Water Storage Pond Dam Seep

Seepage water quality at the Water Storage Pond Dam is represented by station W17. Water quality at station W17 is relatively consistent due to its being fed by a large stable body of water (Water Storage Pond). All dam seepage is collected in a vertical culvert and pumped back to the WSP via a 4" insulated heat traced pipe. Water quality statistics for station W17 from 2007 to 2018 are summarized below in Table 7-1. During February 2018, the 4" insulated heat trace pipe returning the seepage to the Water Storage pond sustained some damage and the water created a glacier formation on the dam, since the glacier melted and flowed back into the W17 sump, no water was discharged. A total of 57 samples were collected in the 2018 monitoring period. Water quality results for W17 are further outlined in Figure 7-48 through Figure 7-56 and include historic water quality results for dissolved copper, dissolved cadmium, dissolved iron, dissolved selenium, and nutrient levels for ammonia, nitrite, and nitrate.

Table 7-1: W17 Water Quality Results Summary (2007-2018)

W17	Effluent Quality Standards (WUL Clause 9)	2007 - 2017 Summary Statistics			2018 Summary Statistics		
Parameters		Mean	Min	Max	Mean	Min	Max
pH	6.0-9.0	8.14	5.4	8.5	8.25824	7.83	8.52
TSS (mg/L)	15	2.02	0.5	267	6.34	1.5	87
Nutrients (mg/L)							
Ammonia Nitrogen	0.75	0.028	-0.01	0.85	0.0121	0.0025	0.060
Nitrite Nitrogen	0.18	0.039	0.0005	7.85	0.00063	0.0005	0.0035
Nitrate Nitrogen	27.3	3.79	0.0025	12.4	0.121	0.0385	0.249
Dissolved Metals (mg/L)							
Aluminum	0.3	0.0057	0.0005	0.26	0.0032	0.0005	0.0537
Arsenic	0.015	0.00037	0.00005	0.0037	0.000420	0.00034	0.00216
Cadmium	0.004104*	0.000028	0.0000025	0.0028	0.0000088	0.0000025	0.000044
Chromium	0.003	0.00058	0.00005	0.008	0.000126	0.0001	0.00028
Copper	0.039	0.0064	0.0001	0.031	0.00814	0.00612	0.0371
Iron	3.3	0.011	0.0025	0.45	0.08988	0.013	0.389
Lead	0.012	0.00011	0.000009	0.0008	3.13E-05	0.000025	0.000307
Molybdenum	0.219	0.0064	0.000025	0.022	0.00596	0.00367	0.0103
Nickel	0.33	0.00092	0.00025	0.011	0.000939	0.00052	0.00727
Selenium	0.006	0.0011	0.000025	0.005	0.000372	0.000124	0.000549
Zinc	0.09	0.0034	0.0005	0.043	0.003636	0.0005	0.0245

Bold values indicate exceedances of the WUL standards

*Based on measured hardness

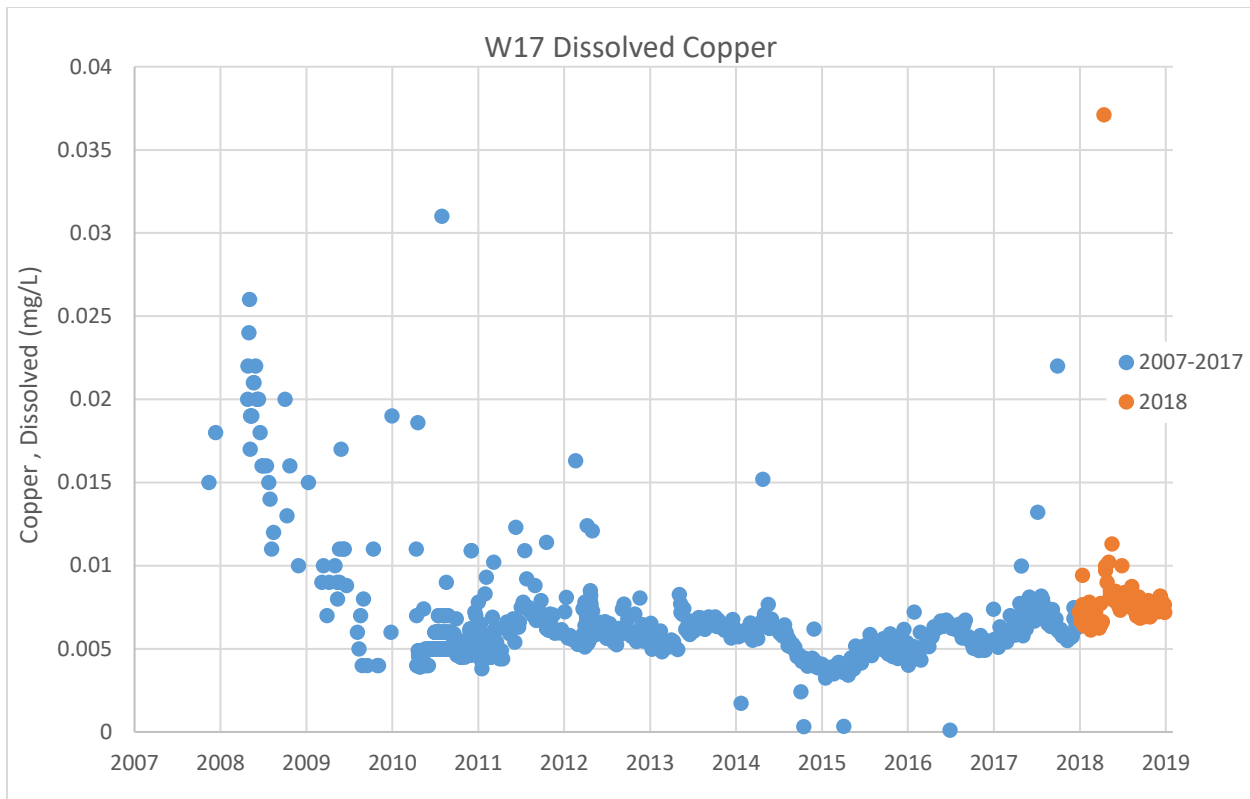


Figure 7-48: W17 Dissolved Copper

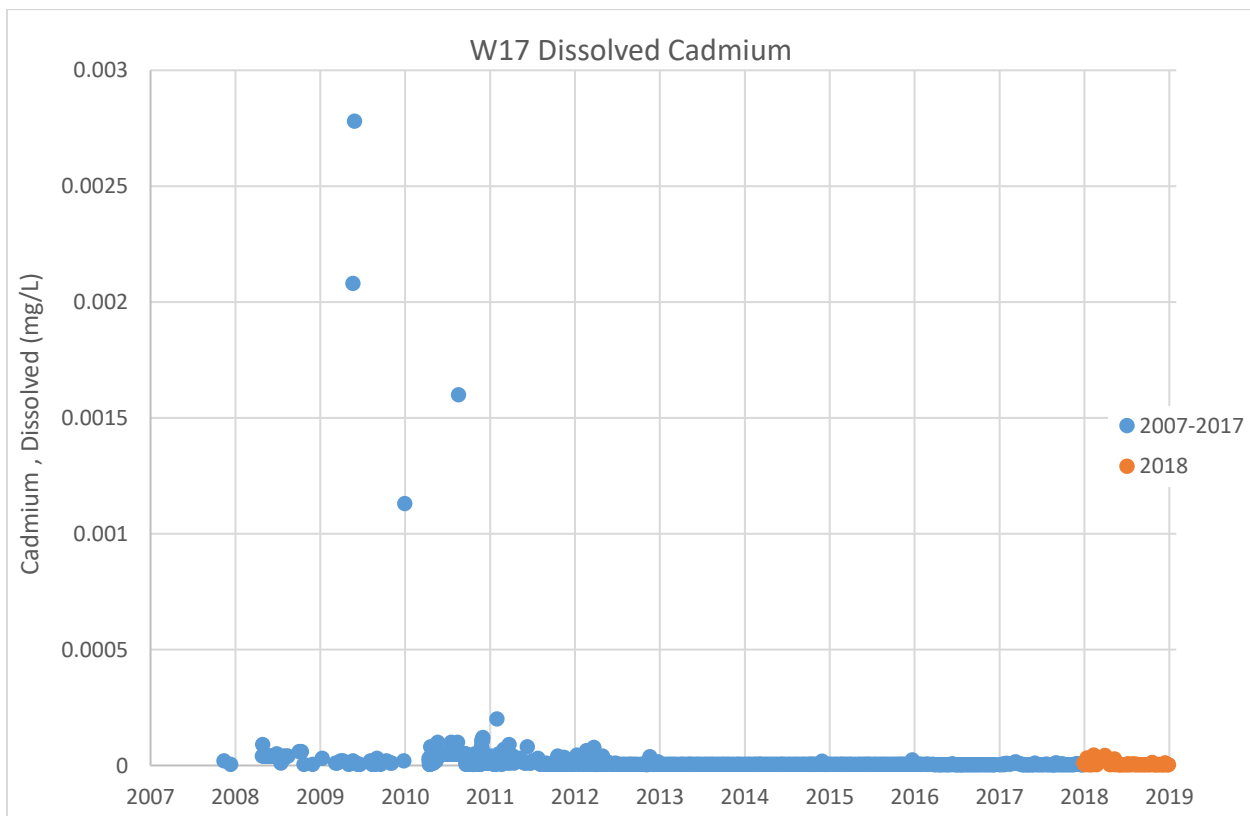


Figure 7-49: W17 Dissolved Cadmium

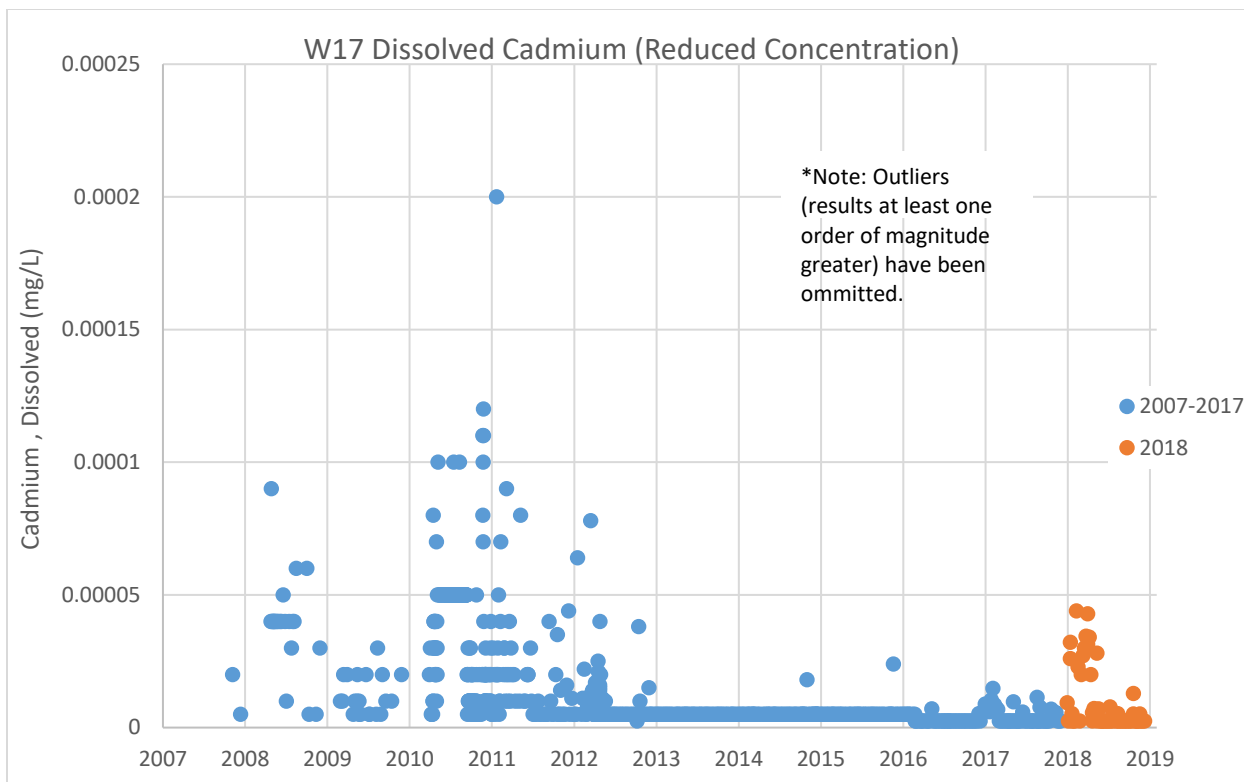


Figure 7-50: W17 Dissolved Cadmium (Reduced Concentration)

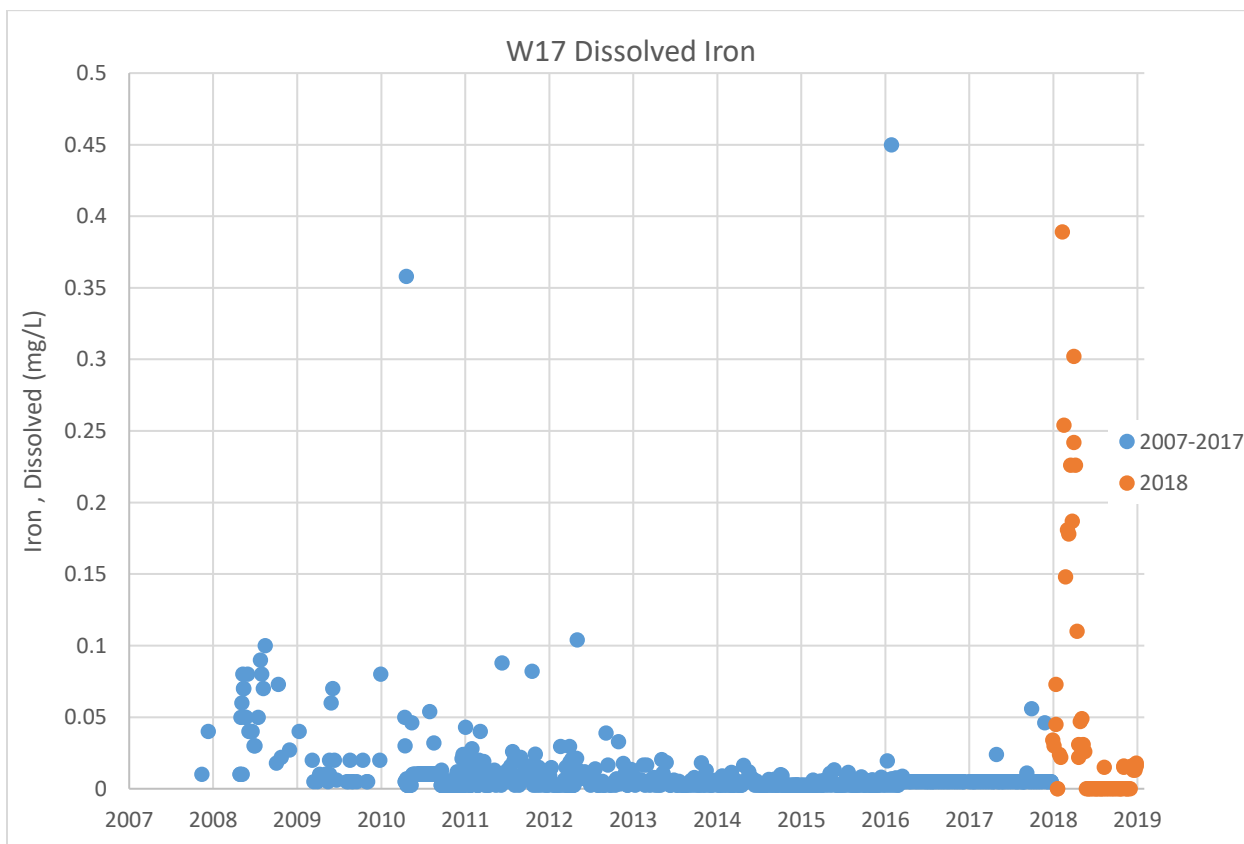


Figure 7-51: W17 Dissolved Iron

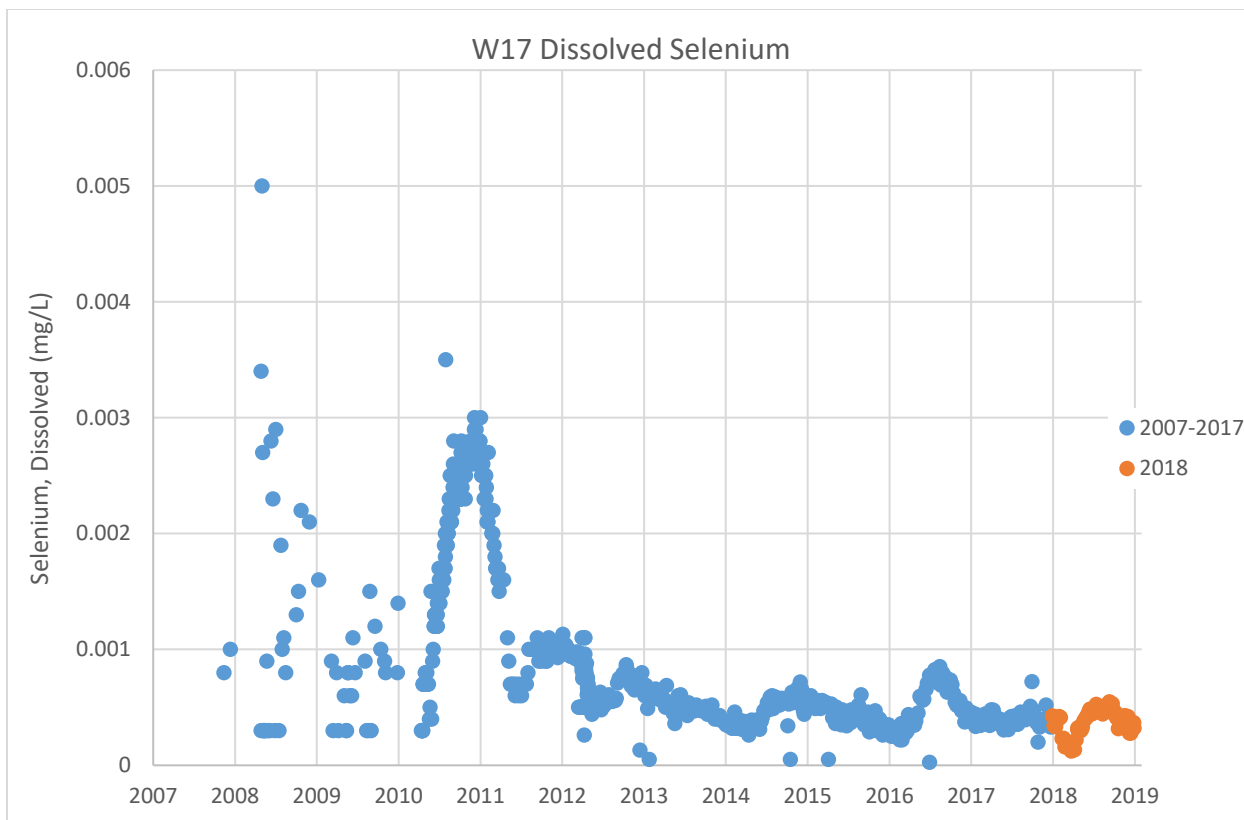


Figure 7-52: W17 Dissolved Selenium

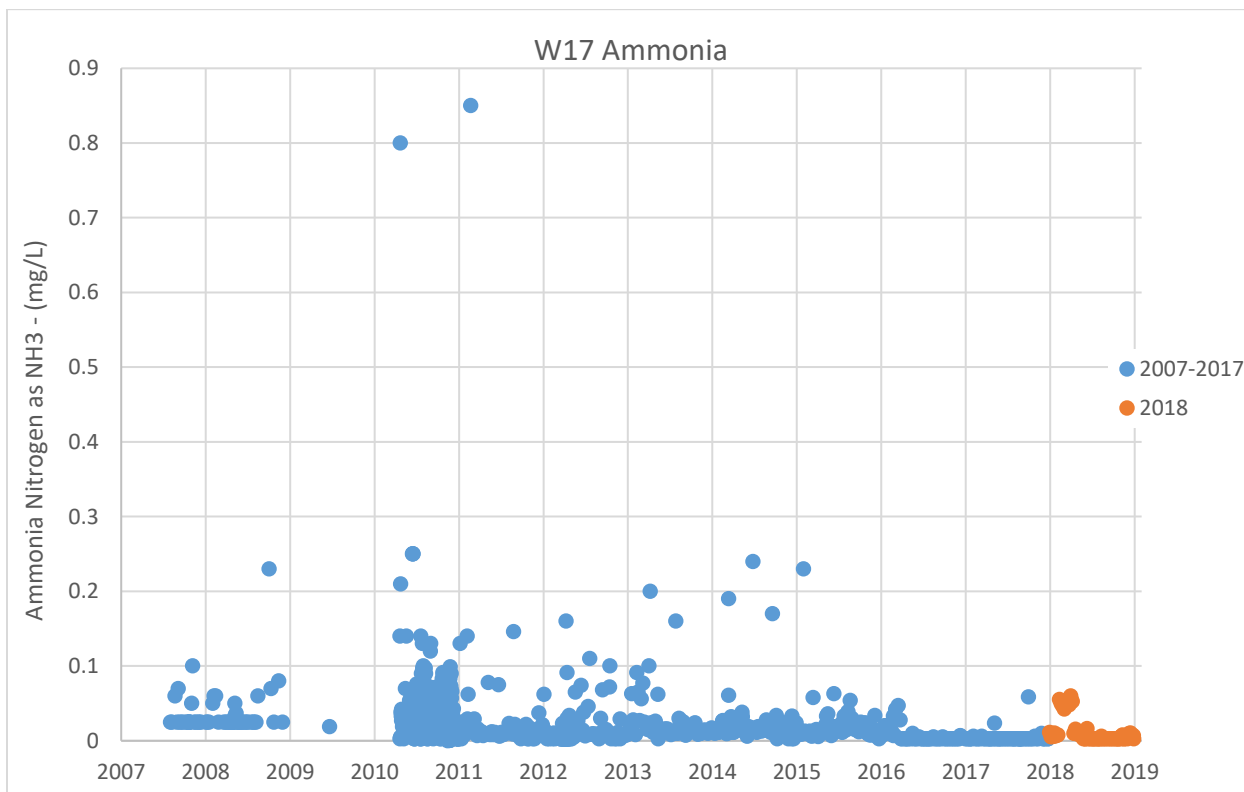


Figure 7-53: W17 Ammonia

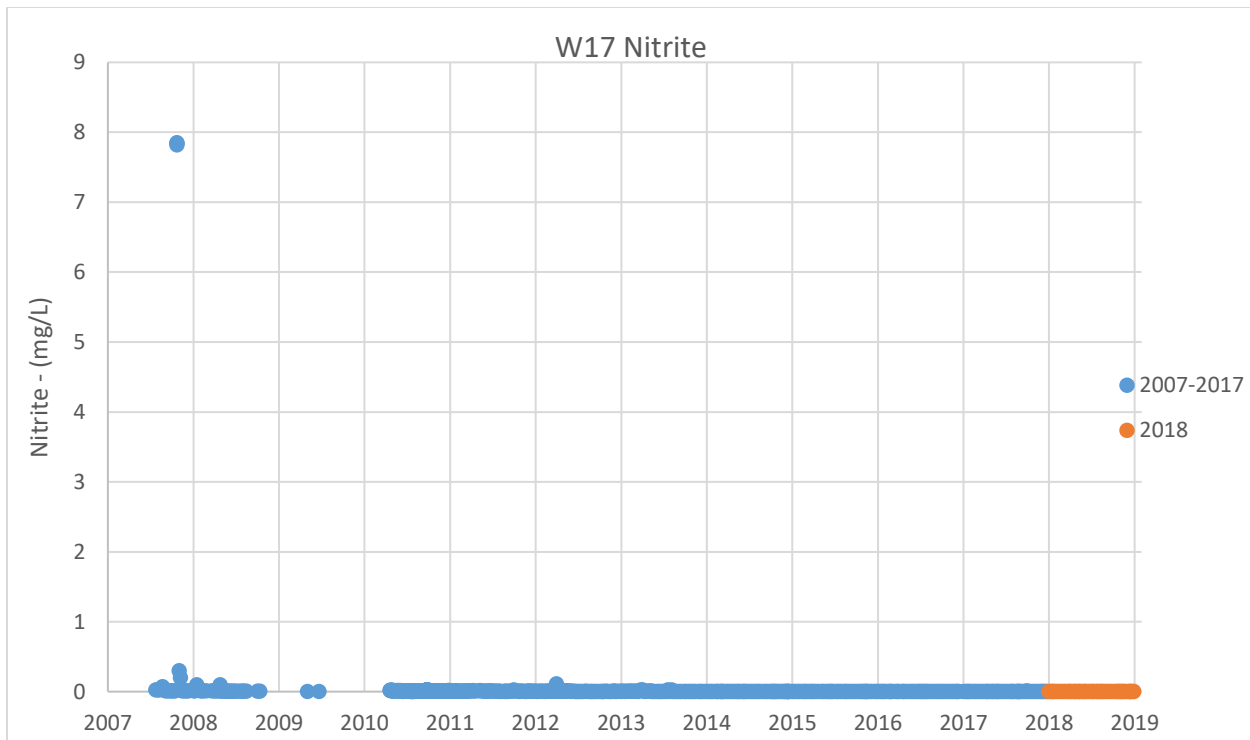


Figure 7-54: W17 Nitrite

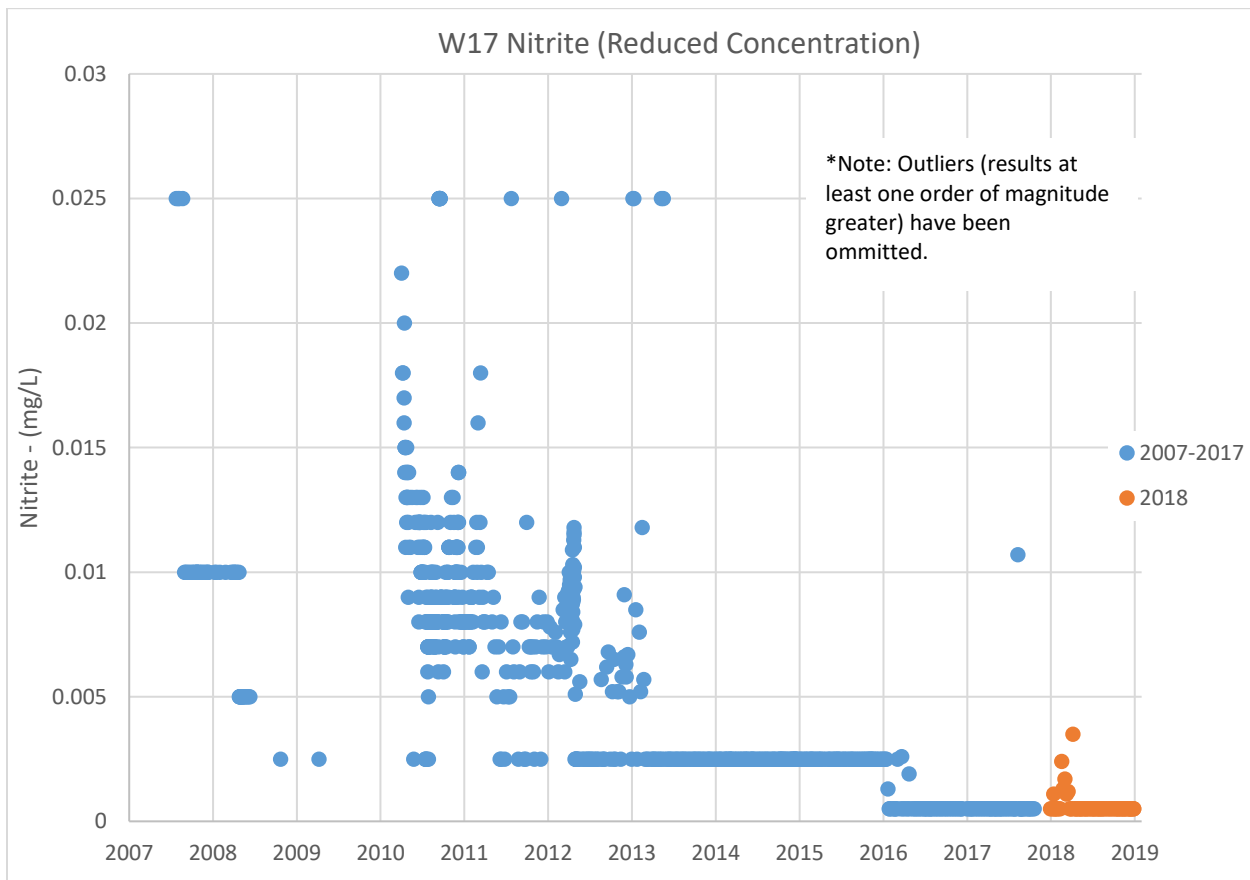


Figure 7-55: W17 Nitrite (Reduced Concentration)

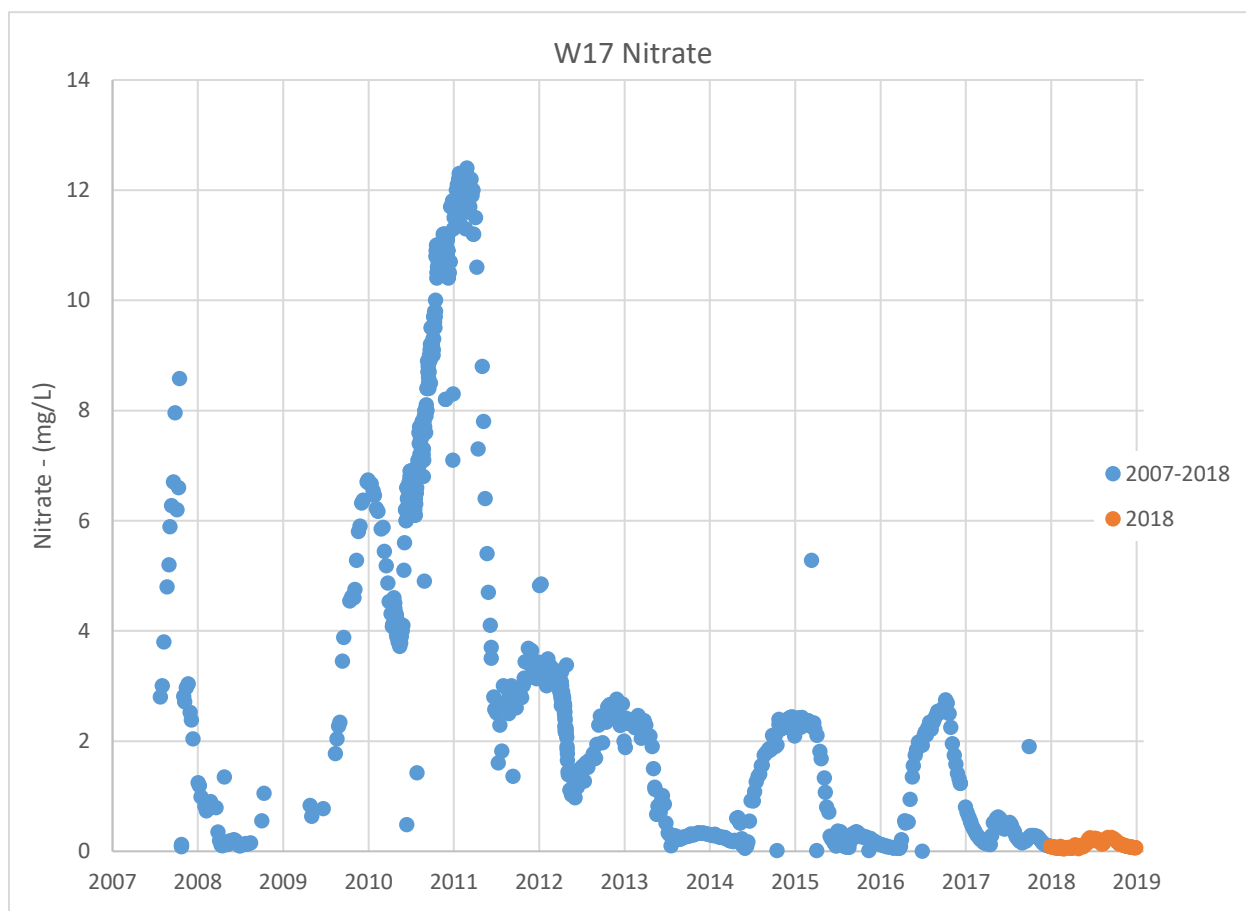


Figure 7-56: W17 Dissolved Nitrate

7.5 Dry Stack Tailings Storage Facility (DSTSF)

No recurring seeps were observed flowing during the spring, though a new seep was identified labelled SS100. During the fall survey, water was found active at SS9, SS36, SS60 and SS61. Previously, water has flowed along the tailings diversion ditch road and down the toe of the south side of the DSTSF. Historical water quality results and 2018 seepage surveys results for the DSTSF-associated seepage sites (SS9, SS10, SS17, SS18, SS19, SS34, SS35, SS36, SS45, SS60 and SS61) are outlined in Figure 7-57 through Figure 7-63 and include results for dissolved copper, dissolved cadmium, dissolved iron, dissolved selenium, and nutrient levels for ammonia, nitrite, and nitrate.

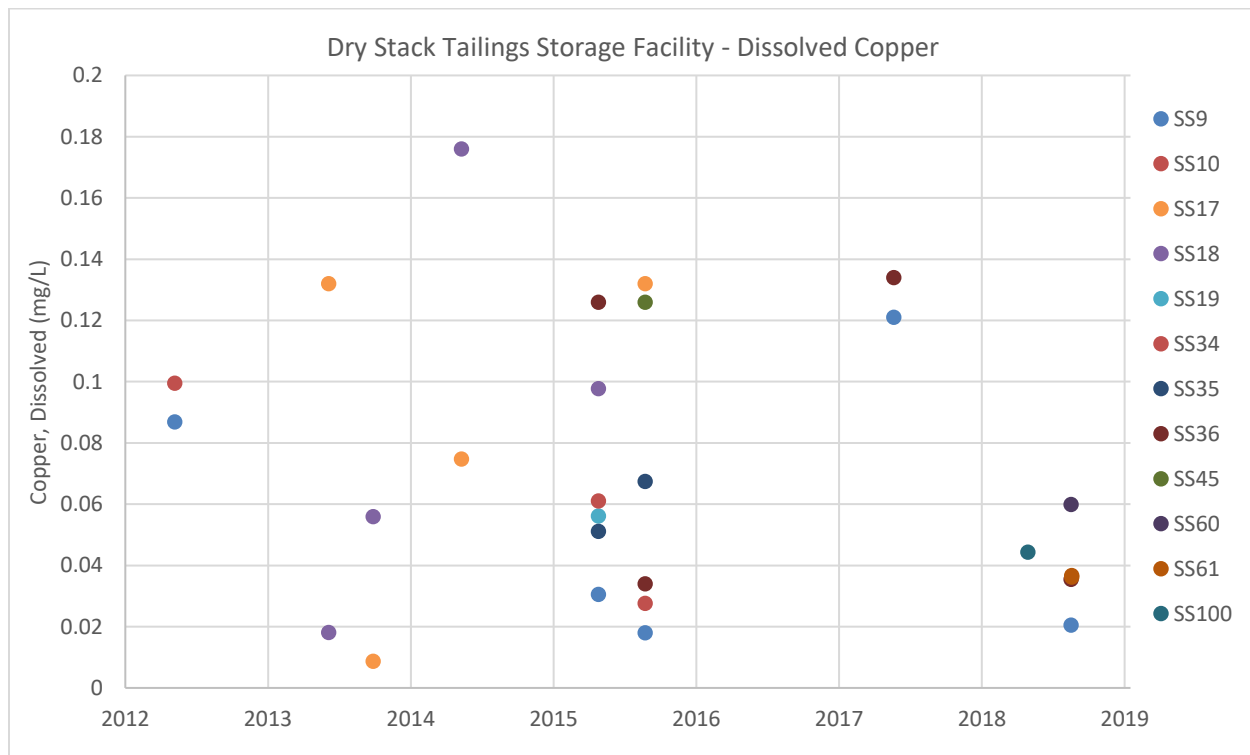


Figure 7-57: Dry Stack Tailings Storage Facility Seepage Sites - Dissolved Copper

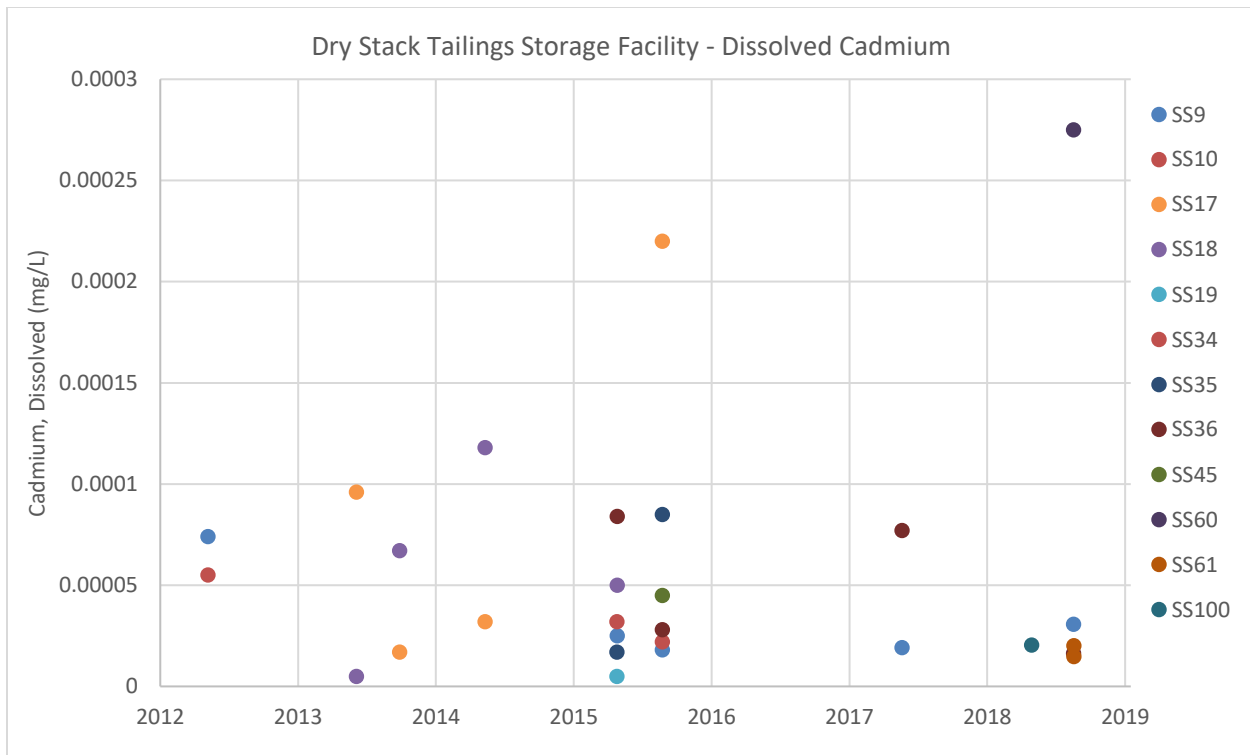


Figure 7-58: Dry Stack Tailings Storage Facility Seepage Sites - Dissolved Cadmium

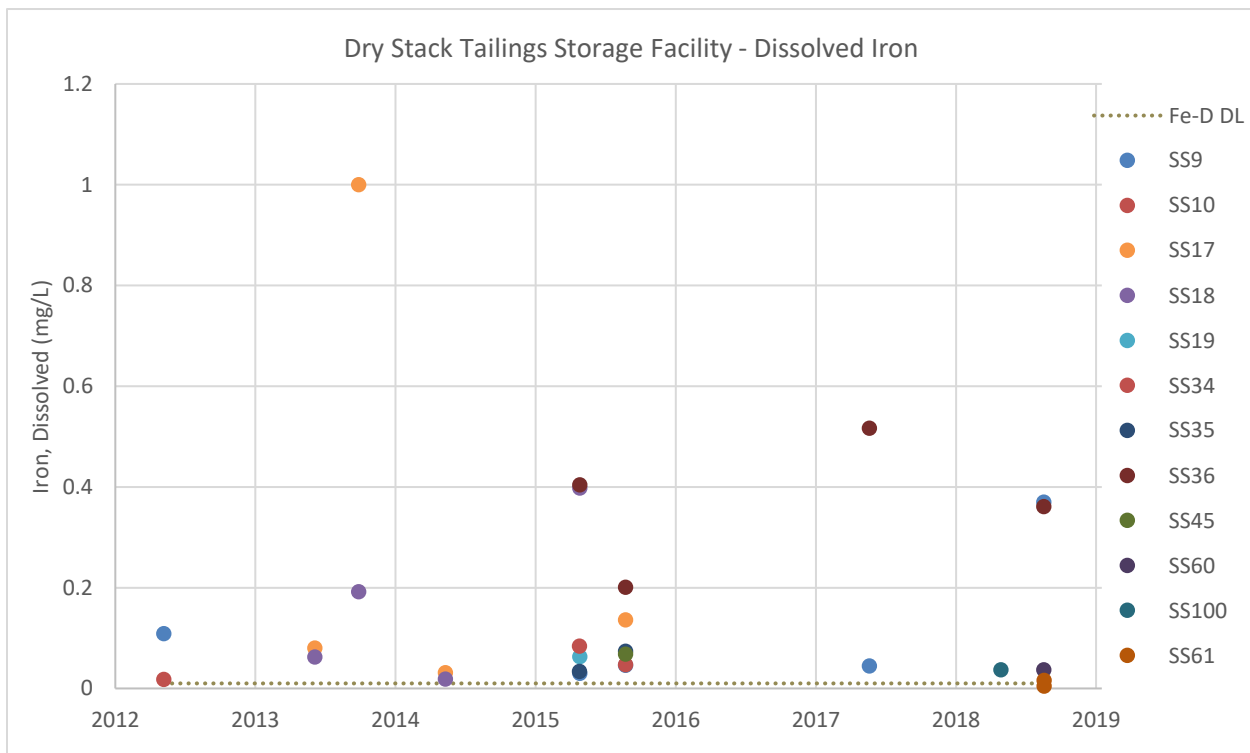


Figure 7-59: Dry Stack Tailings Storage Facility Seepage Sites - Dissolved Iron

DL is Analytical Detection Limit

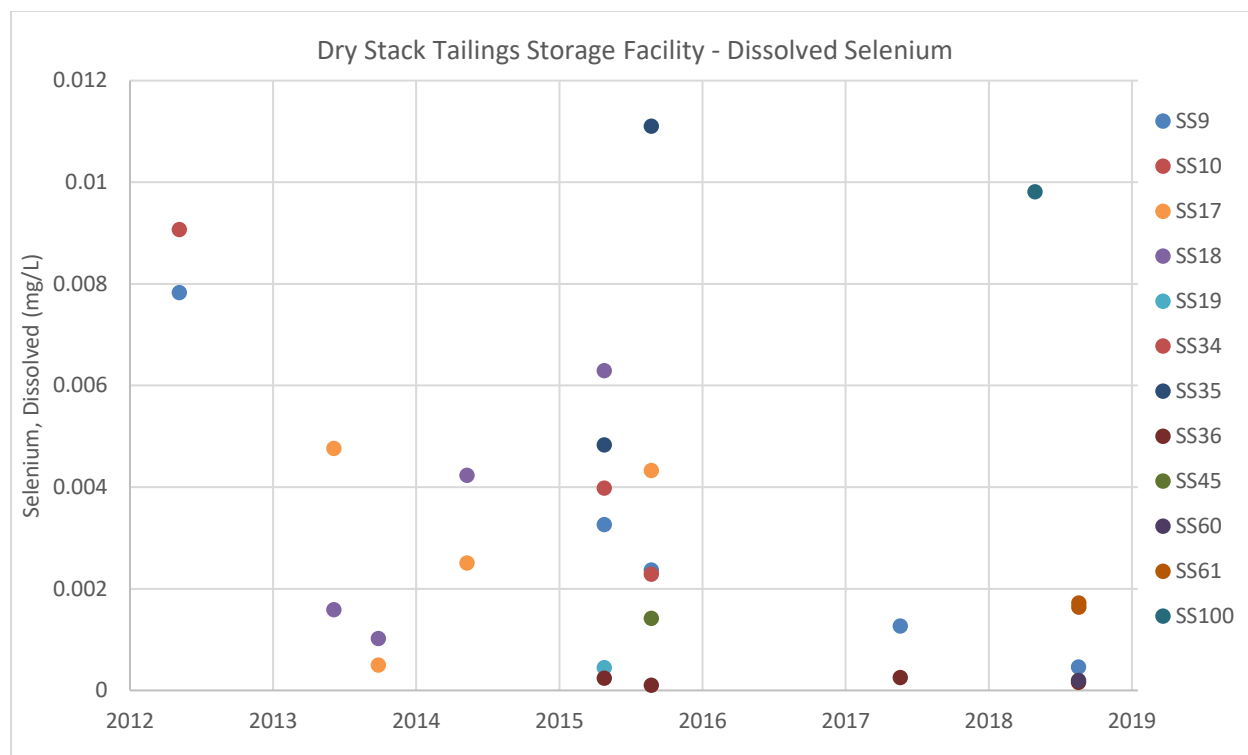


Figure 7-60: Dry Stack Tailings Storage Facility Seepage Sites – Dissolved Selenium

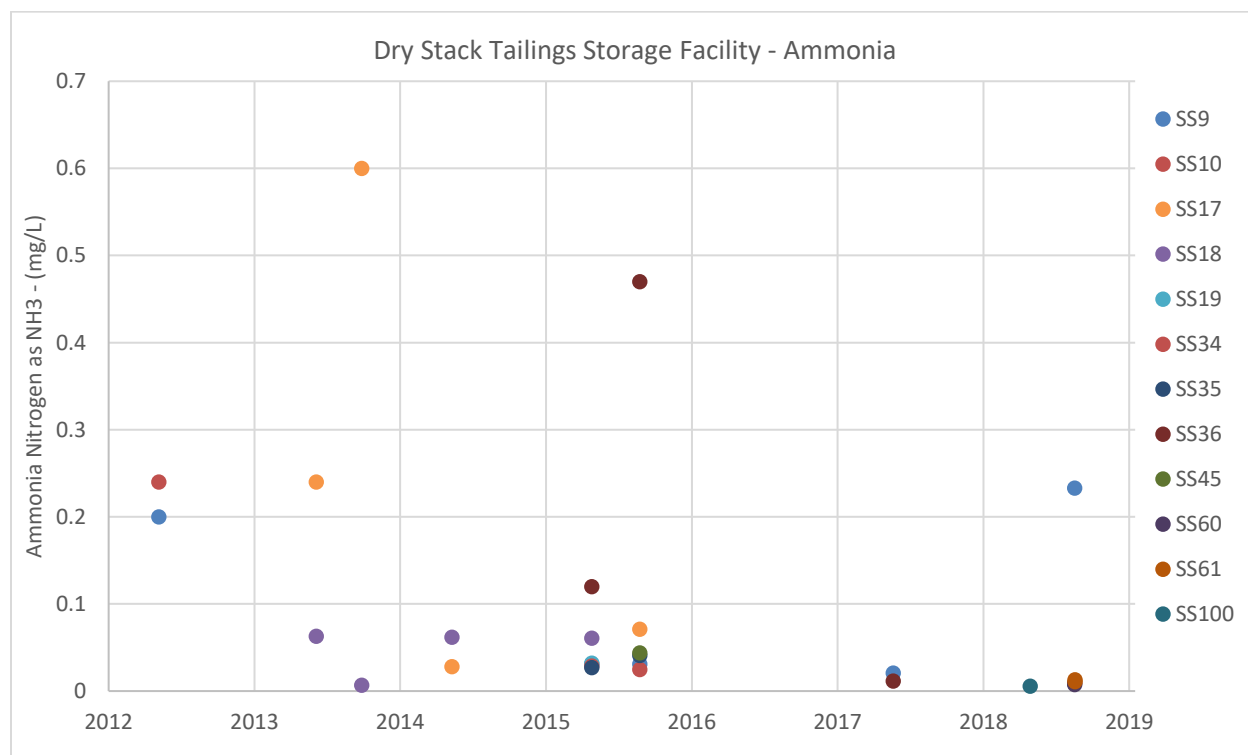


Figure 7-61: Dry Stack Tailings Storage Facility Seepage Sites – Ammonia

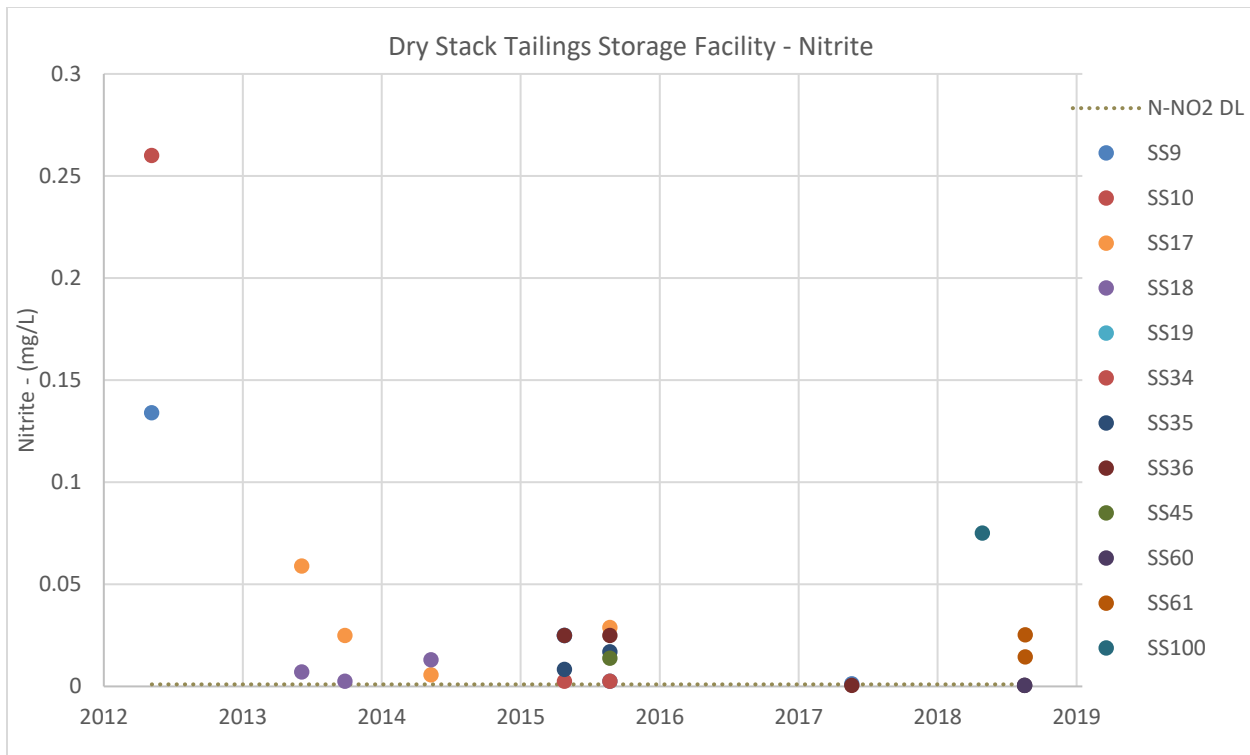


Figure 7-62: Dry Stack Tailings Storage Facility Seepage Sites – Nitrite

DL is Analytical Detection Limit

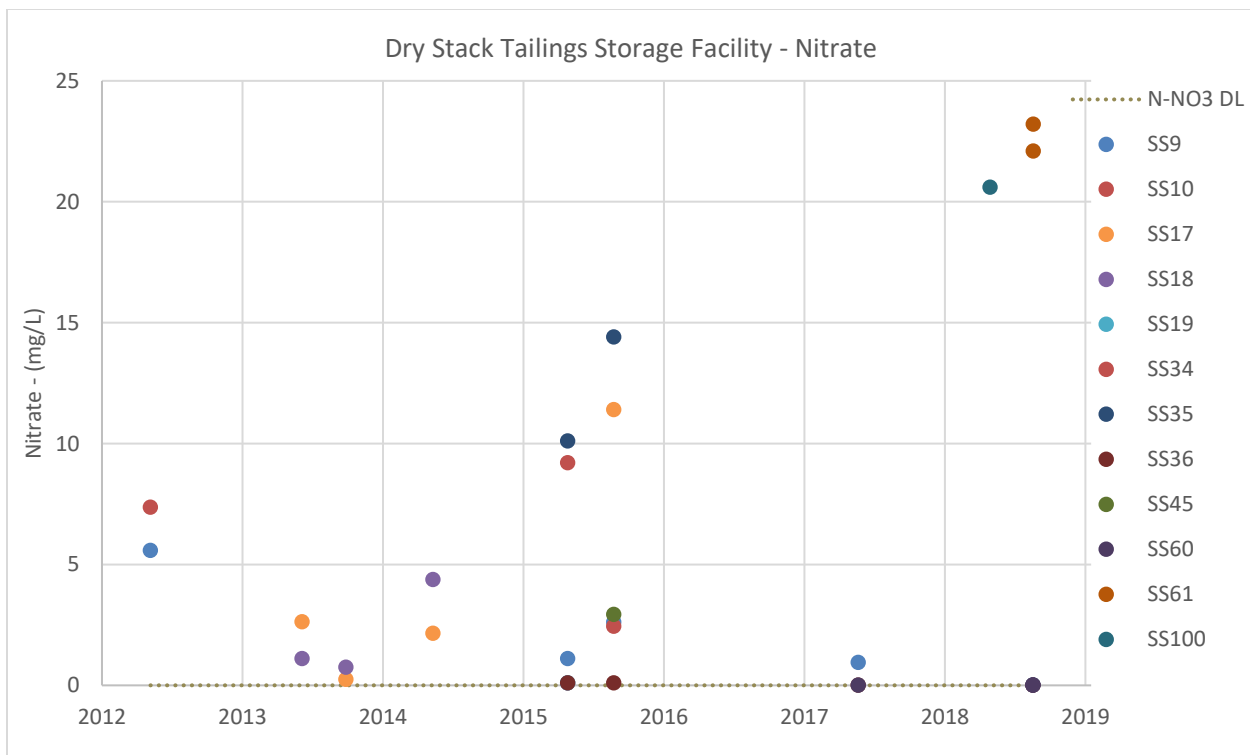


Figure 7-63: Dry Stack Tailings Storage Facility Seepage Sites – Nitrate

DL is Analytical Detection Limit

7.6 Ore Stockpiles

Surface seepage runs along the toe of the west ore stockpile and into the ditch parallel to the heavy vehicle road. All seeps in this area drain into the west ore stockpile sump and are pumped to the Main pit. Seepage monitoring stations SS5, SS6, SS7, SS8, SS33 and SS59 capture seepage from the stockpile during spring and fall sampling programs, this year SS59 was found dry. Seepage sites SS46 and SS47 at the toe of the underground ore stockpiles were discovered and added to the network in the fall of 2015. Water quality results are outlined in Figure 7-64 through Figure 7-71 and include historic water quality results for dissolved copper, dissolved cadmium, dissolved iron, dissolved selenium, and nutrient levels for ammonia, nitrite, and nitrate.

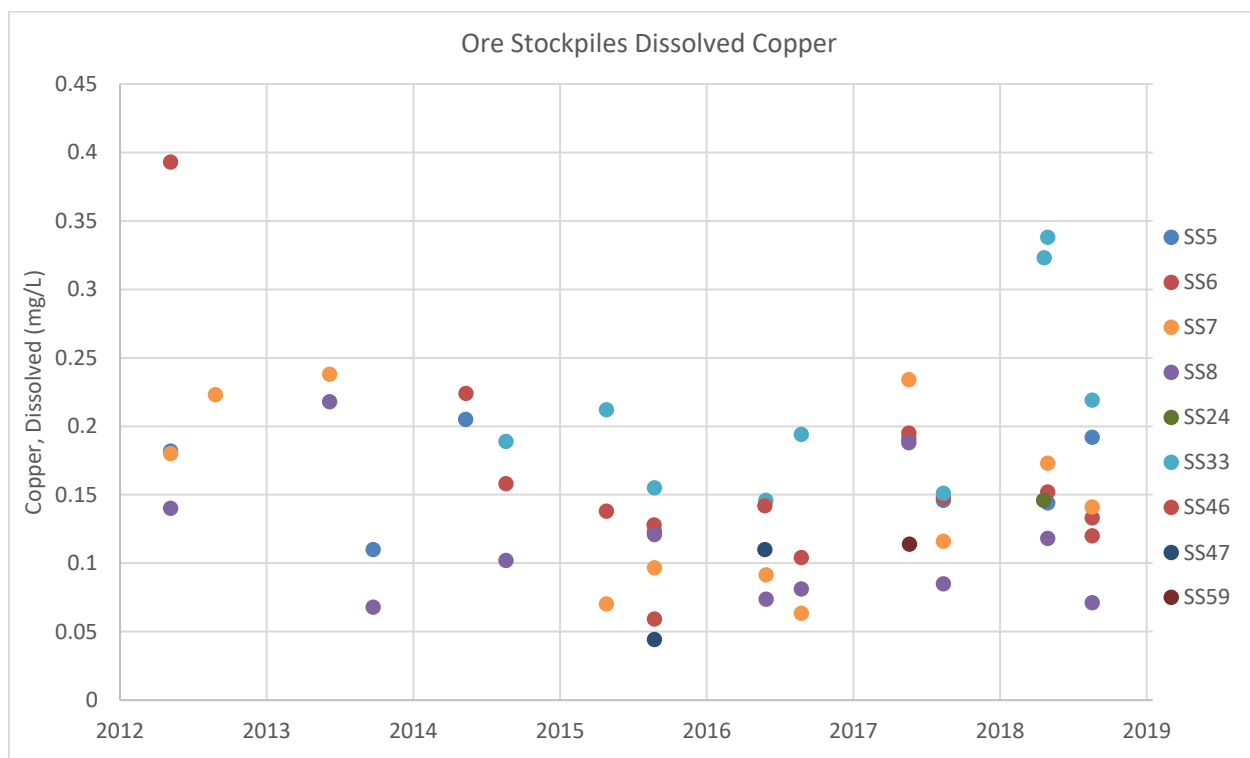


Figure 7-64: Ore Stockpile Sites - Dissolved Copper

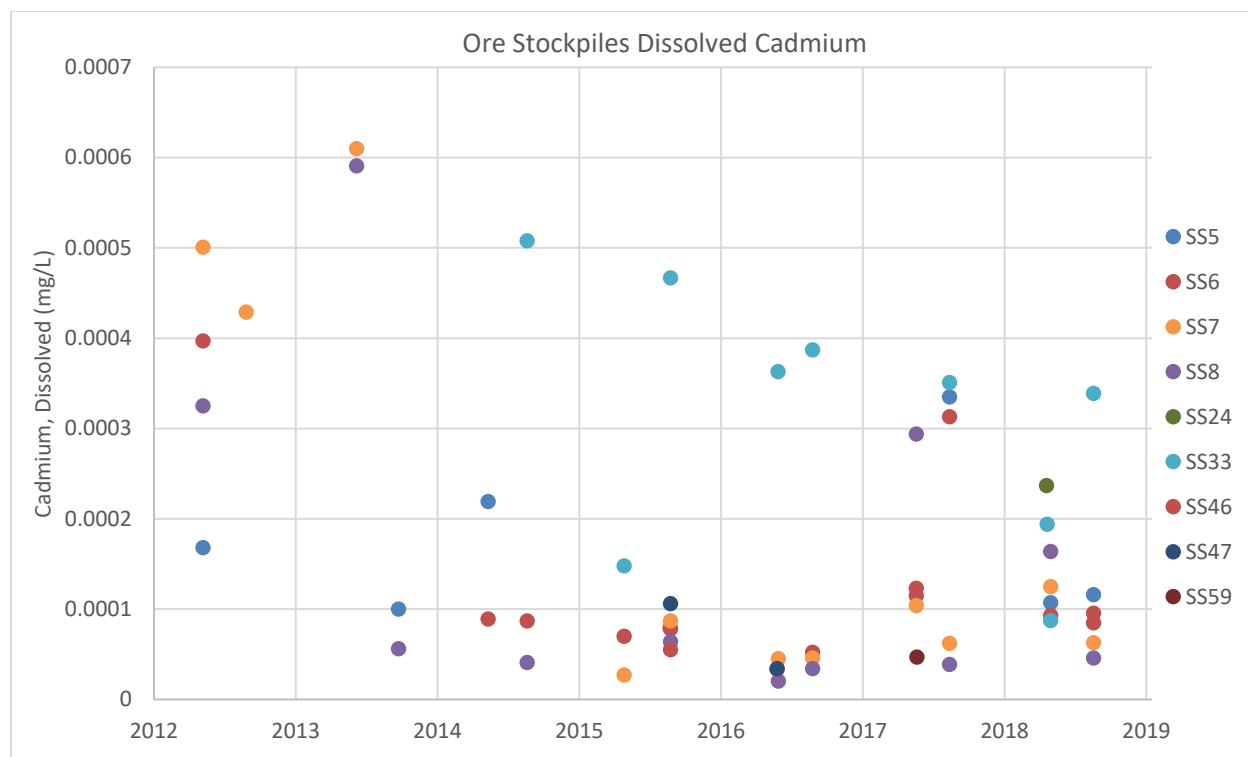


Figure 7-65: Ore Stockpile Sites - Dissolved Cadmium

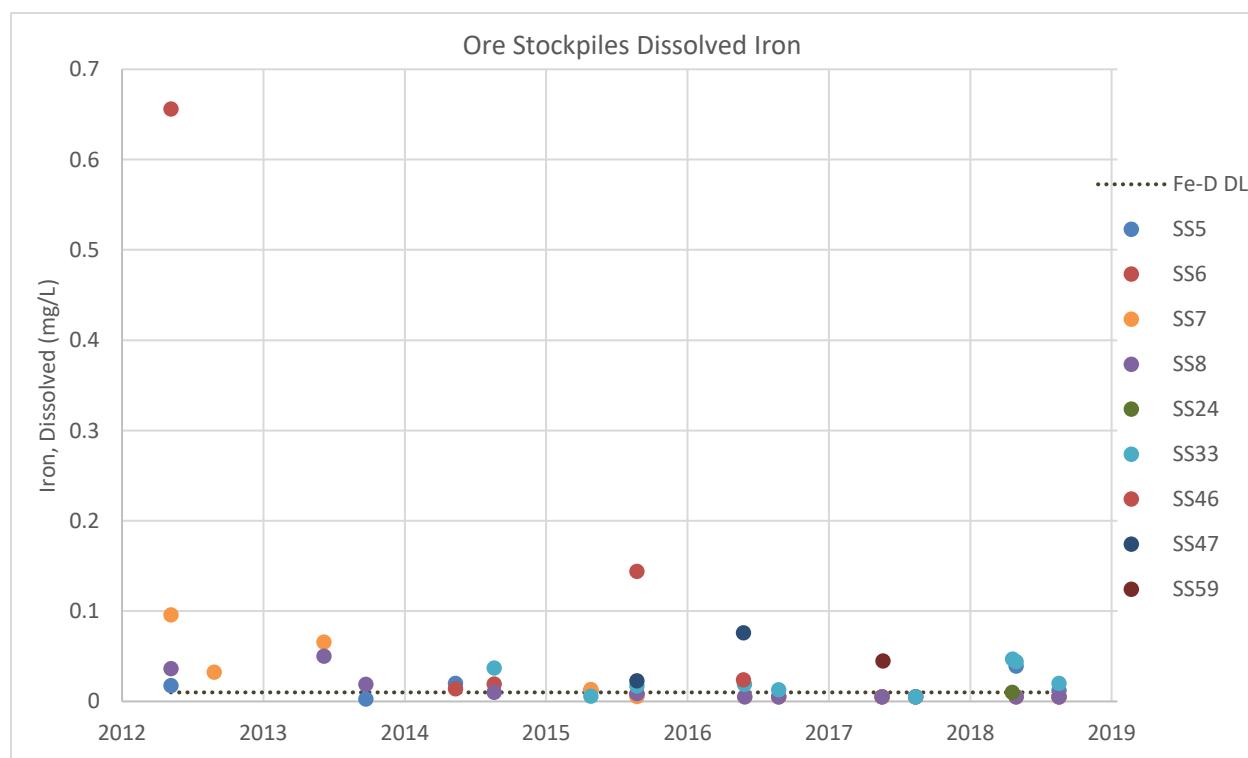


Figure 7-66: Ore Stockpile Sites - Dissolved Iron

DL is Analytical Detection Limit

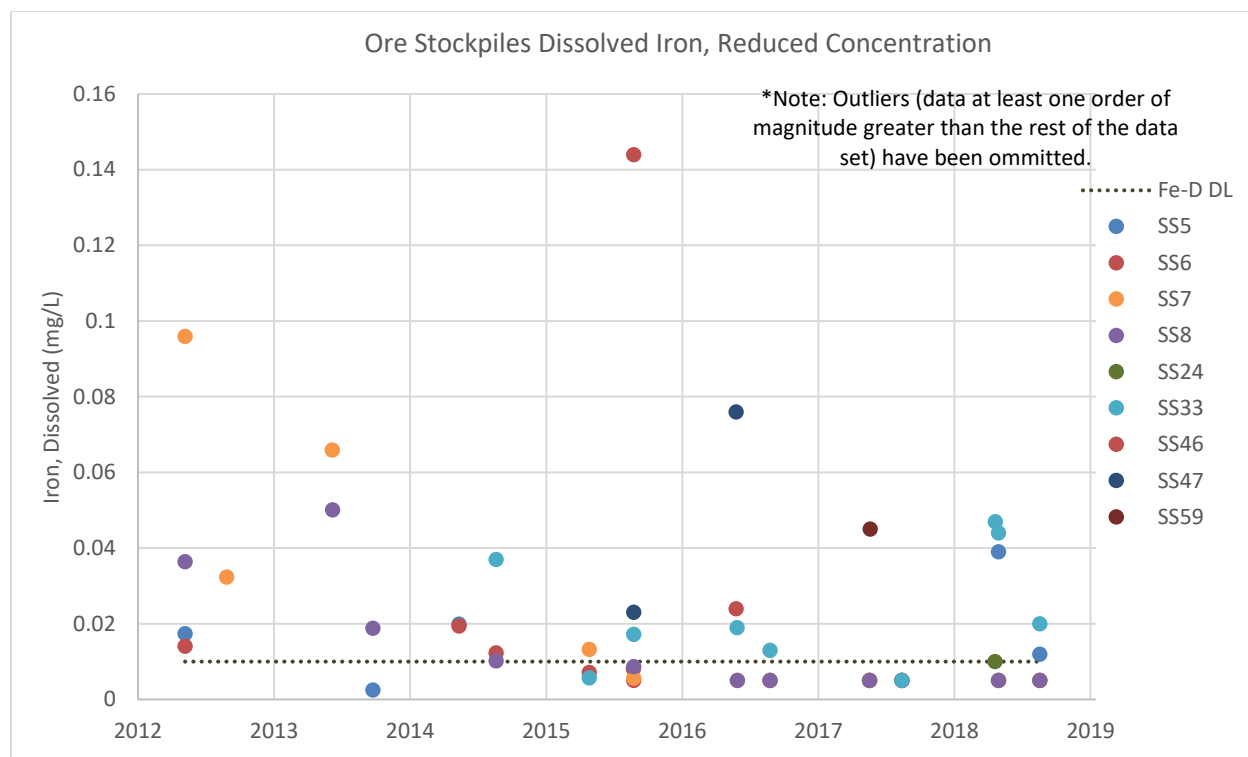


Figure 7-67: Ore Stockpile Sites - Dissolved Iron (Reduced Concentration)

DL is Analytical Detection Limit

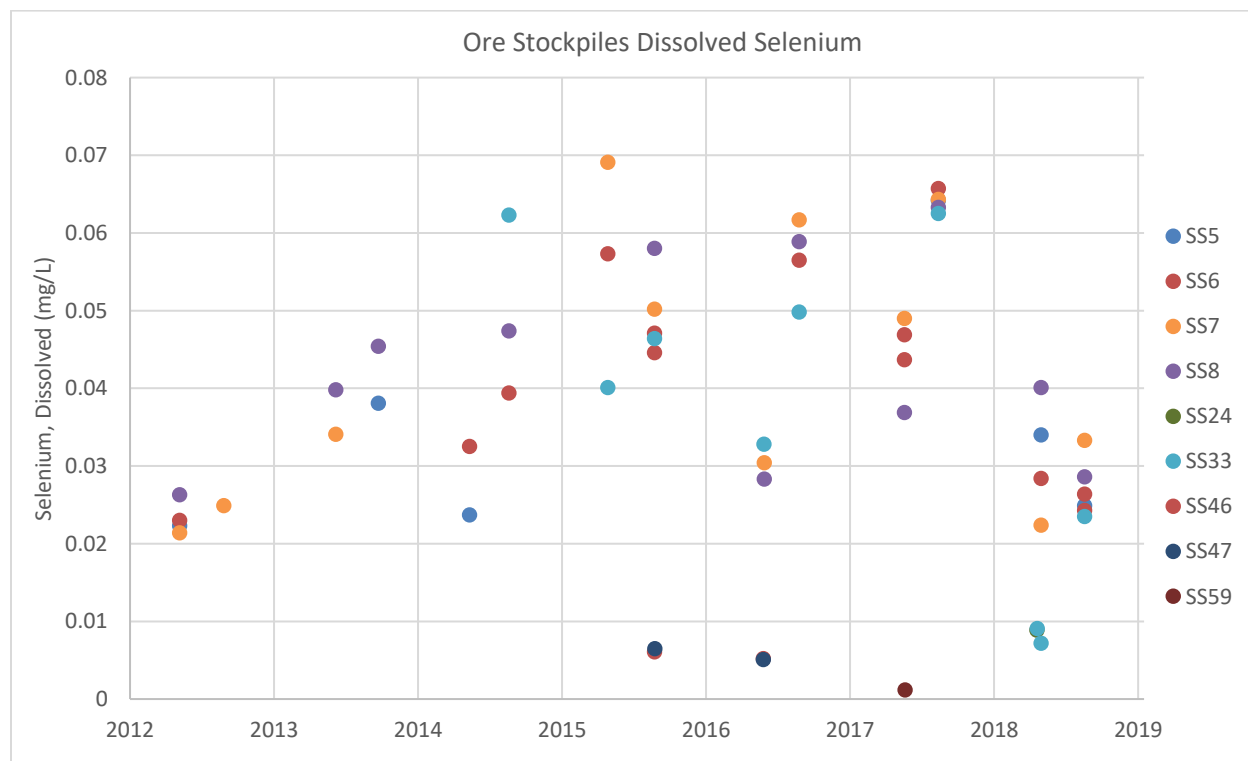


Figure 7-68: Ore Stockpile Sites - Dissolved Selenium

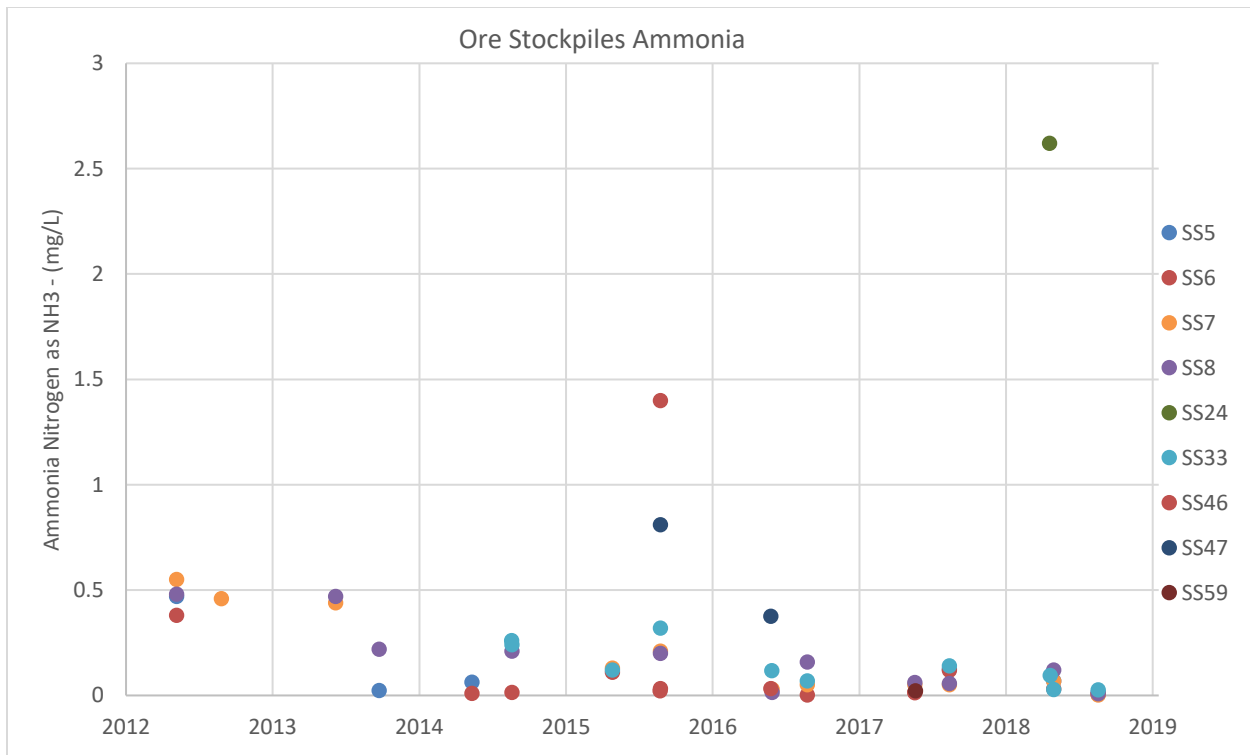


Figure 7-69: Ore Stockpile Sites - Dissolved Ammonia

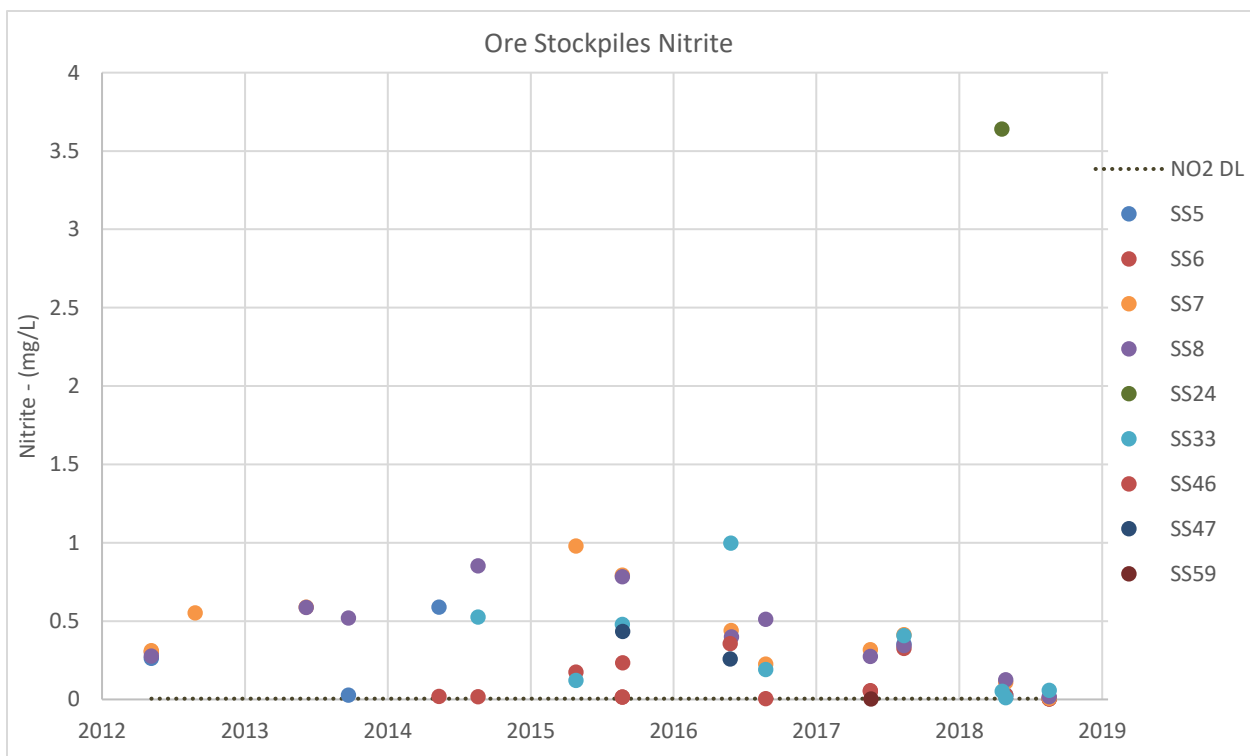


Figure 7-70: Ore Stockpile Sites - Dissolved Nitrite

DL is Analytical Detection Limit

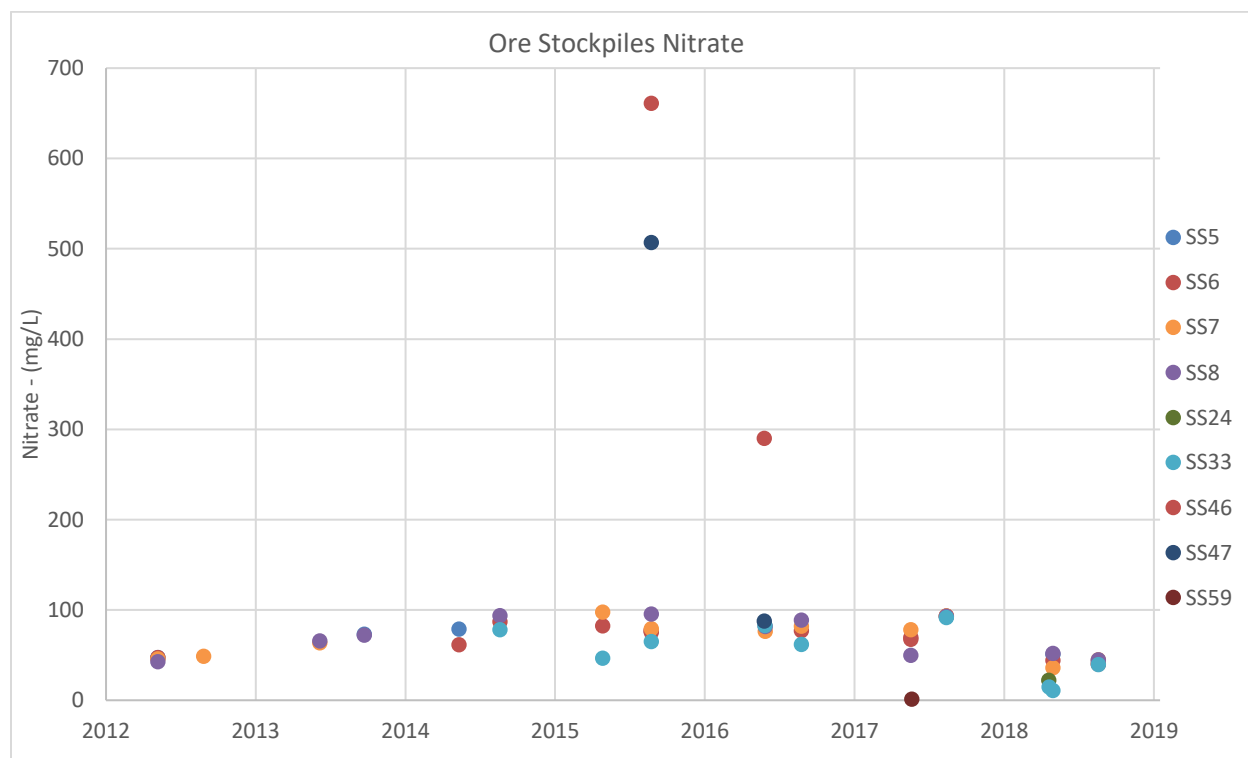


Figure 7-71: Ore Stockpile Sites - Dissolved Nitrate

7.7 Reclamation Overburden Dump (ROD)

All sites along the ROD were observed to be dry during the 2014, 2015, 2016 and 2017 surveys. In the 2017 Seepage Monitoring Survey, no water samples were collected from the ROD sites SS2, SS3, SS11, SS14, and SS15, the survey here was proposed to be canceled in 2017 reporting and therefore, in 2018 the ROD was not surveyed.

7.8 Main Waste Dump

A new seep was discovered along the toe of the Minto North Pit access road close to the Minto North Pit during the spring survey, it was labelled SS101. Furthermore, a new seep at the South end of the Main Waste Dump (MWD) was discovered during the fall survey, it was sampled twice during the fall, it was labelled SS102. The other existing seep (SS12) was observed to be dry during both sampling events in 2018. Historical data is presented in Figure 7-72 through Figure 7-78 and include water quality results for dissolved copper, dissolved cadmium, dissolved iron, dissolved selenium, and nutrient levels for ammonia, nitrite, and nitrate.

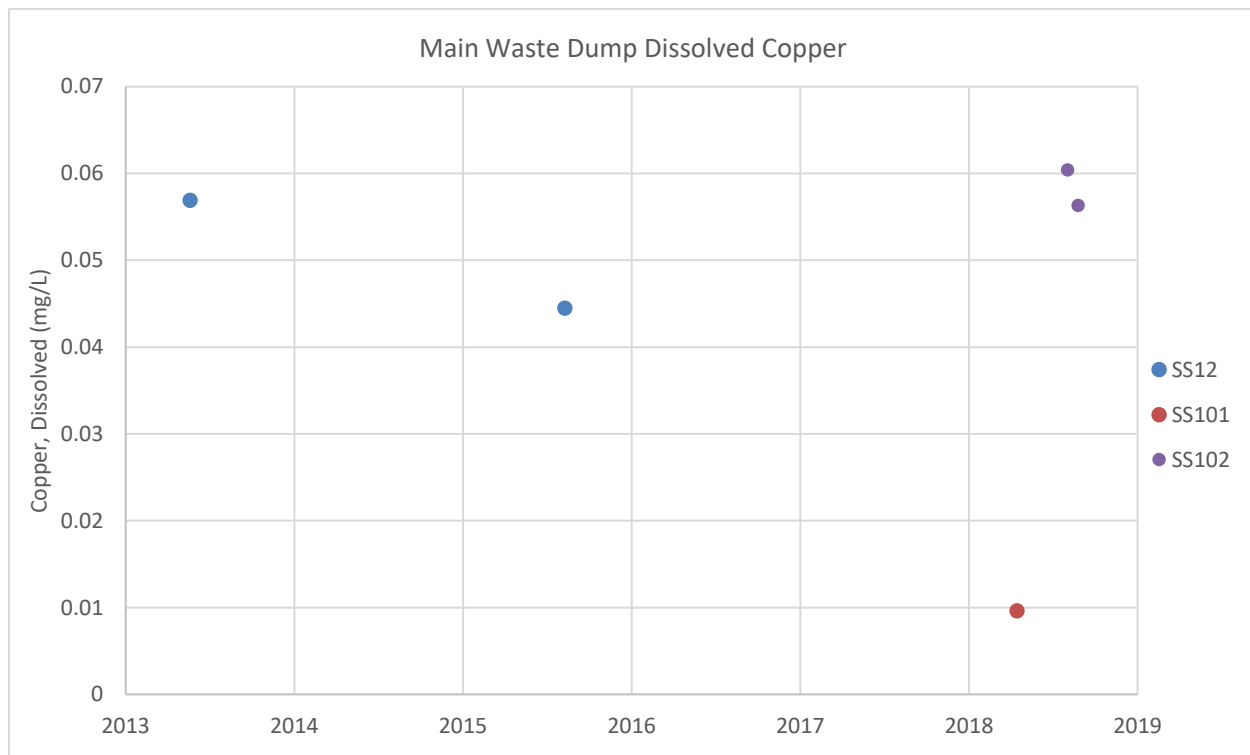


Figure 7-72: Main Waste Dump Sites - Dissolved Copper

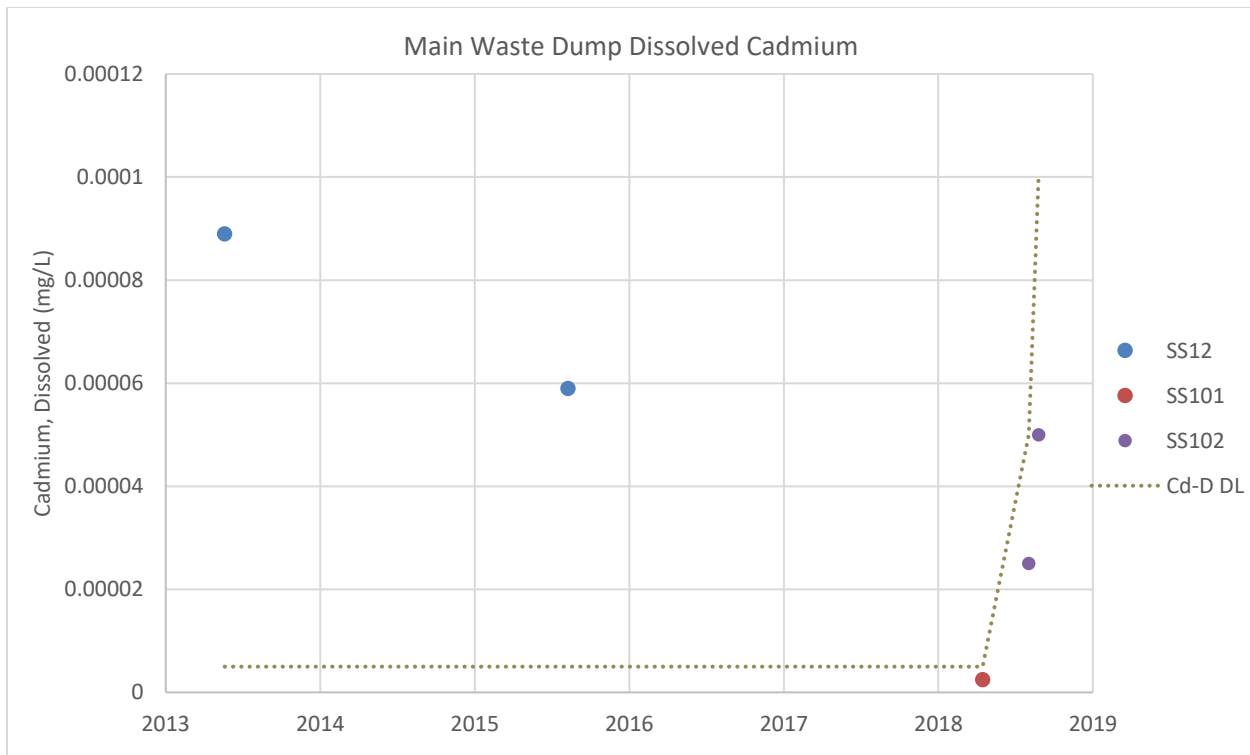


Figure 7-73: Main Waste Dump Sites - Dissolved Cadmium

DL is Analytical Detection Limit

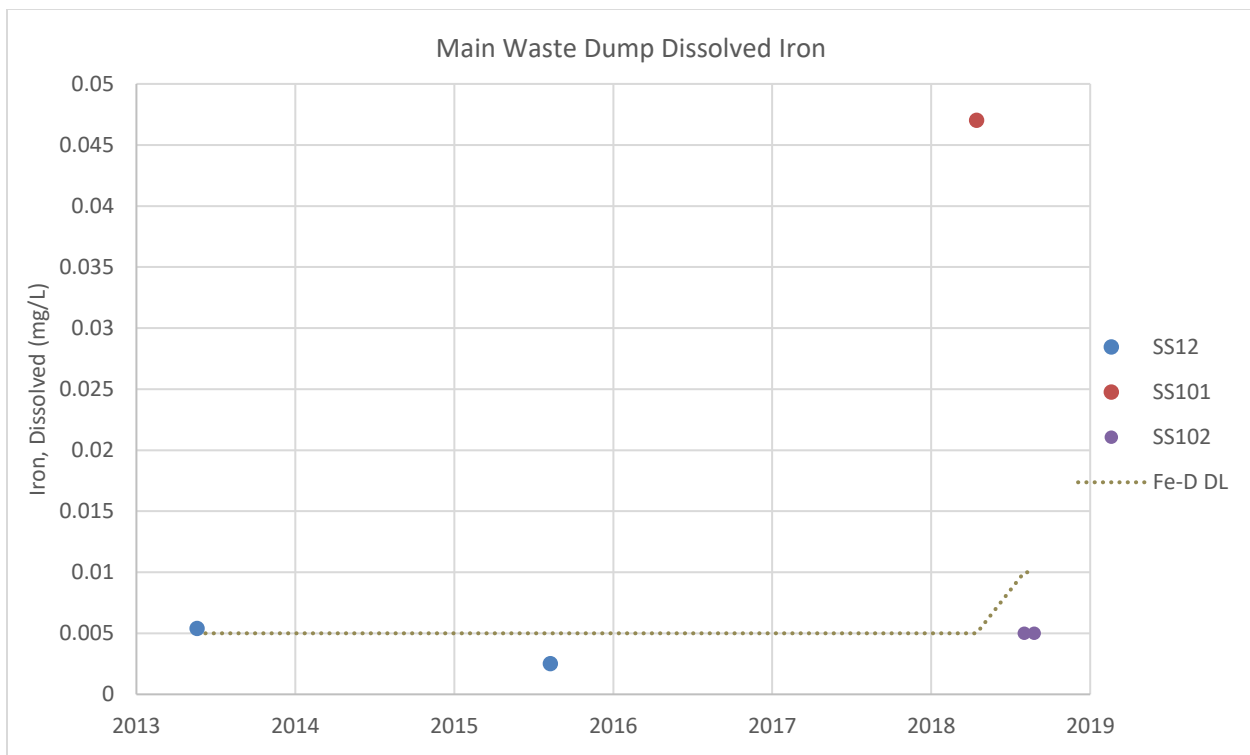


Figure 7-74: Main Waste Dump Sites - Dissolved Iron

DL is Analytical Detection Limit

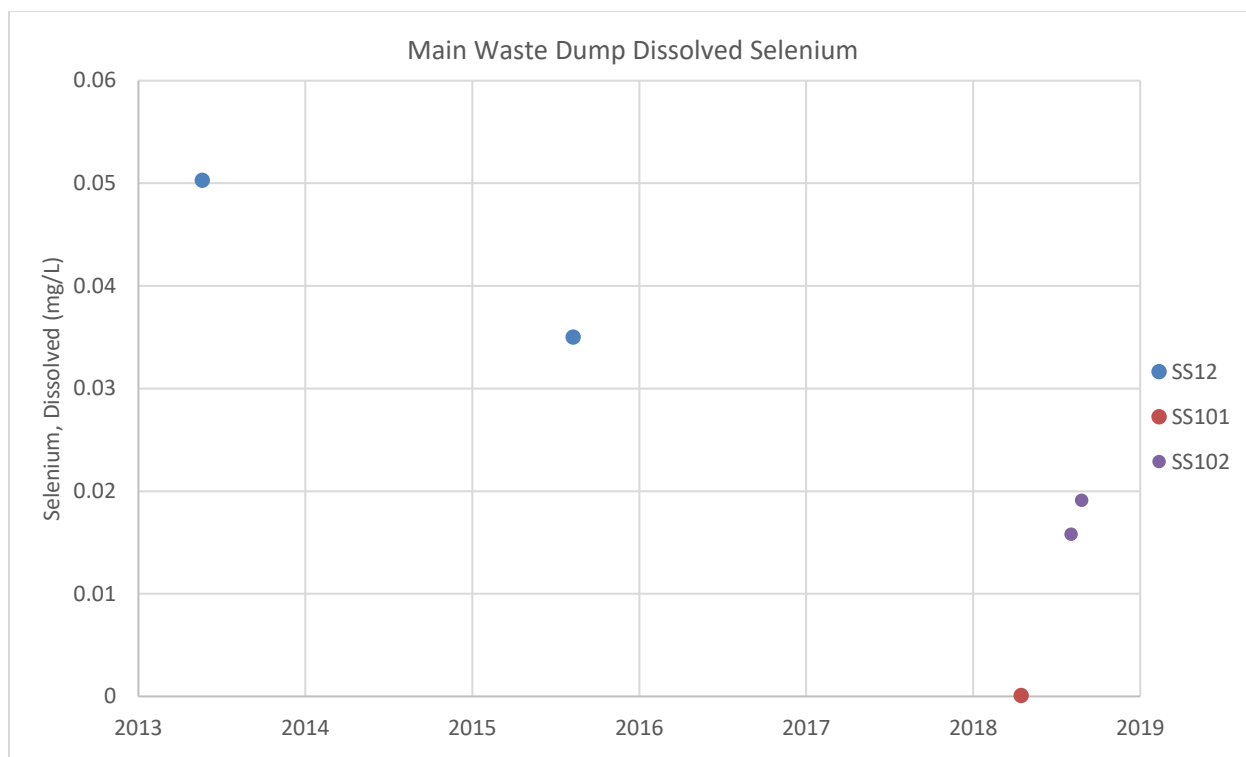


Figure 7-75: Main Waste Dump Sites - Dissolved Selenium

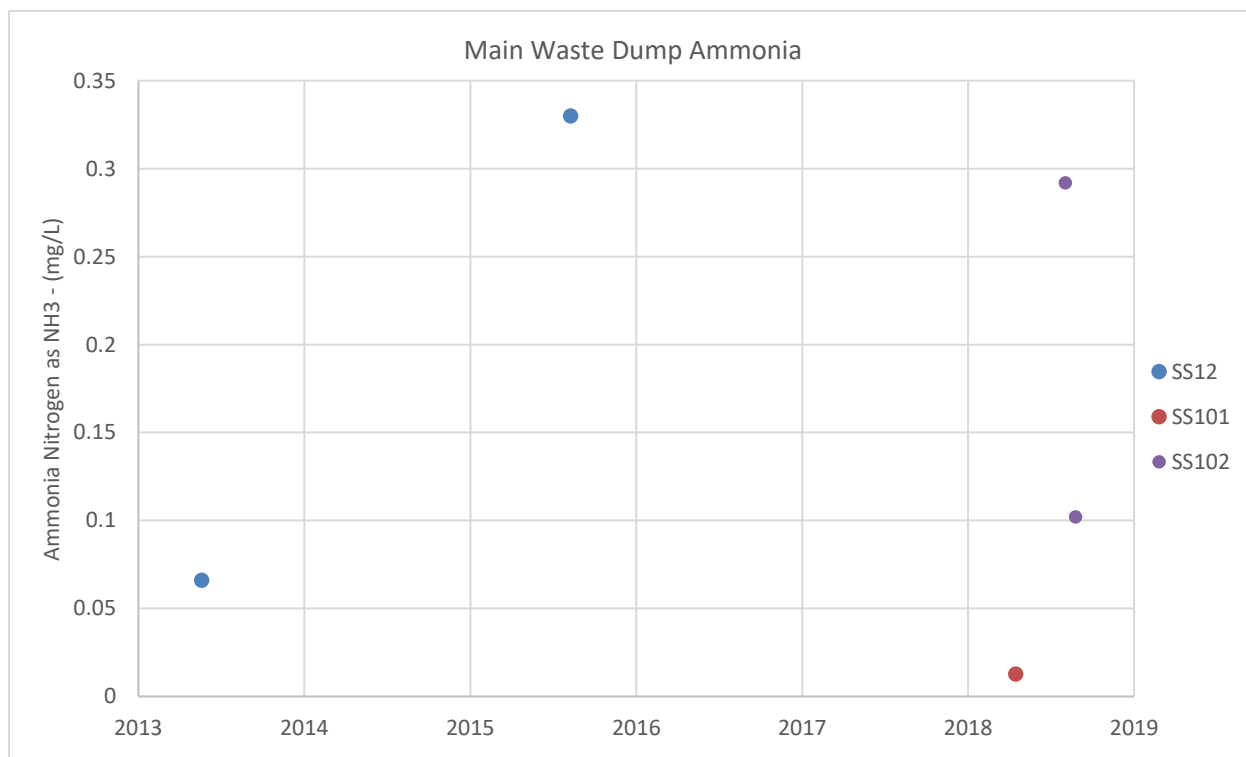


Figure 7-76: Main Waste Dump Sites - Ammonia

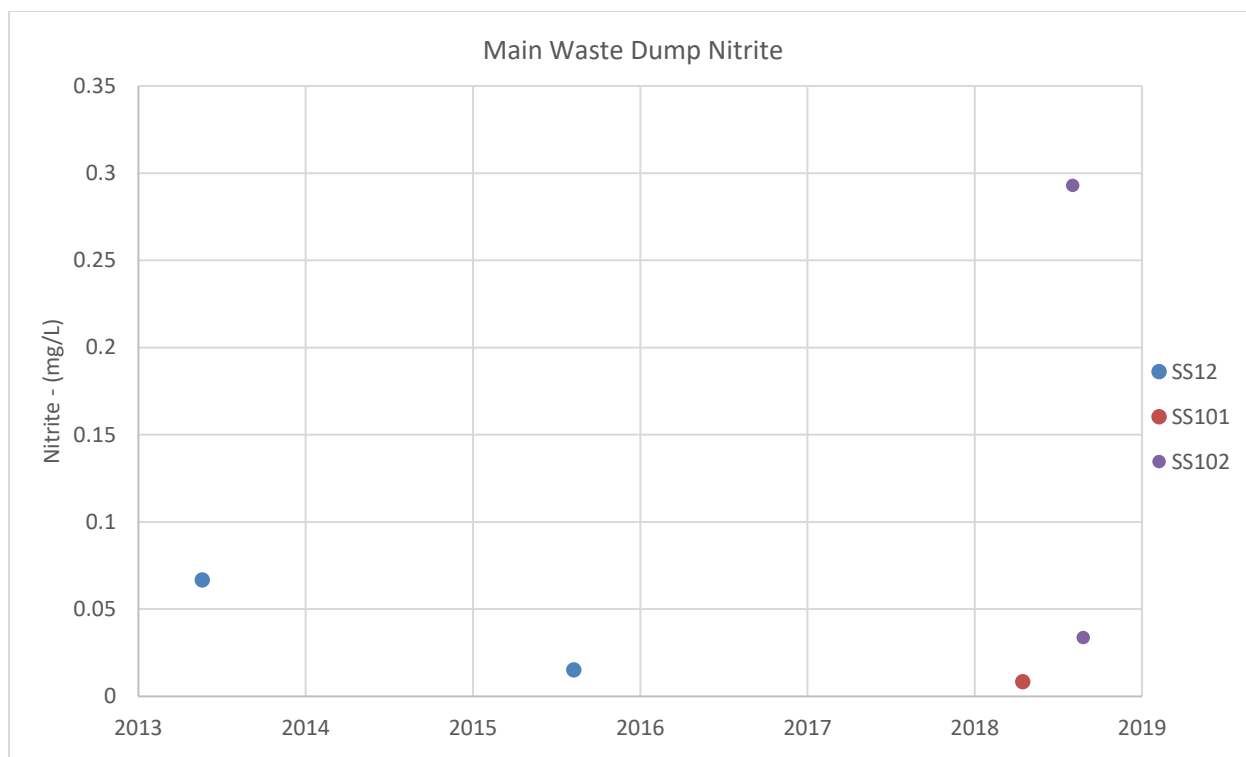


Figure 7-77: Main Waste Dump Sites - Nitrite

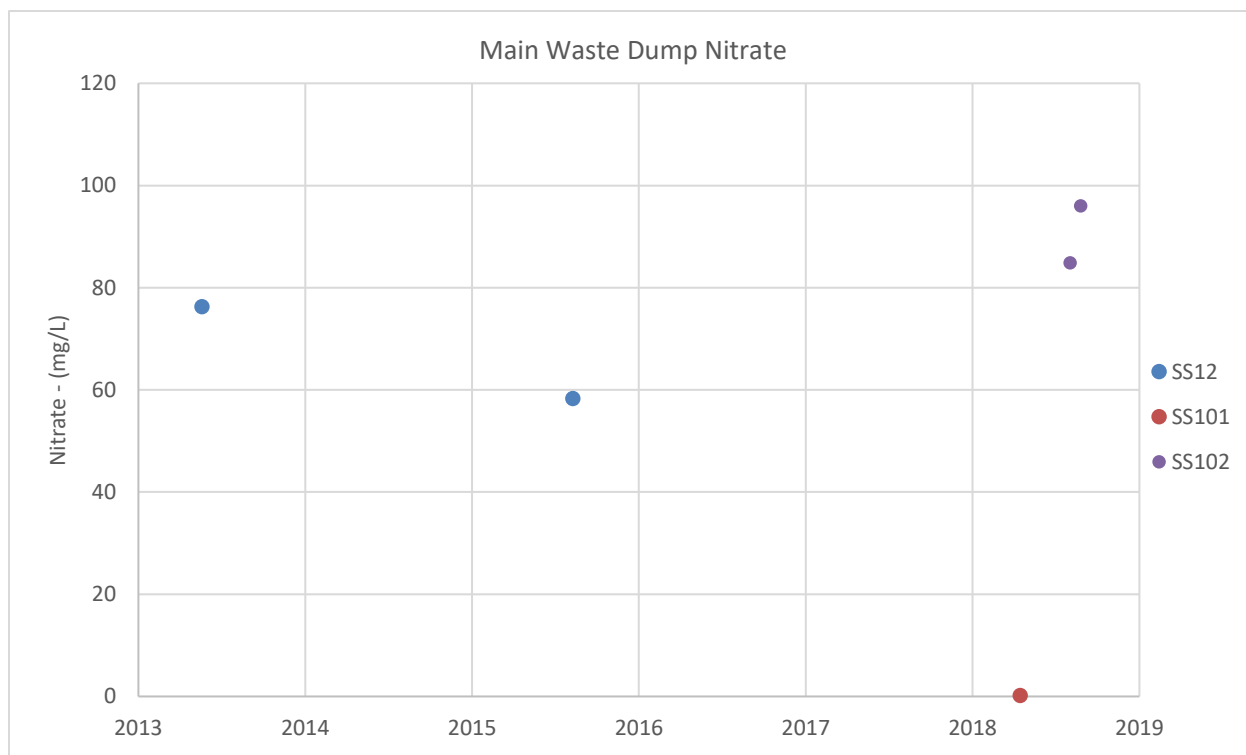


Figure 7-78: Main Waste Dump Sites - Nitrate

7.9 Mill Area

SS32 was discovered in 2014 behind the camp along the mill area survey route. SS32 was sampled in both the spring and fall of 2018 and the results for dissolved copper, dissolved cadmium, dissolved iron, dissolved selenium, and nutrient levels for ammonia, nitrite, and nitrate are displayed in Figure 7-79 through Figure 7-85 along with historical results. No other seeps were identified along the toe of the north ridge behind the camp and mill.

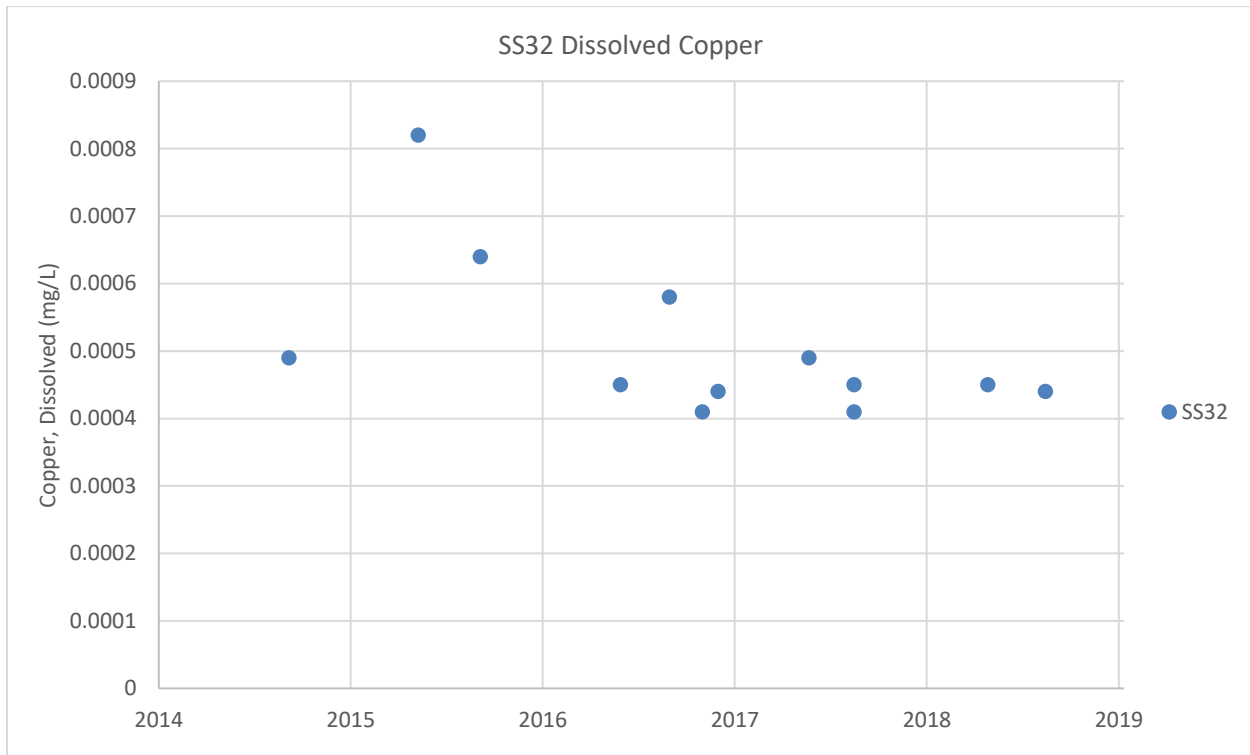


Figure 7-79: SS32 Dissolved Copper

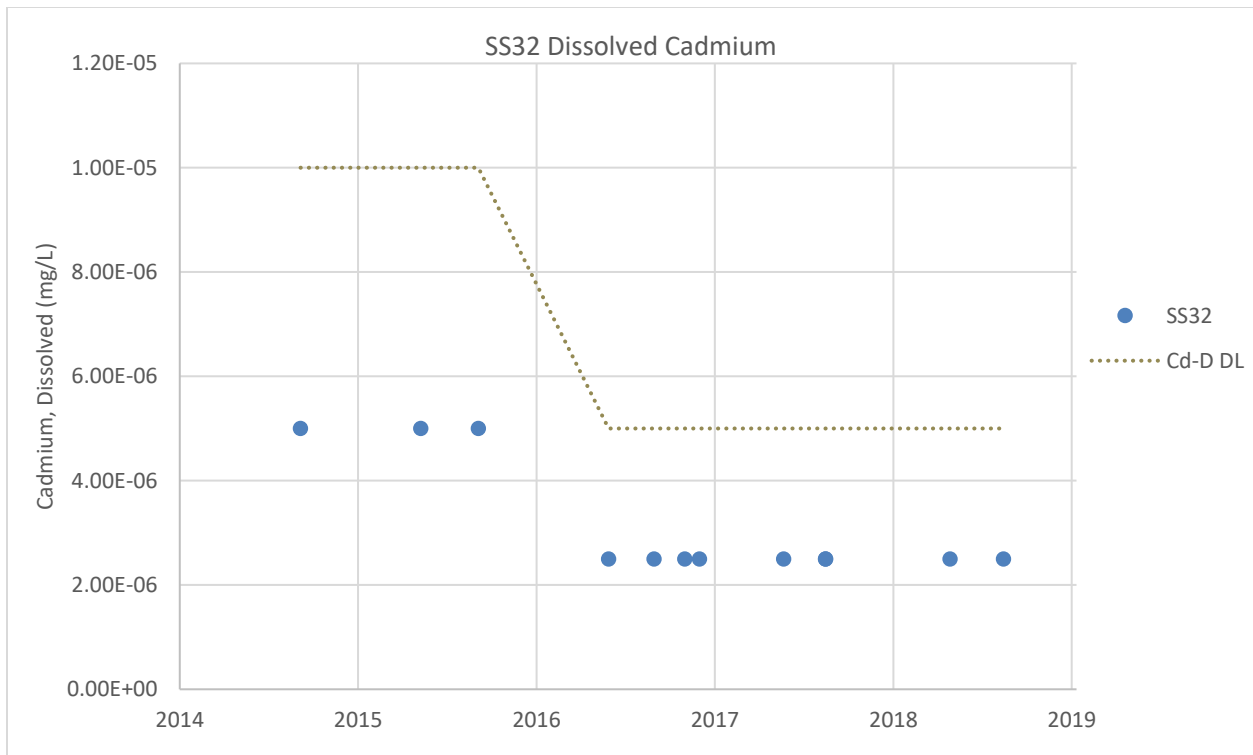


Figure 7-80: SS32 Dissolved Cadmium

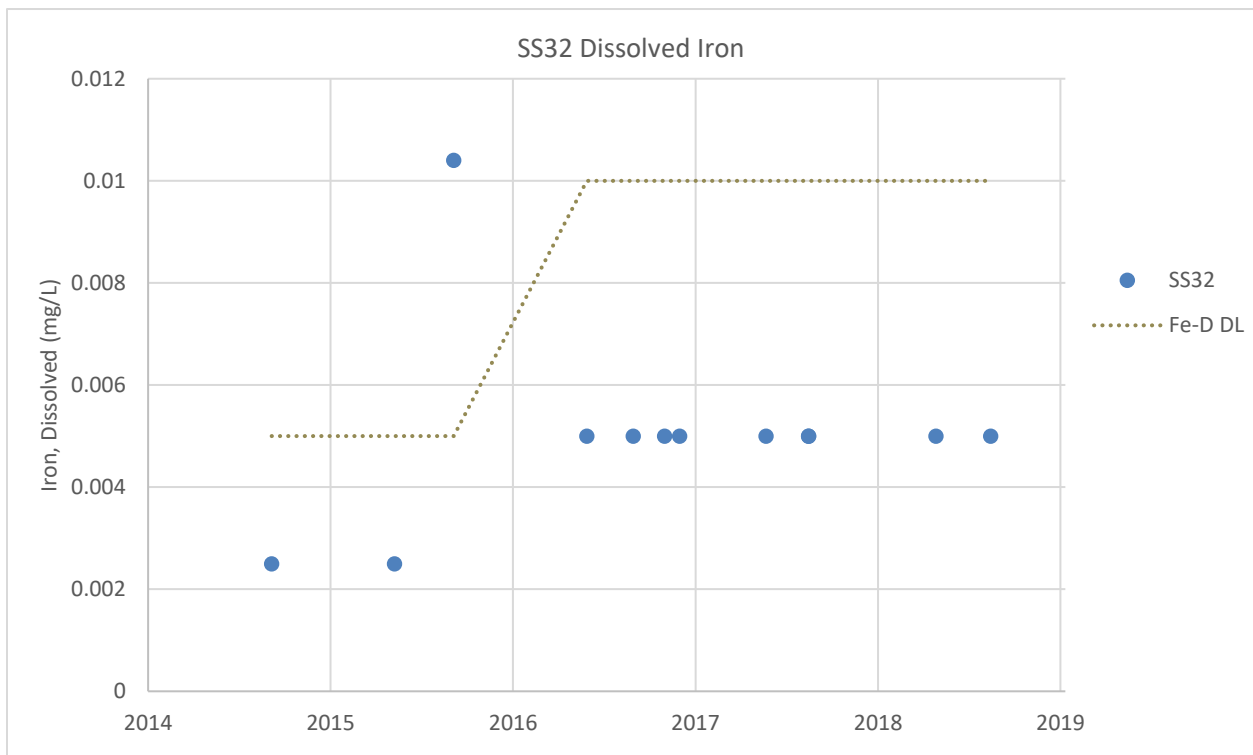


Figure 7-81: SS32 Dissolved Iron

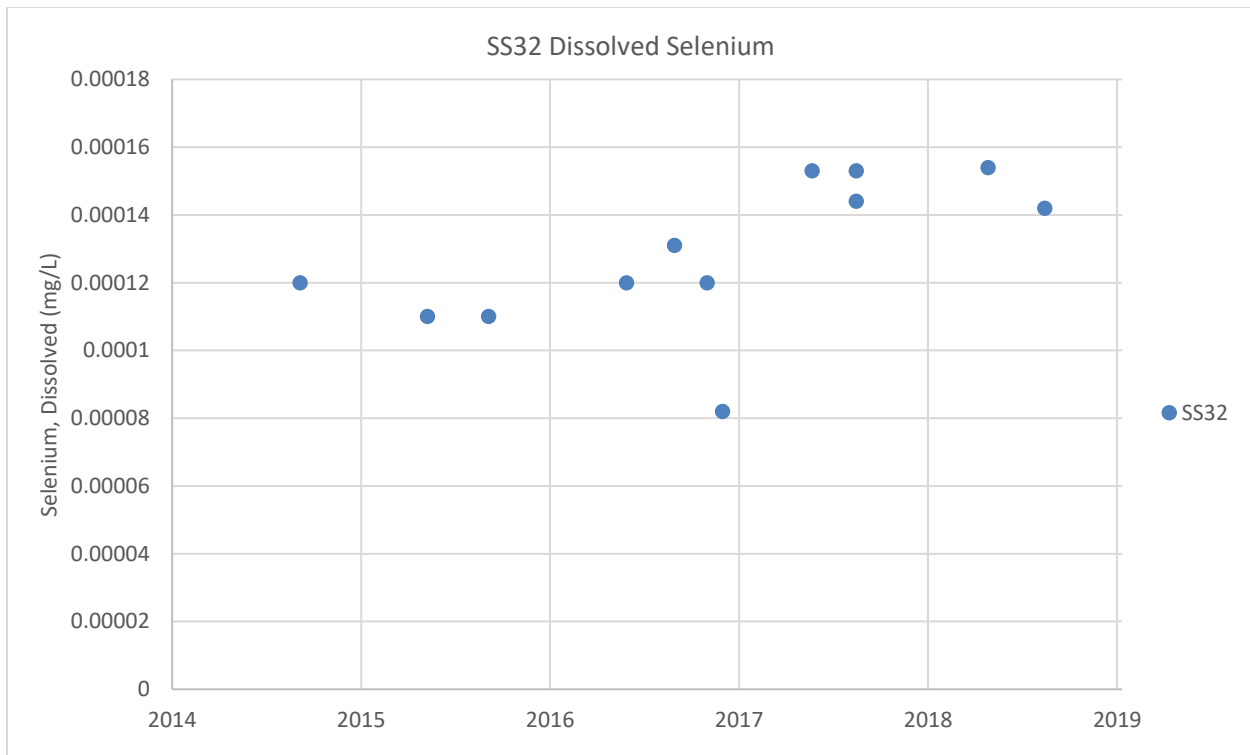


Figure 7-82: SS32 Dissolved Selenium

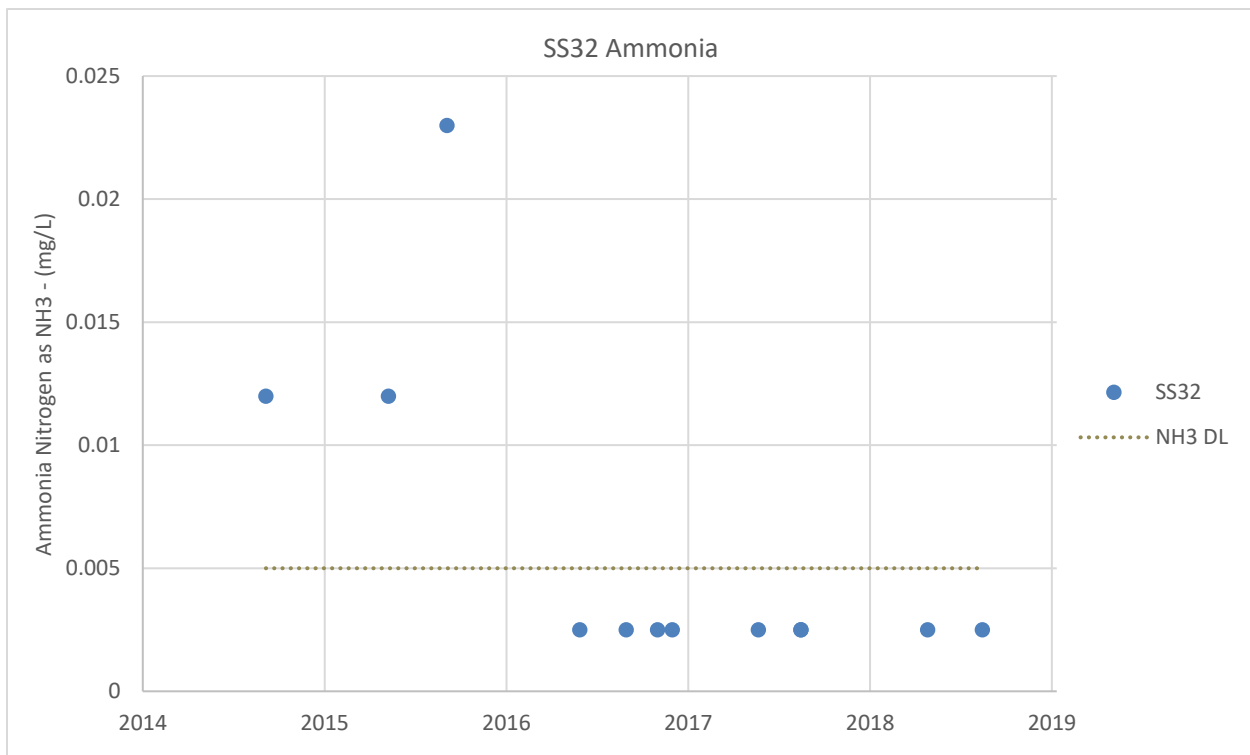


Figure 7-83: SS32 Ammonia

DL is Analytical Detection Limit

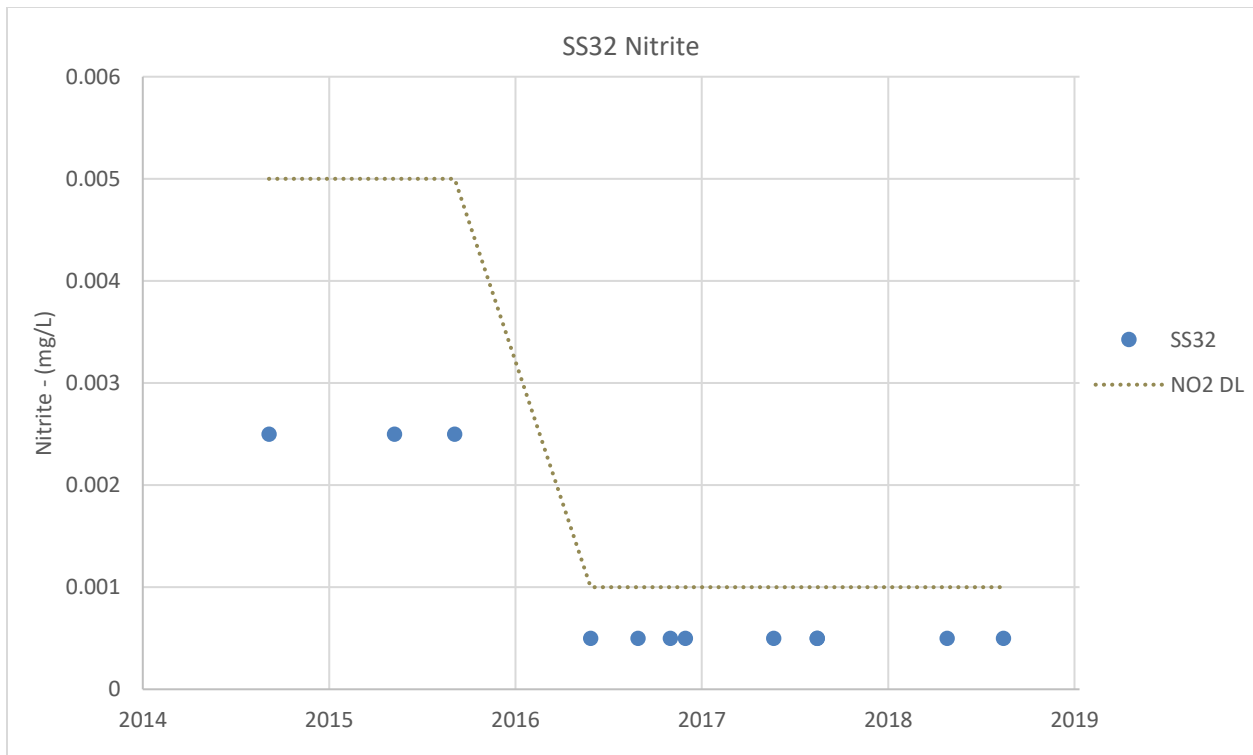


Figure 7-84: SS32 Nitrite

DL is Analytical Detection Limit

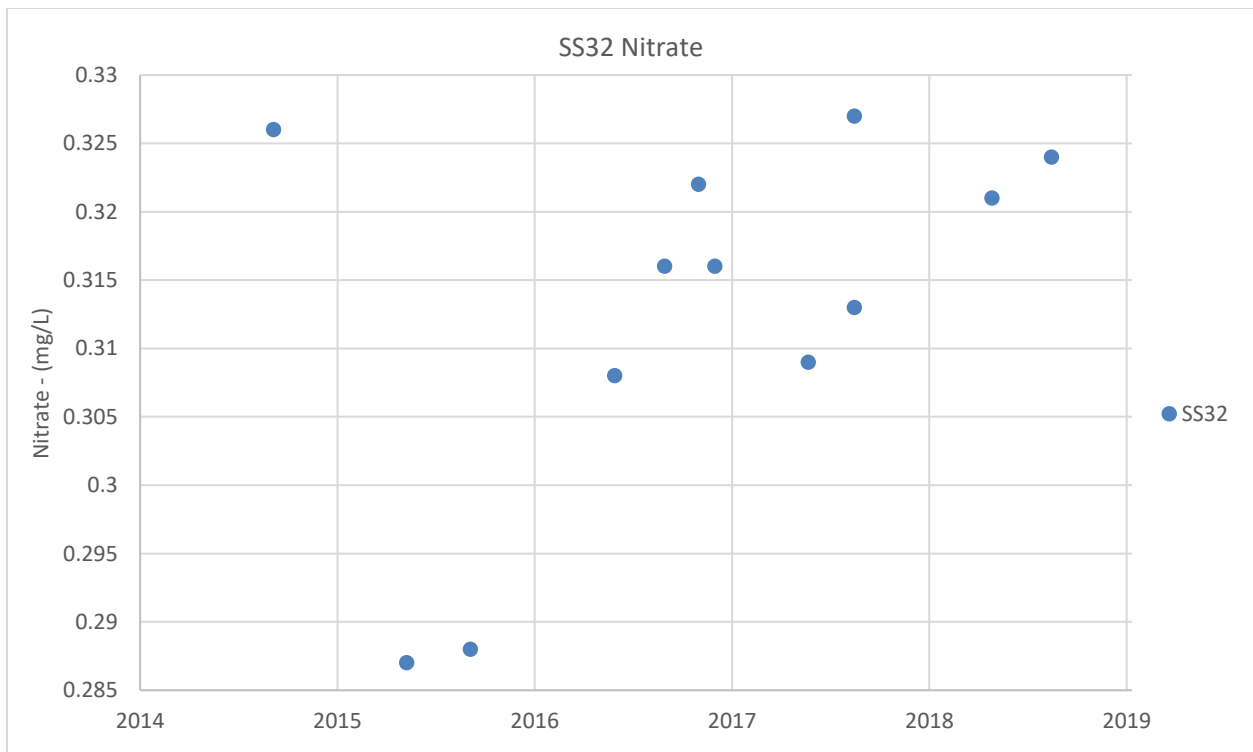


Figure 7-85: SS32 Nitrate

7.10 Ridgetop Road

A survey was conducted along the toe of the new Ridgetop Road, site SS58 was found flowing during the spring survey. As well as W33s seep replacing the W33 site. W33s was sampled monthly during active months. The results for dissolved copper, dissolved cadmium, dissolved iron, dissolved selenium, and nutrient levels for ammonia, nitrite, and nitrate are displayed in Figure 7-86 through Figure 7-93 along with historical results of other sites within this area. No other seeps were identified along the toe of the road.

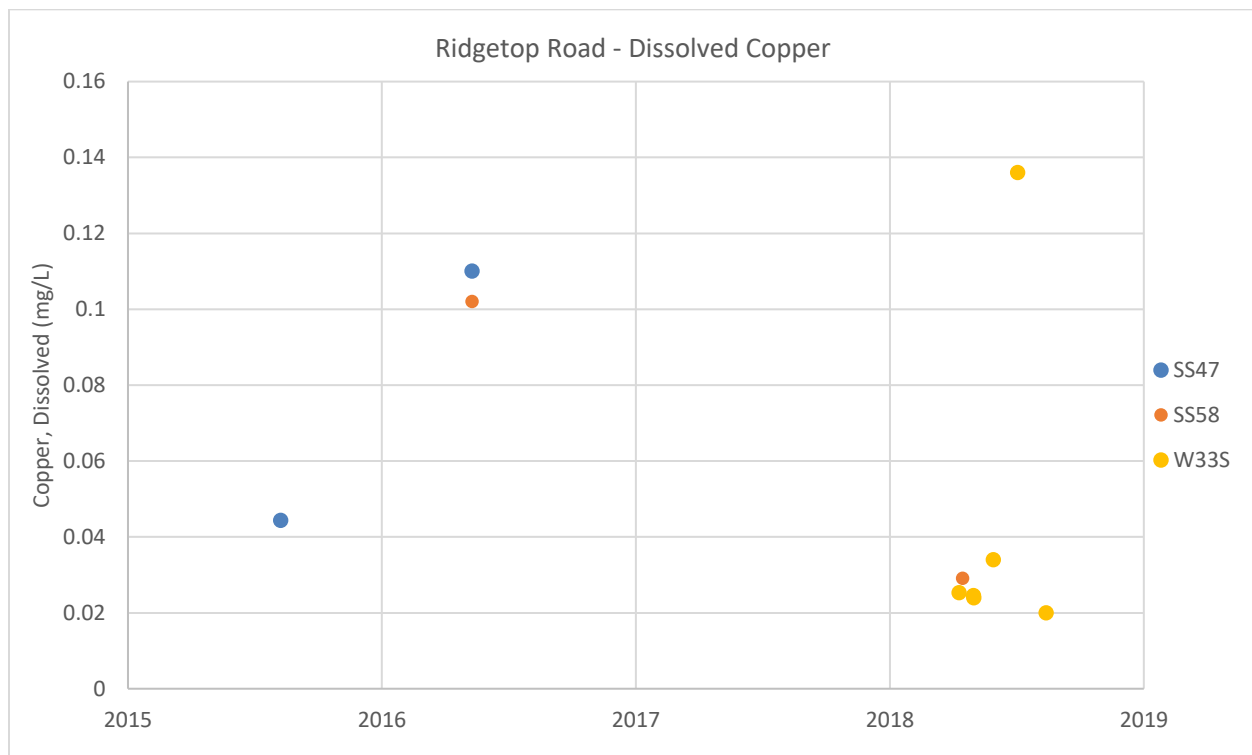


Figure 7-86: Ridgetop Road Sites - Dissolved Copper

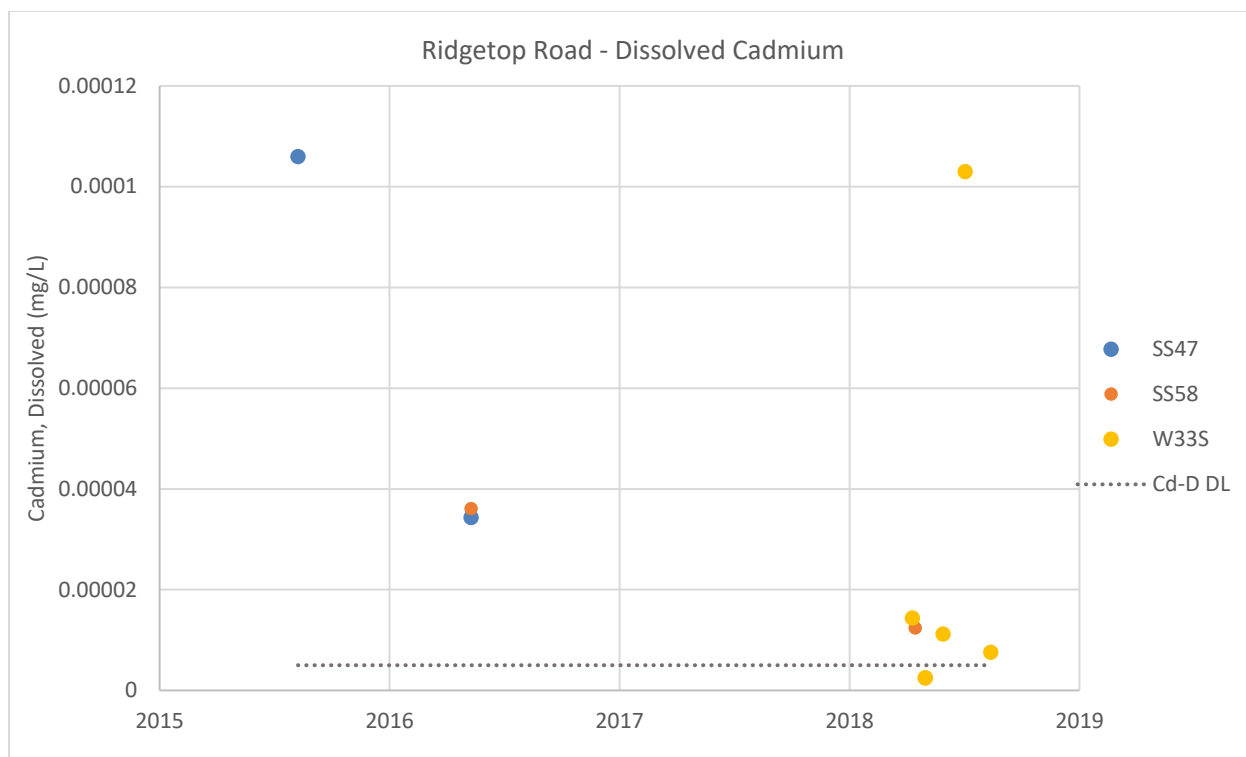


Figure 7-87: Ridgetop Road Sites - Dissolved Cadmium

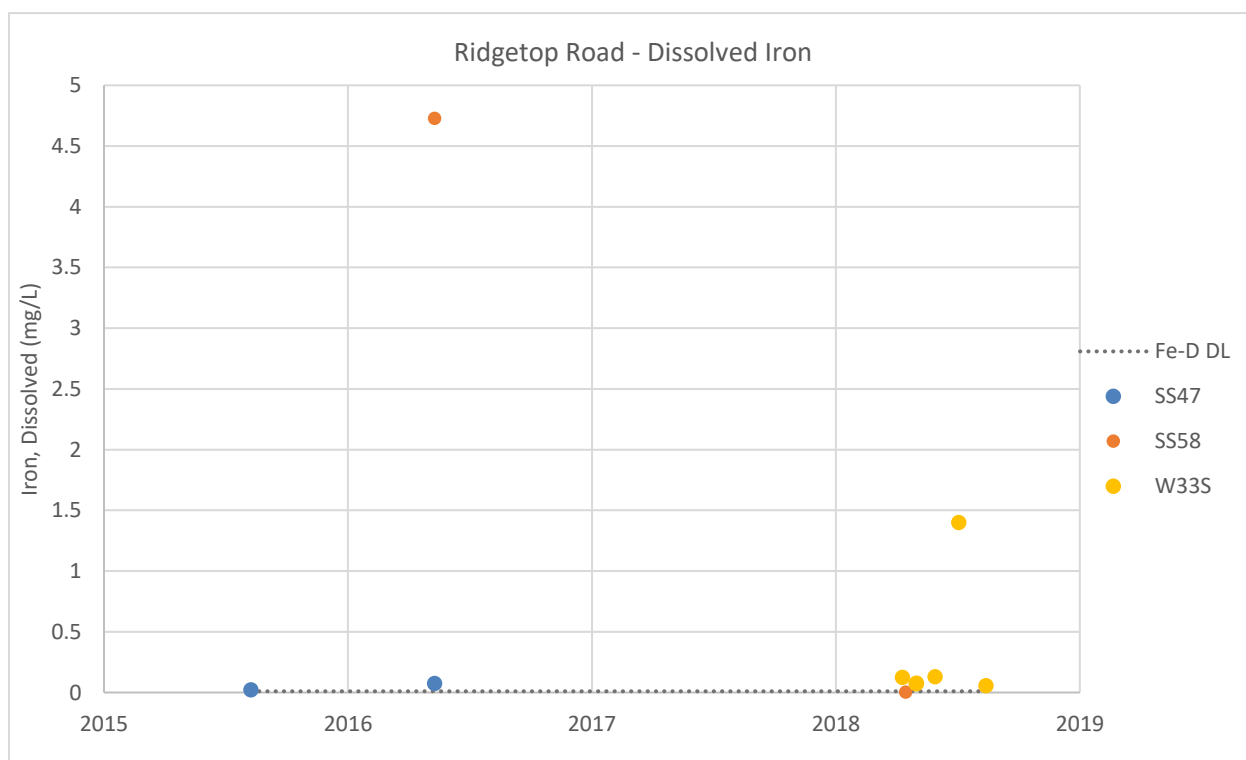


Figure 7-88: Ridgetop Road Sites - Dissolved Iron

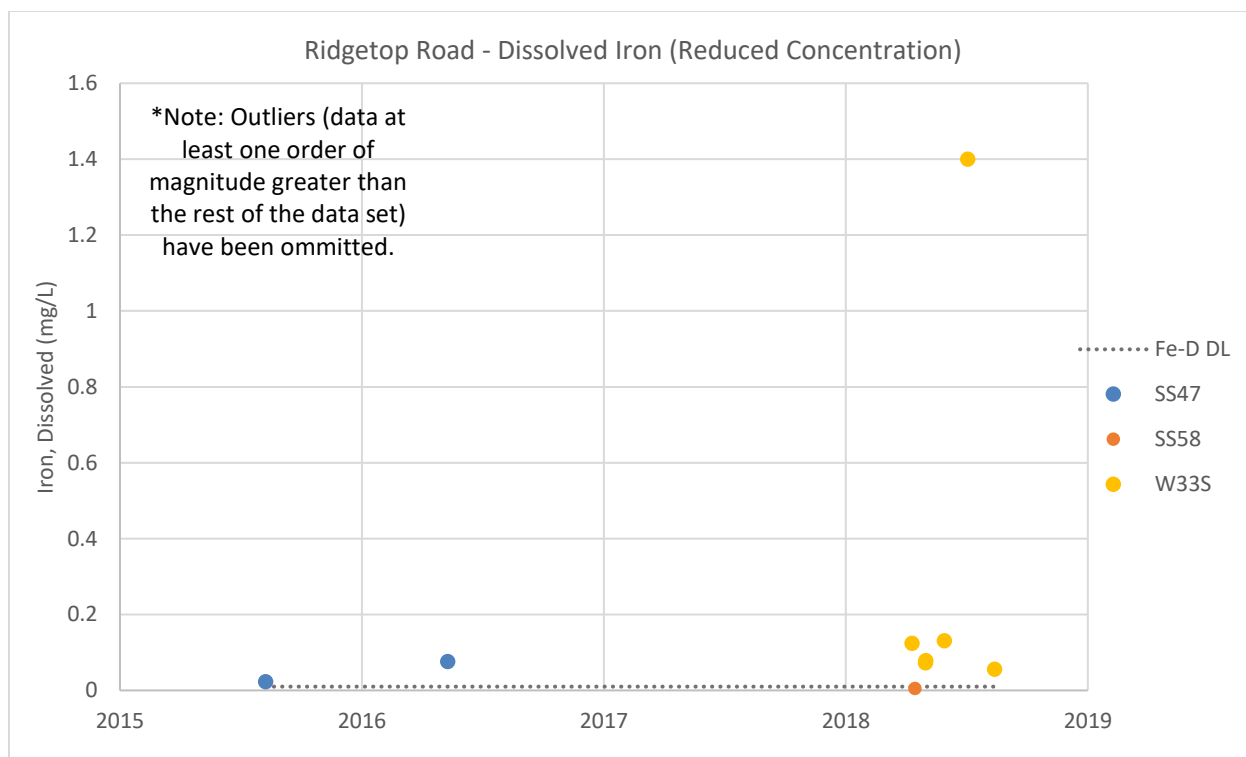


Figure 7-89: Ridgetop Road Sites - Dissolved Iron (Reduced Concentration)

DL is Analytical Detection Limit

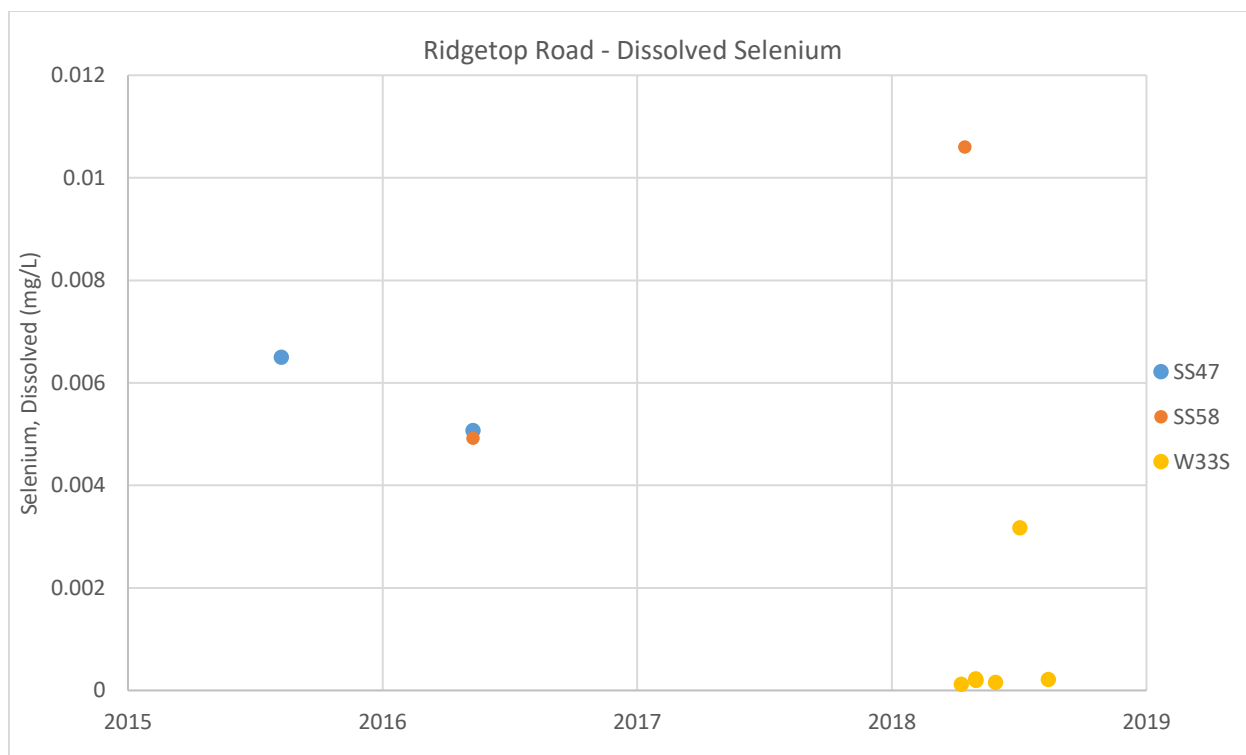


Figure 7-90: Ridgetop Road Sites - Dissolved Selenium

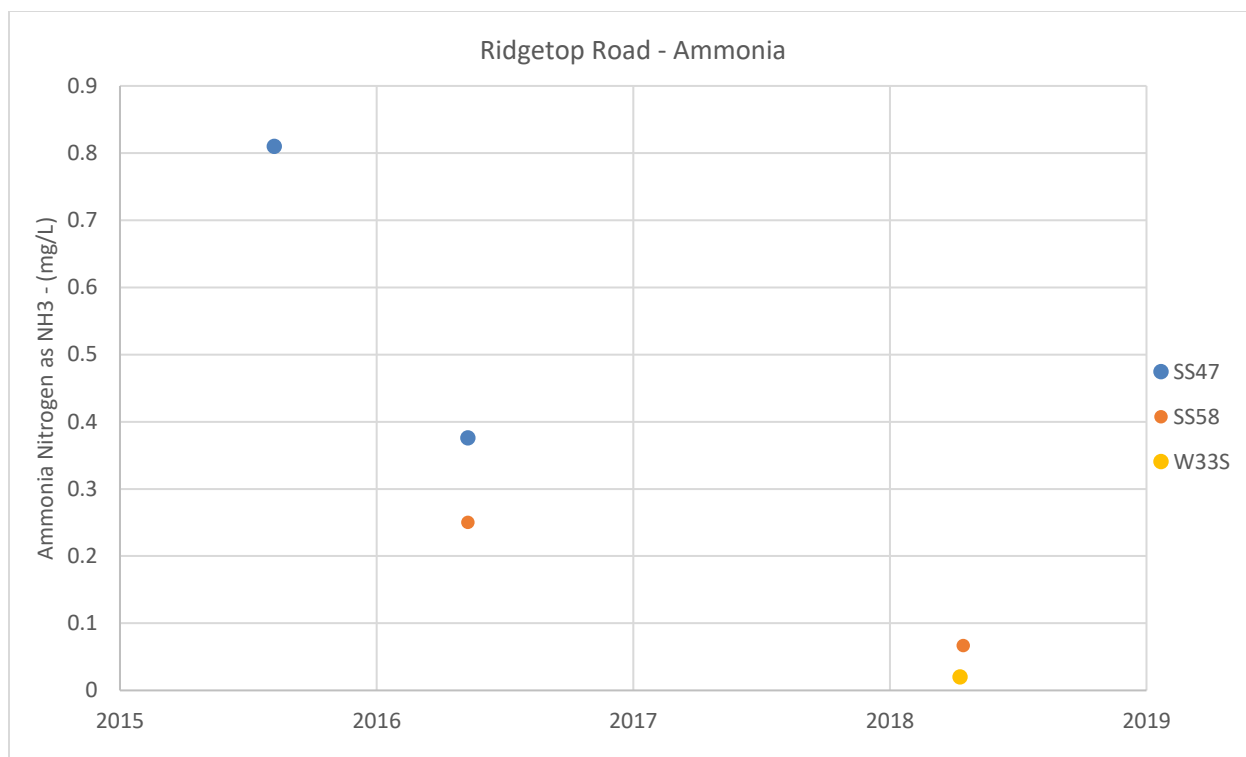


Figure 7-91: Ridgetop Road Sites – Ammonia

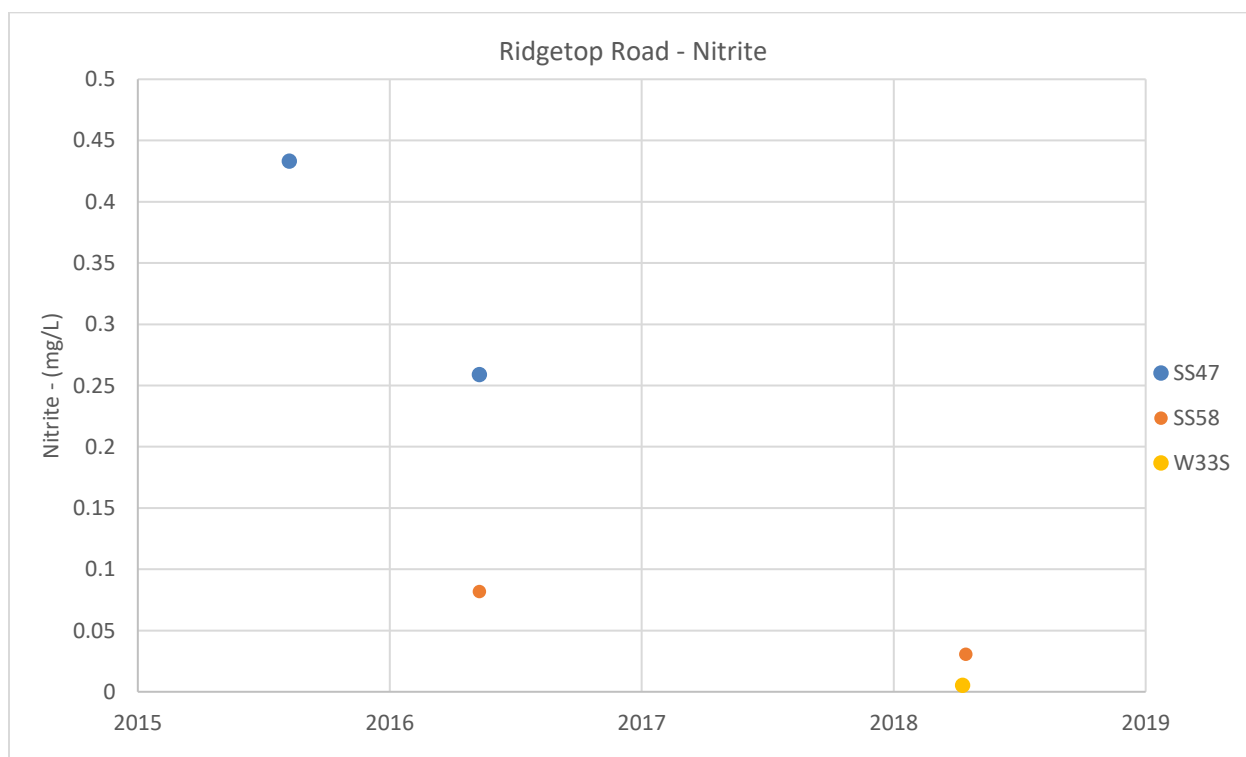


Figure 7-92: Ridgetop Road Site - Nitrite

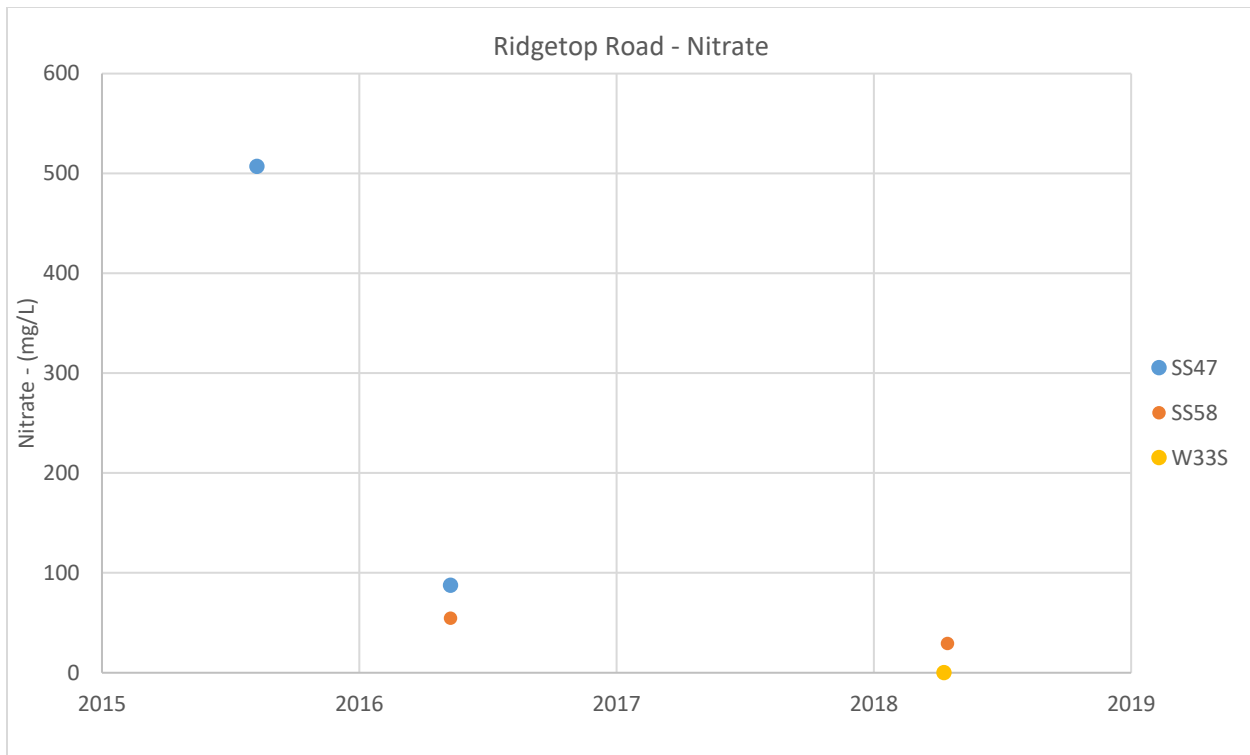


Figure 7-93: Ridgetop Road Sites - Nitrate

7.11 Walls

Seepage monitoring could not be conducted at the pit walls of the Main Pit, Area 2 Pit, and Minto North Pit; all pits were too unsafe to access during the 2018 surveys due to geotechnical instability. Records were taken for each pit where seeps were observable from a distance. See Appendix D for photographic records.

8 Water Management

The water balance for the Minto Mine forms the basis of the water management strategy at the site. The water management strategy at the site is for conveyance structures to either divert or release clean surface water or direct impacted water to the Main Pit and eventually treatment.

The Minto Mine generally has a positive water balance, meaning that the site-wide annual runoff is greater than the volume of water required to operate the mine. Therefore, it is necessary to release water to Minto Creek. In the event surface runoff does not meet the discharge limits stipulated in the WUL, Minto Mine has the ability to treat and release water using a combination of active treatment, conveyance structures and water storage features. The following sections will summarize water treatment, conveyance and storage during the reporting period.

8.1 Water Storage and Conveyance Network

There were no major changes to Minto's conveyance structures in 2018.

The strategy for managing the mine water inventory was unchanged in 2018, and the water conveyance network is illustrated in Figure 8-1. Compliant (clean) surface water was collected and diverted to the WSP, and subsequently discharged to Minto Creek thru W16A. Runoff from developed mine areas (mine water) was collected and stored in the Main Pit and Area 2 Pit, and was used for ore processing, deposition of tailings. The Water Treatment Plant was not required in 2018 to maintain water at target levels.

In November 2017, the Main Pit and Area 2 Pit volume calculations were updated with current survey data to reflect changes in tailings and rock deposition from the previous bathymetry survey, these calculations remained the same throughout 2018.

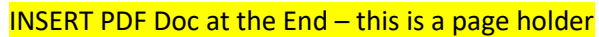


Figure 8-1: Minto Mine Water Conveyance Network (2018)

8.2 Water Storage Volumes Movement and Tracking

Water movement is tracked with flow meters on site, monitored and inspected on a weekly basis. Tables 8-1 to 8-5 provide a summary of water volumes moved by conveyance structures around site in 2018. Please note that the total and net volume for each facility (WSP, MPTMF, A2PTMF) in the following tables only account for flow meter totals and do not account for evaporation and other losses/inputs.

Table 8-1: Water Storage Pond (WSP) Conveyance for 2018

WSP		
Input Volume (m ³)		Total
W15	57,308	130,270
W35	43,882	
WTP	0	
W17	29,080	
Output Volume (m ³)		Total
WTP	0	55,924
Minto Creek (Environment)	26,844	
W17 seepage	29,080	
Net		74,346

Table 8-2: Main Pit Conveyance for 2018

Main Pit		
Input Volume (m ³)		Total
W62	105,988	1,124,839
Minto North	0	
Area 2 Pit	659,676	
W15	77,767	
UG4	113,486	
W35	0	
Mill	167,922	
Output Volume (m ³)		Total
Mill	1,221,022	1,221,022
Net		-96,183

Table 8-3: Area 2 Pit Conveyance for 2018

Area 2 Pit		
Input Volume (m ³)		Total
UG1	163,406	1,274,037
W35	28,016	
Mill	1,074,983	
W51	7,632	
Output Volume (m ³)		Total
Main Pit	659,676	659,676
Net		614,361

Table 8-4: Water Truck Deliveries on Site for 2018

Water Trucks		Total (m ³)
Drills	132	766
Nuway/ Mill crusher	105	
Pit (for cleaning)	141	
Steamer trailer	6	
Core shack	1	
Driftwood	40	
Dust Suppression	340	

The reported volumes are estimates only.

Table 8-5: Well Usage in 2018

Wells		Total (m ³)
Camp	7,751	8,094
ERT	343	

8.2.1 Water Conveyance Tracking

Diversion of W35 water (TDD): Water was diverted from the south catchment (collected at station W35) to the Main Pit and the WSP. An estimated total of 51,670 m³ moved through the TDD in 2018 as measured by a Mace FloSeries® 3 open pipe flow measuring device.

Diversion of W15 water: The W15 sump collects surface runoff from adjacent undisturbed catchments, the SWD and part of the MWD. A total of 289,012 m³ was conveyed through the W15 conveyance structure to the WSP in 2018. The W15 flows were measured and recorded using a Seametrics® mag flow meter with digital head relay module.

Pump Back of W62 water (MVFES2 Sump): Water collected downstream of the mill area, ore stockpiles and DSTSF is collected at the MVFES2 Sump (which replaced the MCDS in 2016) and is pumped back to the Main Pit. A total of 105,988 m³ was conveyed through this structure in 2018. The flow volumes were measured and recorded using a Seametrics® mag flow meter with digital head relay module.

8.2.2 Water Storage Tracking

Water storage on site is monitored for Minto reservoirs which include the Main Pit, the Area 2 Pit, their respective tailings management facilities, the Water Storage Pond (WSP), the Minto North Pit, and the Area 2 Stage 3. Appendix E provides a more comprehensive analysis of water movement, but presented below, Tables 8-7a - 8-7e, provide a summary of their year-end storage volumes and the site-wide water yield.

Main Pit: The Main Pit was used as a reservoir to support the following: water use for the Mill process; collection of impacted runoff; supply feed water to the water treatment plant; and receive water from Area 2 Pit.

Area 2 Pit: The Area 2 Pit was used to support the following: supply water to the Mill via the Main Pit; collection of impacted site water; receiving water/tailings from the Mill.

WSP: The WSP worked effectively as a storage location for un-impacted water and maintained the water quality below effluent quality standards.

Table 8-7a: Main Pit Storage Inventory, 2018

Date	MPTMF Volume Occupied (Water + Tailings)	Change in MPTMF Water Inventory	Tailings Solids Deposition in MPTMF
Month-Year	m ³	m ³ /month	BCM/month
Jan-18	838,076	NA	0
Feb-18	825,551	-12,525	0
Mar-18	793,031	-32,521	0
Apr-18	704,656	-88,374	0
May-18	803,827	99,170	0
Jun-18	795,623	-8,203	0
Jul-18	785,290	-10,333	0
Aug-18	757,760	-27,530	0
Sep-18	707,210	-50,550	0
Oct-18	694,246	-12,964	0
Nov-18	705,096	10,850	0
Dec-18	752,857	47,761	0
SUM		-85,219	0

Table 8-7b: Area 2 Pit Storage Inventory, 2018

Date	A2PTMF Volume Occupied (Water + Tailings)	Change in A2PTMF Water Inventory	Tailings Solids Deposition in A2PTMF
Month-Year	m ³	m ³ /month	*monthly volumes unavailable
Jan-18	1,263,912	NA	NA
Feb-18	1,373,425	109,514	NA
Mar-18	1,477,914	104,489	NA
Apr-18	1,598,605	120,691	NA
May-18	1,591,567	-7,038	NA
Jun-18	1,598,605	7,038	NA
Jul-18	1,606,398	7,793	NA
Aug-18	1,611,155	4,757	NA
Sep-18	1,559,794	-51,361	NA
Oct-18	1,559,793	-1	NA
Nov-18	1,628,516	68,723	NA
Dec-18	1,597,639	-30,877	NA
SUM		333,727	*879,417

Table 8-7c: WSP Storage Inventory, 2018

Date	WSP Volume	Change in WSP Water Inventory
Month-Year	m ³	m ³ /month
Jan-18	64,942	NA
Feb-18	60,557	-4,386
Mar-18	55,926	-4,631
Apr-18	64,906	8,980
May-18	81,400	16,494
Jun-18	89,948	8,548
Jul-18	86,248	-3,700
Aug-18	92,863	6,615
Sep-18	91,022	-1,841
Oct-18	87,924	-3,098
Nov-18	83,317	-4,607
Dec-18	80,875	-2,442
SUM		15,933

Table 8-7d: Area 2-Stage 3 Water Storage Inventory, 2018

Date	A2S3PTMF Volume Occupied (Water + Tailings)	Change in A2S3PTMF Water Inventory
Month-Year	m ³	m ³ /month
Jan-18	NA	NA
Feb-18	NA	0
Mar-18	NA	0
Apr-18	NA	0
May-18	117,022	117,022
Jun-18	152,098	35,076
Jul-18	NA	NA
Aug-18	378,878	226,780
Sep-18	NA	NA
Oct-18	437,643	58,765
Nov-18	NA	NA
Dec-18	507,104	69,460
SUM		507,104

Table 8-7e: Minto Mine Total Site Storage Yield, 2018

	Units	Main Pit TMF	Area 2 Pit TMF	WSP	Area 2 Stage 3
Volume Change 2018 (water + tailings)	m ³	-85,219	333,727	15,933	507,104
Tailings Deposited, total	BCM	0	879,417	0	0
Water Volume Change 2018	m ³	-85,219	-545,690	15,933	507,104
Estimated Groundwater Inflow	m ³	0	30,000	0	0
Total Water Inventory Change in 2018	m³	-107,872			
Total Water Discharged to Minto Creek	m ³	26,844			
Total Site-Wide Yield in 2018	m³	-81,028			

8.2.3 Water Conveyance Construction

Maintenance activities consisted of routine maintenance on water conveyance structures. In September 2018, the TDD tie-in was nearly completed with some additional work to be completed in 2019.

8.2.4 Water Balance and Water Quality Predictions Modeling

As per the WUL Clause 108, Minto is required to update the Water Balance and Water Quality Model. Minto retained SRK Consulting to complete a 2018 site water balance and water quality prediction model update. An updated 2018 Water Balance and Water Quality Model Summary for the Minto Mine is provided by SRK Consulting in Appendix E.

8.3 Water treatment

Surface runoff that did not meet the WUL effluent standards was directed to the Main Pit or Area 2 pit through the W15 Pipeline, W35, or via the W62 pump back.

Minto has the option of treating for:

- Total suspended solids (TSS) only: clarification;
- TSS, copper and cadmium: clarification and chemical precipitation; or
- All water quality parameters present in the Main Pit: clarification and reverse osmosis (RO).

Water treatment by-products including TSS sludge and RO reject is pumped back to the Main Pit.

8.3.1 Operations Overview

The water treatment plant did not operate in 2018.

8.4 Water Discharge

8.4.1 Discharge Volumes

Minto Mine discharged approximately 26,843 m³ of water to Minto Creek from the WSP via W16A in 2018.

8.4.2 Compliance

As per WUL Clause 6 the rate of water discharge to Minto Creek is calculated based on daily creek flow measurements. The daily discharge volumes are presented below.

The calculated maximum allowable discharge was exceeded on two occasions in 2018. On June 17th the mine discharged 956 m³ while the calculated allowable volume was 912m³. This exceedance was due to human error in reading the daily calculations and was reported in the monthly WUL report. Additionally, on June 21st the mine discharged 558 m³ while the calculated allowable volume was 505 m³. This exceedance was also due to human error in not obtaining a flow reading earlier in the day and not adjusting the flow rate soon enough for the day. This exceedance was also reported in the monthly WUL report. There were no other exceedances for the year. The 2018 daily discharge corrected values are presented in Table 8-8 and is presented graphically in Figure 8-2 below.

Table 8-8: 2018 Discharge Data

Date	Daily flow rate in Minto Creek	Treated water from RO to Minto Creek, day previous	Daily water discharged WSP to Environment, day previous	Actual Daily Discharge	Qeff-c, Maximum Allowable Daily Discharge
9-Jun-18	0.029	0	0	150.2	835
10-Jun-18	0.029	0	150.2	605.8	785
11-Jun-18	0.034	0	605.8	594.8	777
12-Jun-18	0.04	0	594.8	618.8	954
13-Jun-18	0.036	0	618.8	711.3	831
14-Jun-18	0.045	0	711.3	842.5	1059
15-Jun-18	0.052	0	842.5	596.6	1217
16-Jun-18	0.037	0	596.6	635	867
17-Jun-18	0.039	0	635	965.2	912
18-Jun-18	0.038	0	965.2	571.3	773
19-Jun-18	0.032	0	571.3	562	731
20-Jun-18	0.027	0	562	472.9	590
21-Jun-18	0.023	0	472.9	558.4	505
22-Jun-18	0.022	0	558.4	16.5	447
23-Jun-18	0.019	0	16.5	0	542
24-Jun-18	0.024	0	0	373.5	691
25-Jun-18	0.086	0	373.5	1469.4	2352
26-Jun-18	0.074	0	1469.4	1339.2	1641
27-Jun-18	0.054	0	1339.2	934.2	1109
28-Jun-18	0.046	0	934.2	843.2	1013
29-Jun-18	0.155	0	843.2	2523.8	4183
30-Jun-18	0.11	0	2523.8	2125.5	2327
1-Jul-18	0.07	0	2125.5	1050.8	1308
2-Jul-18	0.042	0	1050.8	688	859
3-Jul-18	0.041	0	688	687.9	951
4-Jul-18	0.034	0	687.9	564	750
5-Jul-18	0.029	0	564	560.7	647
6-Jul-18	0.026	0	560.7	224.3	562
No discharge					

Date	Daily flow rate in Minto Creek	Treated water from RO to Minto Creek, day previous	Daily water discharged WSP to Environment, day previous	Actual Daily Discharge	Qeff-c, Maximum Allowable Daily Discharge
16-Jul-18	0.014	0	0	215	403
17-Jul-18	0.017	0	215	394.9	418
18-Jul-18	0.019	0	394.9	3.8	416
No discharge					
9-Aug-18	0.031	0	0	0	893
10-Aug-18	0.05	0	0	828.7	1440
11-Aug-18	0.045	0	828.7	868.3	1020
12-Aug-18	0.03	0	868.3	191.1	575
13-Aug-18	0.022	0	191.1	0	570
No discharge					
27-Aug-18	0.035	0	0	533.2	1008
28-Aug-18	0.05	0	533.2	863.8	1262
29-Aug-18	0.04	0	863.8	730.4	864
30-Aug-18	0.031	0	730.4	554.7	649
31-Aug-18	0.032	0	554.7	414	737
No discharge					

Water Quality monitoring stations are discussed in Section 5.2.

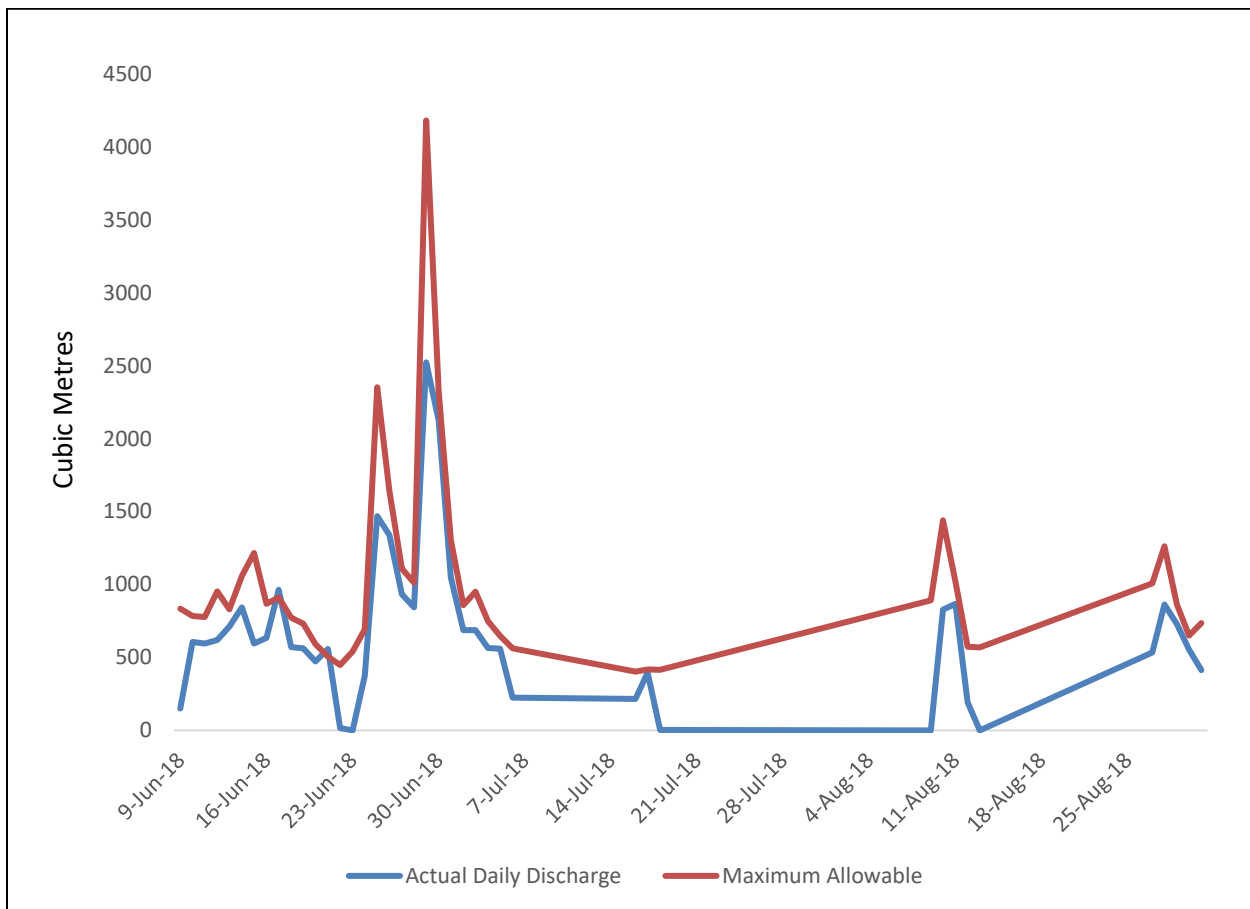


Figure 8-2: 2018 Discharge to Minto Creek

8.5 Hydrology

In 2018, as part of the EMSRP, Minto monitored hydrological conditions at water quality stations including the following: stations within the operational mine area; stations downstream from the mine operational area that are influenced by mine effluent discharge; and reference stations downstream from the mine operational area that are not exposed to effluent. Hydrological monitoring is performed using a variety of methods including: manual discrete discharge measurements with combinations of flow meters, continuous stage measurements through the deployment of Solinst Level Loggers and Barometric Loggers and monitoring of an engineered flume.

8.5.1 Minto Creek Hydrology

Hydrological monitoring on Minto Creek is conducted in accordance with the requirements outlined in the WUL. During the 2018 monitoring period, Minto Mine maintained and collected data from the following four hydrometric stations along Minto Creek:

- W3: Flume downstream of the Water Storage Pond (WSP);
- MC-1: Located in Minto Canyon – mid-catchment;
- W1: Located approximately 1 km upstream of Yukon River – lower catchment; and
- W7: Tributary on the south side of Minto Creek.

At the hydrometric stations, Solinst Level Loggers and Barometric Loggers were used in conjunction with staff gauge readings and manual flow measurements to produce volumetric flow rates.

For details on the 2018 results of Minto Creek hydrology see the *Summary of Minto and McGinty Creek 2018 Surface Hydrology Memo* in Appendix F.

8.5.2 McGinty Creek Hydrology

In 2018, hydrological monitoring on McGinty Creek was conducted as per the schedule outlined in the EMSRP. In 2018, Minto Mine added a hydrometric station at MN-1.5. During the 2018 monitoring period, Minto Mine maintained and collected data from the following four hydrometric stations along McGinty Creek:

- MN-0.5: West Tributary of McGinty Creek
- MN-1.5: Upper East arm of McGinty Creek
- MN-2.5: East Tributary of McGinty Creek
- MN-4.5: McGinty Creek near the Mouth

At the hydrometric stations, Solinst Level Loggers and Barometric Loggers were used in conjunction with staff gauge readings and manual flow measurements to produce volumetric flow rates.

For details on the 2018 results of McGinty Creek hydrology see the *Summary of Minto and McGinty Creek 2018 Surface Hydrology Memo* in Appendix F.

8.5.3 Hydrology QA/QC

Detailed procedures for hydrology monitoring at the Minto Mine are detailed in the *Minto Mine Surface Water Hydrology SOP*. A few changes were made in the hydrology SOP, to ensure duplicate measurements were done on a 1:10 ratio as well as some changes to staff gauge measurements that would ensure consistency between users.

9 Physical Monitoring Program

Minto's physical monitoring program consists of a combination of instrumentation and visual inspections. Site wide inspections are carried out semi-annually – post-thaw in May/June and pre-free-up in September. Q2 inspection must be completed by an external geotechnical engineering consultant in accordance with Clause 13.2 of the QML. Table 9-1 lists the additional inspections also performed as specified in the WUL and *Minto Physical Monitoring Plan*. Revision 2018-01 of the PMP was updated in December 2018 for care and maintenance. A copy of the revised Physical Monitoring Program can be found in Appendix G.

Table 9-1: WUL and PMP Additional Inspection Requirements

Component	PMP Rev 2017-1 (Operations)	PMP Rev 2018-01 (Care and Maintenance)
Active waste rock and overburden dumps	Daily during construction	n/a
Active open pits	Daily during construction	n/a
Dry Stack Tailings Storage Facility, Mill Valley Fill Extension and Mill Valley Fill Extension 2	Monthly	Quarterly
Main Pit and Area 2 Pit tailings storage facilities	Quarterly	Quarterly
WSP dam	Weekly (seepage), Monthly (stability)	Weekly (seepage), Monthly (stability)

Deformation monitoring instrumentation includes survey hubs and borehole inclinometers, described in the following sections. A layout of physical monitoring instrumentation is provided in Figure 9-1, below.

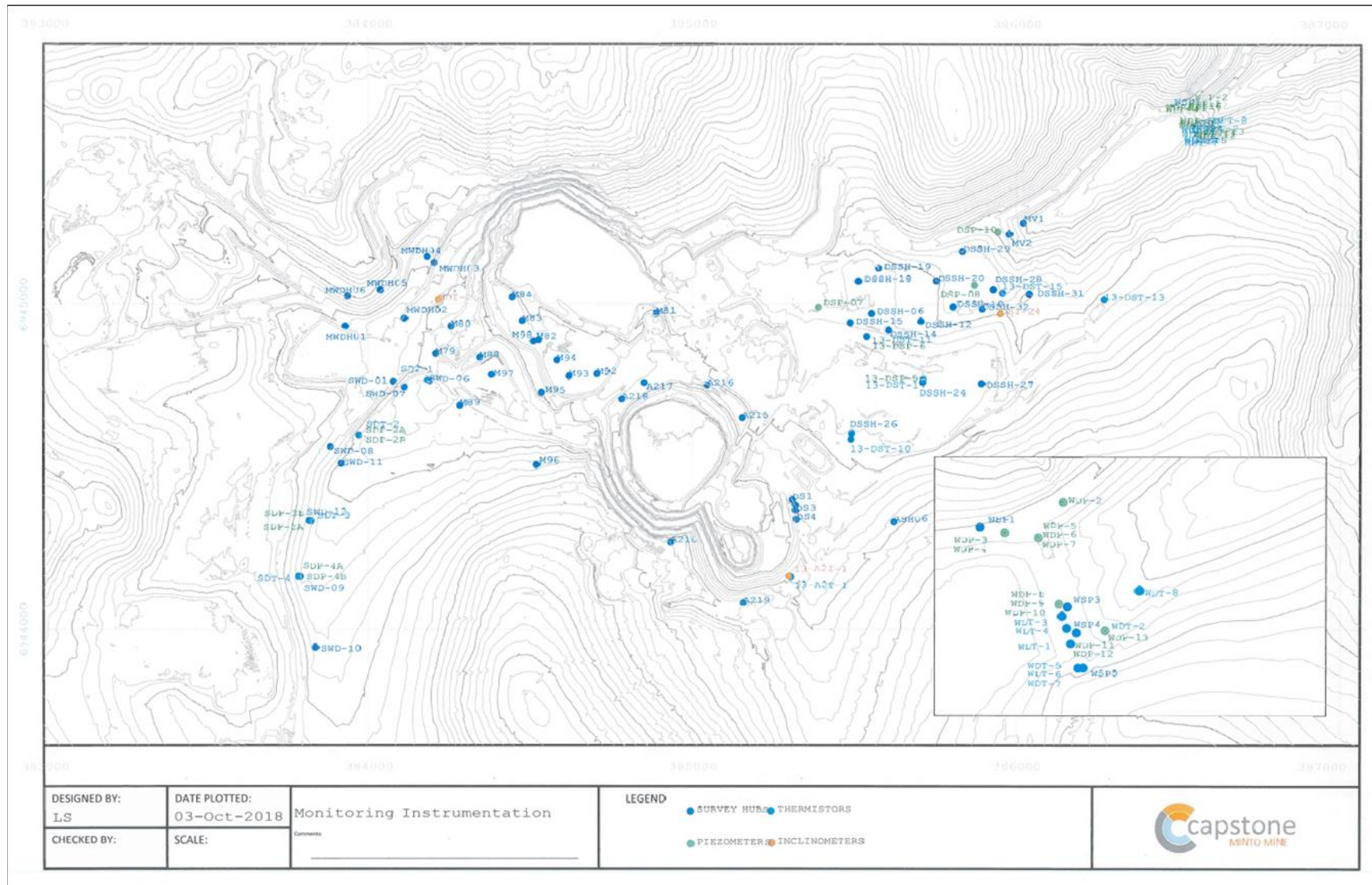


Figure 9-1: Physical Monitoring Program Installation (2018)

9.1 Physical Deformation Monitoring Instrumentation

9.1.1 Survey Hubs

Physical deformation monitoring consists of survey hubs at the Main Pit, Area 2 Pit, DSTSF, SWD, and WSP Dam. The monitoring results are summarized below.

9.1.1.1 Main Pit Dump/South Wall Buttress Survey Hubs

There are currently 14 operating survey hubs on the Main Pit Dump and South Wall Buttress. Data collected are presented in Figures 9-2 and 9-3. During operations, data was collected weekly. In December 2018, the reading frequencies were updated with frequencies ranging from monthly to annually.

In 2017, M82 and M83 saw an increase in movement in May during construction of the Main Pit Dump (MPD), prompting the installation of additional hubs and review of the data by the SRK Consulting (the Engineer of Record). This movement was associated with settlement of the in-pit dump, not part of the South Wall Buttress. In 2018, the M82, M83, M93, and M94 still show higher rates of movement with a decreasing trend. The movement rates are significantly less than those observed in survey hubs prior to the south wall failure and are not considered to be a stability concern.

Four additional hubs were installed in May 2018 following completion of the MPD (to monitor movement rates due to the construction of the Main Pit Dump). The readings from these new hubs show no movement or decreasing movement trends and are not considered to be a stability concern.

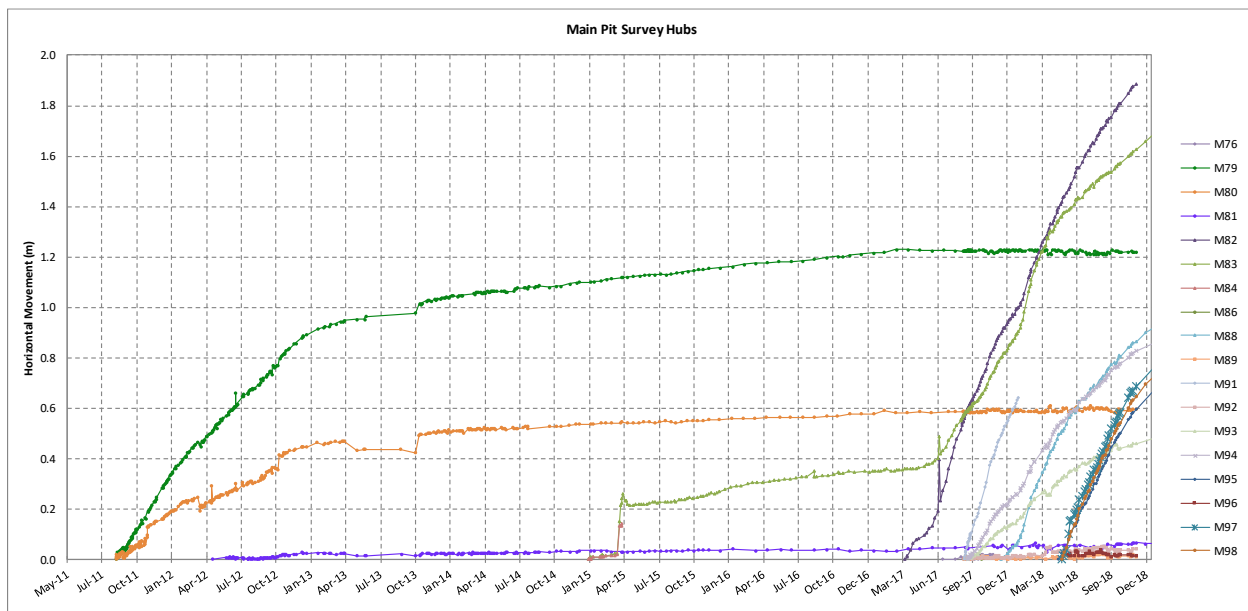


Figure 9-2: Main Pit/South Wall Buttress Survey Hub Data (2011-2018)

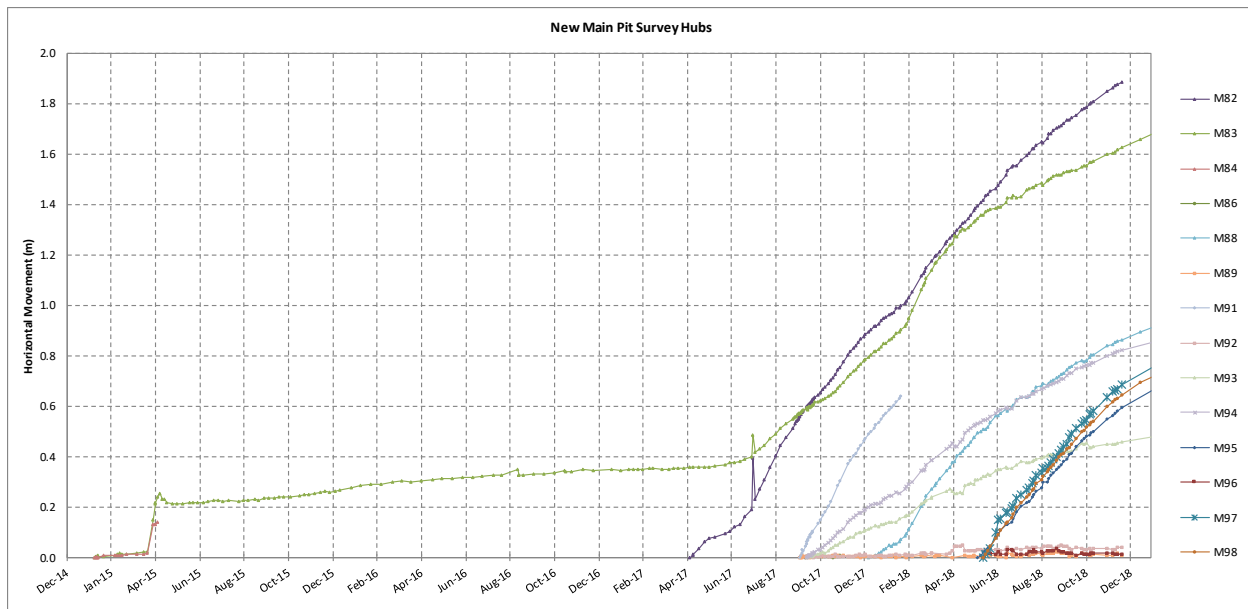


Figure 9-3: Main Pit/South Wall Buttress Survey Hub Data (2014-2018)

9.1.1.2 Main Waste Dump Wrap Survey Hubs

Six survey hubs were installed on the Main Waste Dump Wrap in August 2018. Data collected are presented in Figure 9-4. Data was collected weekly with the frequency reduced to quarterly starting in December. Most hubs have shown no movement, or a decrease in movement rate since the construction of the dump was completed.

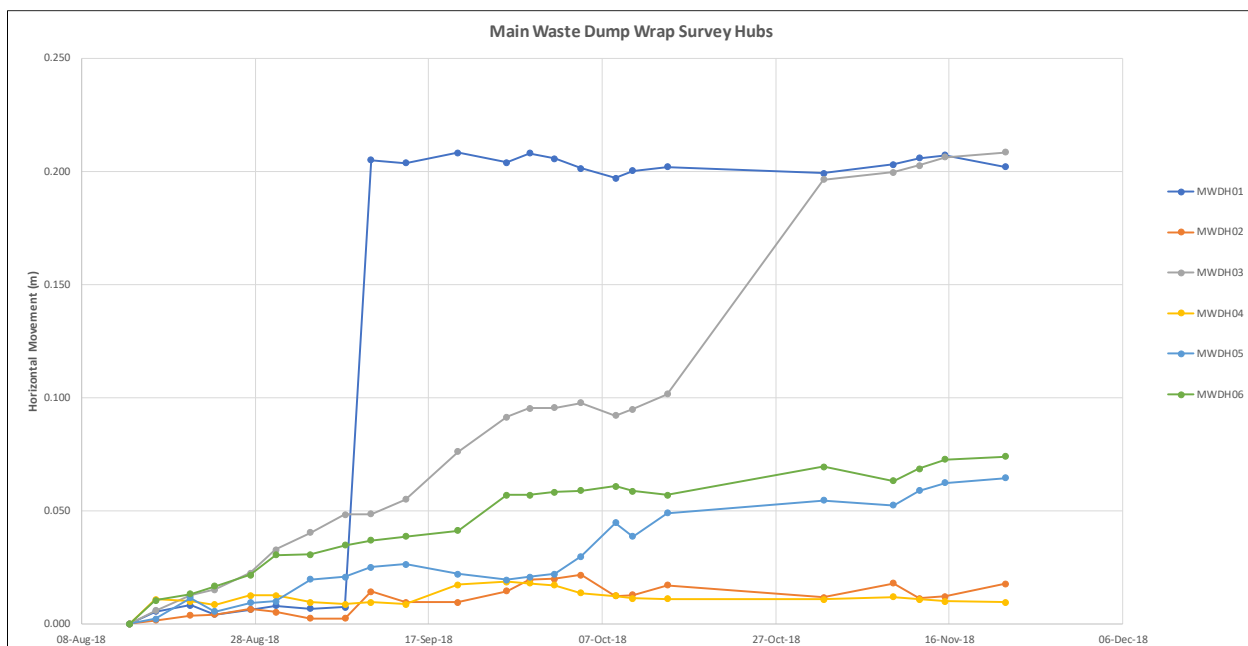


Figure 9-4: Main Waste Dump Survey Hub Data (2018)

9.1.1.3 Dry Stack Tailings Storage Facility/Mill Valley Fill Survey Hubs

There are currently 17 operating survey hubs on the DSTSF and MVFE2. Data collected are presented in Figures 9-5 and 9-6. During operations, data was collected weekly. In December 2018, the reading frequencies were updated with frequencies ranging from monthly to annually. All hubs indicated a continued gradual decrease in movement rates in 2018. Most hubs have shown a decrease in movement rate since the construction of the MVFE2 in summer 2016.

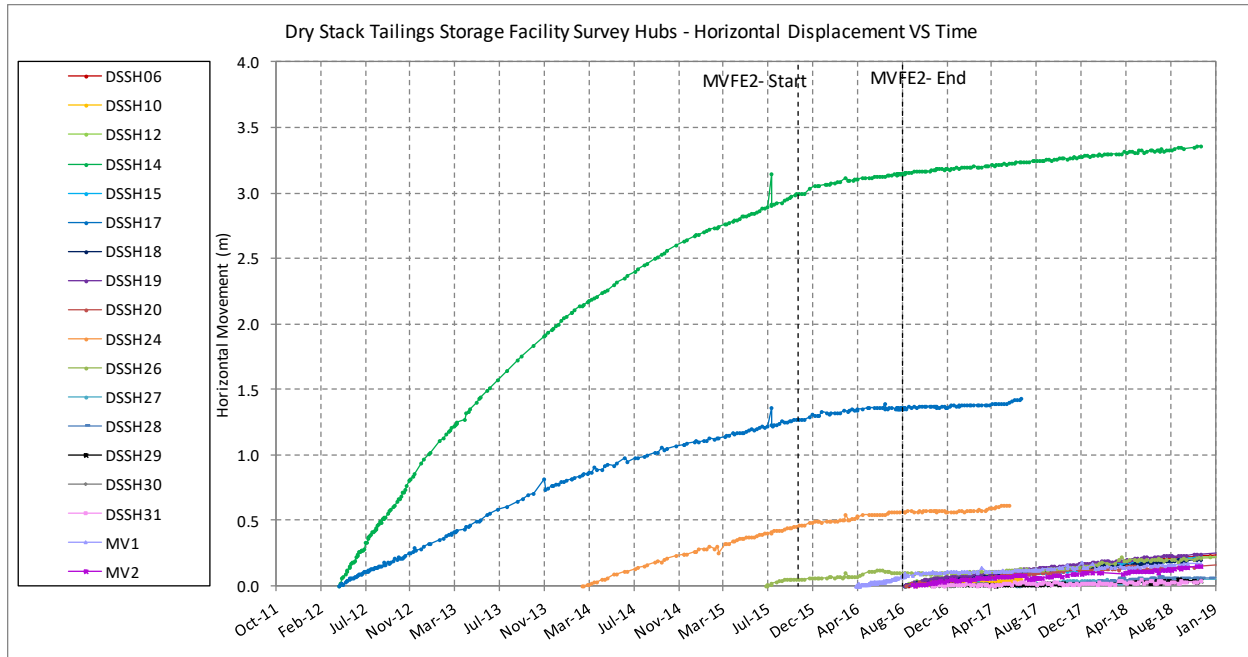


Figure 9-5: DSTSF Survey Hub Data (2012-2018)

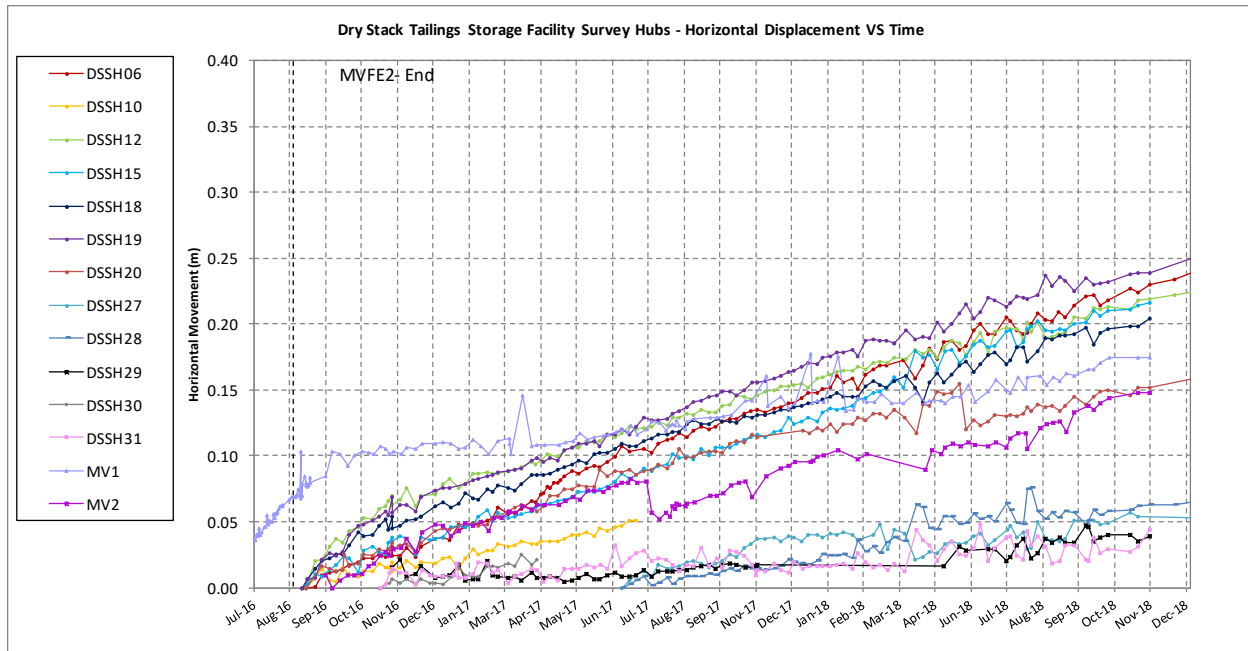


Figure 9-6: DSTSF Survey Hub Data (2016-2018)

9.1.1.4 Southwest Dump Survey Hubs

There are currently 8 operating survey hubs on the SWD. A new hub SWD12 was installed in September 2018 at the location of inclinometer SDI-03 that sheared-off in the summer. Data collected are presented in Figure 9-7. The survey data was collected monthly through November, with the collection frequency reduced to quarterly starting in December. The hubs indicated relatively consistent or decelerating movement rates in 2018.

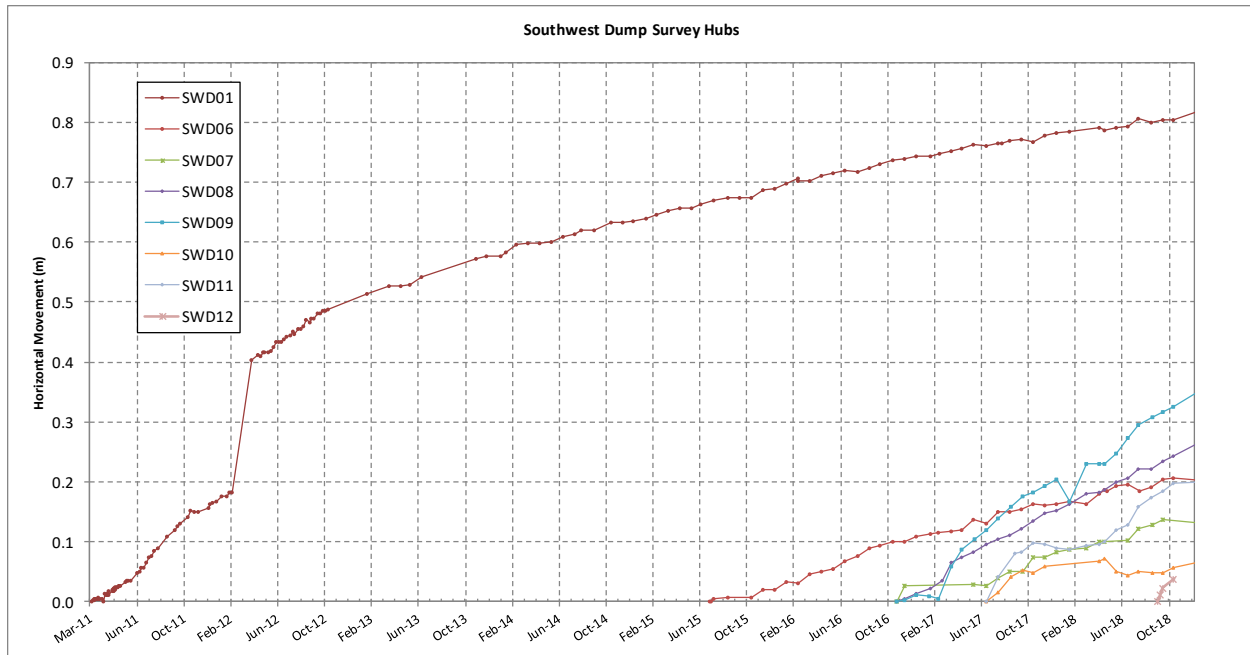


Figure 9-7: SWD Survey Hub Data (2011-2018)

9.1.1.5 Water Storage Pond Dam Survey Hubs

There are currently four operating survey hubs on the WSP dam. There was no change to the operational status of any the hubs in 2018. Data collected are presented in Figure 9-8. Data are collected monthly. Data continue to indicate no movement.

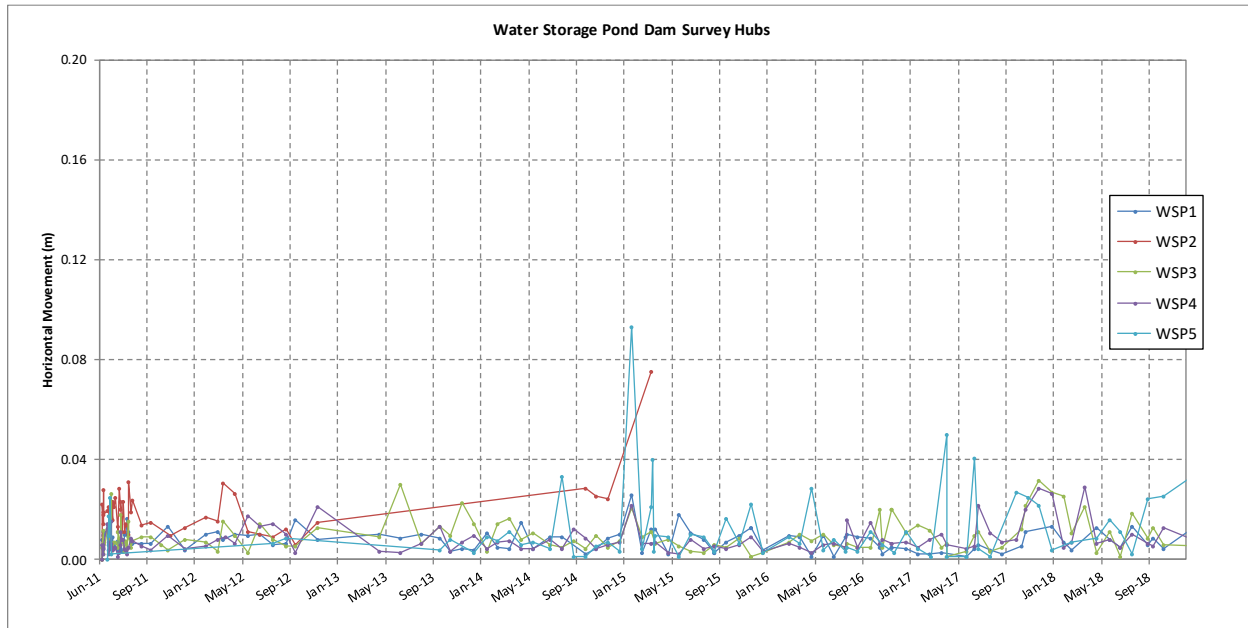


Figure 9-8: Water Retention Dam Survey Hub Data (2011-2018)

9.1.2 Inclinerometers

Physical deformation monitoring consists of monitoring of inclinometers at the DSTSF, Area 2 Stage 3 Pit and Main Pit. The monitoring results are summarized below.

9.1.2.1 DSTSF Inclinerometers

There is currently one operating inclinometer in the DSTSF area. DSI-23 sheared off in April 2017 and DSI-22 sheared off in December 2017. DSI-24 is monitored monthly and the cumulative displacement data collected in 2018 is presented in Figure 9-9. The displacement rate has shown a decelerating trend in 2018 with movement rates similar to those observed at neighboring survey hubs.

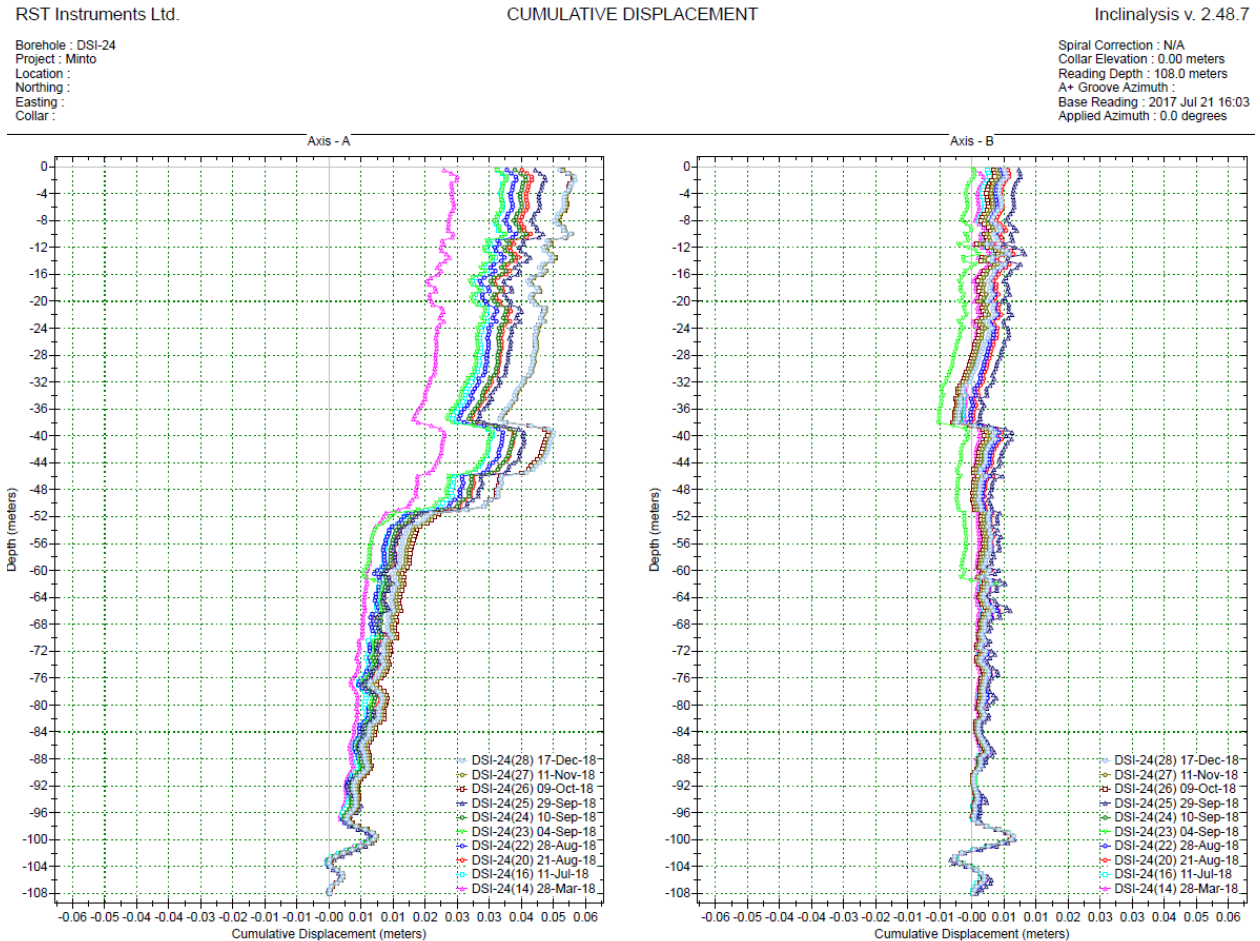


Figure 9-9: DSTSF Inclinometer DSI-24 (2018)

9.1.2.2 Area 2 Stage 3 Pit Inclinometer

There is currently one operating inclinometer (A2I-1) in the Area 2 Stage 3 Pit area that was installed in 2013 prior to development of the Area 2 Stage 3 Pit. A2I-1 is monitored quarterly with the cumulative displacement data collected in 2018 is presented in Figure 9-10. The displacement rate increased during mining of the Area 2 Stage 3 Pit in late 2017 and early 2018. Since completion of the pit, the movement rate has slowed and is not considered to be a stability concern.

A2I-1 is monitored quarterly.

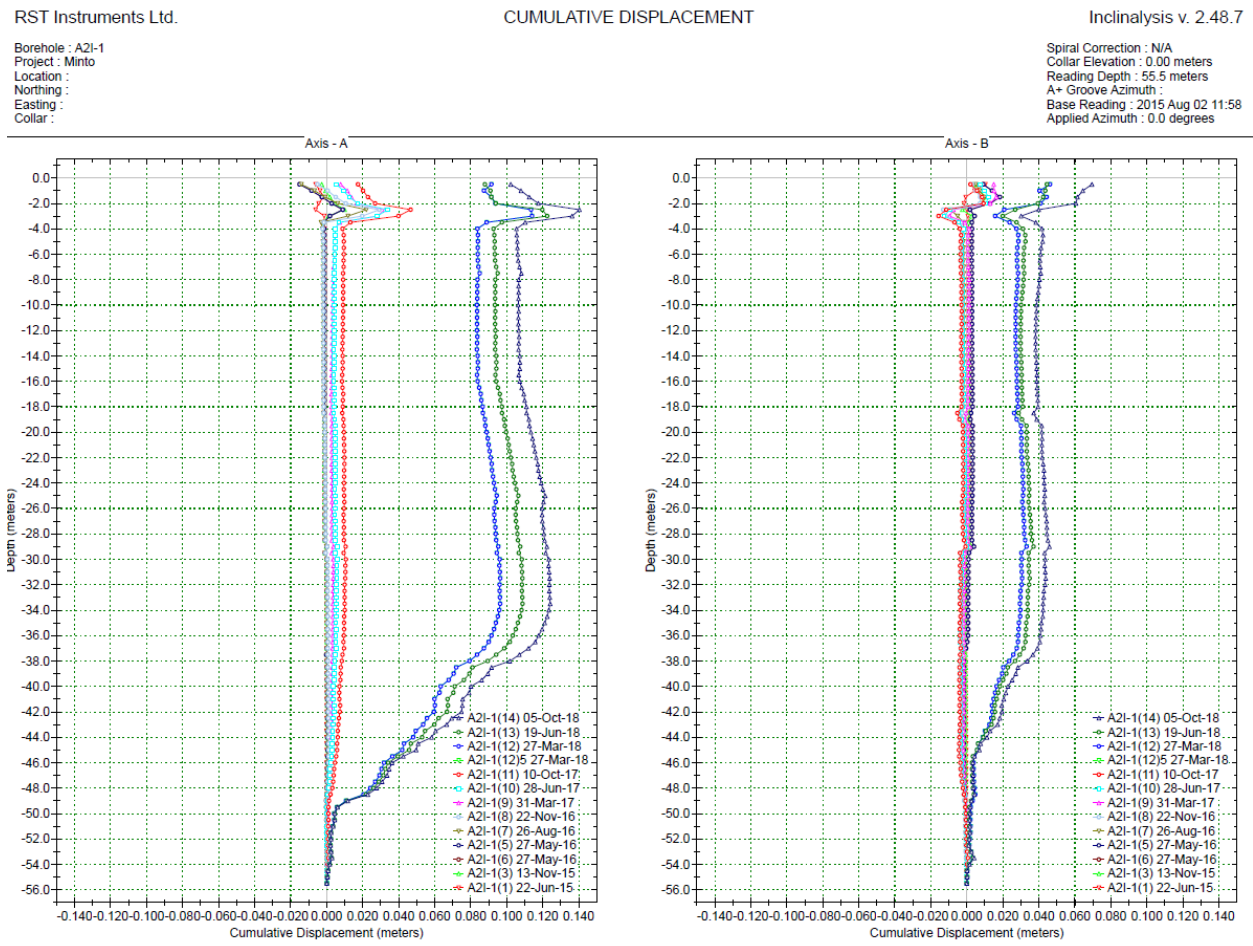


Figure 9-10: Area 2 Stage 3 Inclinometer A2I-1 (2015-2018)

9.1.2.3 Main Pit Inclinometer

There is currently one operating inclinometer in the Main Pit west/south wall area. Readings have been recorded since November 2012, with data currently collected quarterly. Data collected are presented in Figure 9-11. The data shows a minor displacement that is attributable to the construction of the Main Waste Dump Wrap. Additional survey hubs were installed because of the displacement, with the survey hubs showing a decelerating trend following dump construction.

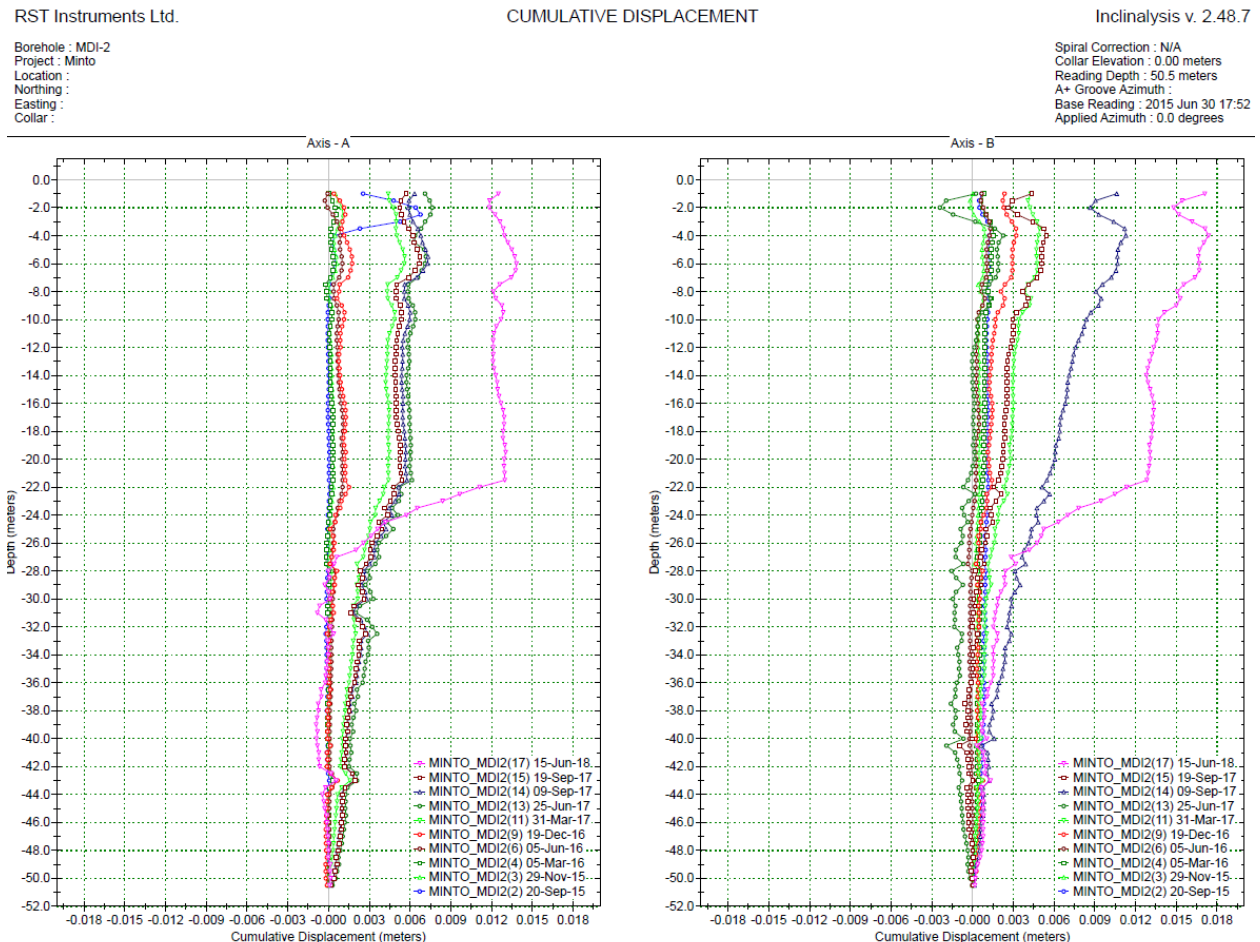


Figure 9-11: Main Pit Inclinometer MDI-2 (2015-2018)

9.2 Engineer's Annual Physical Inspection Reports

As required by the WUL and QML, the following structures are inspected semi-annually by Minto's geotechnical engineer and annually by an external geotechnical engineering consultant:

- Big Creek Bridge;
- Mill and camp site;
- Dry Stack Tailings Storage Facility and Mill Valley Fill Extension (Stage 1 and 2);
- Fuel containment facility;
- Main Waste Dump;
- Ore stockpiles;
- Reclamation Overburden Dump;
- Ice Rich Overburden Dump;
- South Diversion Ditch;
- Tailings Diversion Ditch
- Southwest Waste Dump;
- Main Pit including South Wall Buttress and In-Pit Dumps;
- Water Storage Dam;
- Area 118 and Area 2 Pit; and,
- Minto North Pit.

Table 9-2 summarizes the recommendations from the most recent external inspection in June 2018 and the associated planned actions.

Table 9-2: Annual Physical Inspection Report Summary (2018)

Area	Recommendation	Action
DSTS/MVFE2	The extent of the cracking at the south end of the DSTSF should be surveyed and a wireline extensometer should be installed at a minimum of two locations where the cracking is significant to confirm that the cracks are a result of thaw settlement of the recently placed material and not due to deep-seated movement of the DSTSF. The wireline extensometer should be read on a monthly basis. Two readings should be collected from DSI-24 on the same day confirm accuracy of the readings, and readings collected on a weekly basis until the quality of inclinometer data can be confirmed. As the movement rates at the DSTSF and MVFE2 have slowed significantly in the past two years, it is	The crack was surveyed, and two extensometers were installed in September. Data collected from the extensometers indicate no significant movement. Two readings were collected as recommended and the readings were found to be consistent. The inclinometer data issue was determined to be due to software incompatibility between two different inclinometer analysis programs. The external consultant changed analysis programs and the issue was determined to be resolved.

Area	Recommendation	Action
	recommended that the monitoring frequency of the survey hubs be reduced from weekly to monthly. Continue to monitor the slope to the south of the Minto Creek Seepage Collection System as part of the monthly visual inspection for signs of retrogressive sloughing to determine if any slope stabilization measures are required.	Monitoring frequencies were revised as part of the PMP Revision 2018-01 issued in December 2018. Slope has been monitored monthly during the MFE2 inspections. No changes have been noted.
Tailings Diversion Ditch	The vegetation in the western portion of the channel should be cleared. The berm within the Overflow Spillway should be removed and replaced with either large diameter rocks (or equivalent) that would not significantly impede flow if the spillway is utilized. Construction of the Inlet Channel should be completed in a manner that meets all design requirements documented in the SRK design memo that include minimum channel dimensions, grades, rip-rap gradations and thicknesses. During construction, survey and visual inspections of the channel should be implemented to confirm adequate rip-rap gradations. Remaining construction should be completed prior to snowfall in order to be in-place by the 2019 freshet.	Completed in Fall 2018. Completed during resumption of the construction of the TDD Overflow spillway in October 2018. Construction of the Tailings Diversion Ditch and Overflow Spillway was substantially completed in the fall of 2018. Some additional liner is required to be placed near the sump that was unable to be completed in the 2018 due to poor weather conditions in October 2018. This work is planned to be completed in July 2019. As above.
Main Waste Dump	Additional survey hubs are recommended to be placed on the MWD Wrap crest and toe to confirm no large-scale mass movement is occurring.	Completed in August 2018.
Camp Site	Continue to monitor the slough at the west end of the camp area and the erosion channels below the camp pad following large rainfall events. Develop and implement measures to mitigate the erosion observed near the camp refrigeration trailer. Measures to consider include surface regrading, fill placement to direct flow away from the slope, installation of a sump/drainage system.	Monitoring of erosion channels already apart of the Camp Site inspection carried out bi-annually. Slope continue to be monitored, especially after heavy rainfall, with no mitigation measures yet implemented.
Main Pit Dump / South Wall Buttress / In Pit Dump	Access to the areas above and below the over steepened slopes (Main Pit Dump) should be restricted, or the slopes should be regraded. Signs or barricades should be considered.	Access has remained limited to the Mine Technical staff.
Area 2 Pit	Move the transformer shed further from the crest and away from the observed cracks in the road. The safety berm should pulled back uphill of the cracking. Alternatively, access to the pit rim road	Surface cables moved in August and the transformer was moved in September. Access to the A2S3 pit, crest above the 'bullnose' and along the radar road is restricted.

Area	Recommendation	Action
	should be limited and the utility lines be moved further to the north.	
Instrumentation	Accuracy of the inclinometer readings continues to be an issue. It is understood that the inclinometer probe has been sent for repairs more than once in the past year, and high check-sum values continues to be an issue. Additional investigation of the cause of the error is recommended and additional training be provided to staff as required.	As noted above (DSTS) the inclinometer data issue was determined to be due to software incompatibility and has now been resolved.

10 Adaptive Management Plan - Operations

The Operations Adaptive Management Plan has been in use since WUL QZ14-031 became active. Adaptive Management Plan 2017-01 (AMP 2017-01) is currently approved by Energy, Mines and Resources (EMR) under the current Quartz Mining License (QML-0001); while the Adaptive Management Plan 2017-02 (AMP 2017-02) is approved under by the Yukon Water Board under the current Water Use Licence (QZ41-031). This section includes the assessment to the AMP of 2017-02 specific thresholds.

The comparative tables and associated trigger levels for the adaptive management stations and the required trend analyses are included in the monthly WUL reports.

A summary of the AMP 2017-02 exceedances is included in the sections below. Not all threshold concentration exceedances result in the triggering of AMP responses, as determined by the AMP2017-02.

10.1 Surface Water Quality – Minto Creek

There were no triggers of the AMP in January, February, March, or September to December.

10.1.1 Minto Creek – W2

A summary of the W2 exceedances of the AMP are discussed below in Table 10-1. Trend analysis, evaluations and data has been presented in the monthly reports.

Table 10-1: Minto Creek Surface Water threshold exceedances, Station W2

Date	Parameter	Exceedance Threshold Triggered	Context
1-May-18	Al-D	SPT1	2 out of 22 samples exceeded threshold concentration, prior to the discharge period
7-May-18		SPT1	
10-Apr-18	As-D	SPT3	1 out of 22 samples exceeded threshold concentration, prior to the discharge period
10-Apr-18	Cu-D	SPT3	4 out of 22 samples exceeded threshold concentration, prior to the discharge period
17-Apr-18		SPT2	
24-Apr-18		SPT2	
1-May-18		SPT1	
10-Apr-18	Mo-D	SPT3	5 out of 22 samples exceeded threshold concentration, 1 prior to and 4 during the discharge period.
19-Jun-18		SPT3	
11-Aug-18		SPT3	
3-Jul-18		SPT3	
28-Aug-18		SPT3	

Ongoing events are addressed specifically as follows:

March 2019

Arsenic – Trend analysis and comparison to W3 results indicate the source of the As-D is not mine related, as presented in monthly reports. A trend analysis was conducted on arsenic concentrations at W2 and W3 over 2 years. W2 concentrations are higher than W3, indicating a natural source in the Minto Creek watershed. No further investigation is required.

Copper - The comparison of the W3 results, including trend analysis was conducted and showed W3 values to be stable and lower than those at W2 for dissolved copper. The mine was not actively discharging during April and the W3 values were lower than W2; therefore, mine loading is not indicated. Elevated levels did not continue into the discharge season. No further investigation is required.

Molybdenum - Minto applied the specific responses as detailed in Table 2-1 of the Adaptive Management Plan (AMP Dec 2015) following the first event in May 2016. An investigation was conducted, AMP1 - Molybdenum Investigation, the report has been submitted to the inspector and to SFN. Mo-D will continue to be monitored but no further investigation will occur unless there is an increased level equivalent to half the CCME guideline for the protection of aquatic life (0.0365 mg/L). The concentrations of Mo-D appear to have stabilized during discharge events.

10.1.2 Minto Creek – W50

Minto monitored the specific performance thresholds for surface water quality in Minto Creek at WQO station W50 after October 9, 2018. There was no water and therefore no samples collected after October 9th, 2018 at W50. No adaptive management was required.

10.2 Surface Water Quality – McGinty Creek

Minto monitored the specific performance thresholds for surface water quality in McGinty Creek.

A summary of the MN-4.5 exceedances of the AMP are discussed below. Trend analysis and data has been presented in the monthly reports.

Not all threshold concentration exceedances result in the triggering of AMP responses.

Table 10-2: McGinty Creek Surface Water threshold exceedances, MN-4.5

Date	Parameter	Exceedance Threshold Triggered	Context
13-Oct-18	Cu	SPT1	1 out of 6 samples exceeded threshold concentration
26-May-18	NO3	SPT3	1 out of 6 samples exceeded threshold concentration
26-May-18	Se	SPT1, SPT3	3 out of 6 samples exceeded threshold concentration
25-Sep-18		SPT3	
13-Oct-18		SPT2, SPT3	

Ongoing events are addressed specifically as follows:

The 12-month average CTE for nitrates was an on-going threshold exceedance of the AMP Specific Threshold 3 in May, and all monthly samples were below all thresholds, dropping the CTE below SPT# by June. A consistent natural increase is observed during the summer months at both locations. The comparative examination of the results from MN-1.5 indicated mine loadings were not likely responsible for the exceedance, as MN-1.5 is closer to the mine than MN-4.5, yet values are consistently below all AMP thresholds. It was determined that the source of nitrates is not likely mine related and therefore does not trigger Specific Response Threshold 3.

The 12-month average CTE for dissolved selenium remained above the AMP Specific Threshold 3 at the end of 2018. The comparative examination of the results from MN-1.5 indicated mine loadings were not likely responsible for the exceedance, as Station MN-1.5 is closer to the mine than MN-4.5, the source of selenium does not appear to be mine related, therefore the Specific Response Threshold 3 is not triggered. Refer to the *Selenium Memo – Minnow 2018* for further analysis in Appendix H, which summarizes Minto's investigations as follows:

"Dissolved selenium exceeded the ST-3 objective at MN-4.5, but the source was unrelated to the Minto Mine and consistent with reference concentrations further upstream on the west arm of McGinty Creek. Dissolved selenium was well below applicable guidelines for the protection of aquatic life, so effects to aquatic life would not be expected."

"It is recommended that sampling continue as scheduled since the exceedance of dissolved selenium was unrelated to the mine. Increased frequency is not required at this time. Two investigations show that exceedances of dissolved selenium are unrelated to the mine, and it is recommended that a reevaluation of the Specific Thresholds (which are lower than reference) be conducted. No further investigation is required at this time."

10.3 Groundwater Quality – Minto Creek

Various exceedances of AMP levels triggered a review of the groundwater data by the qualified professional. All groundwater data was forwarded to SRK Consulting for review and recommendations. See Appendix I, *2018 Minto Groundwater Quality AMP Review Memo - SRK*, for details.

10.4 Groundwater Quality - McGinty Creek

Minto monitored the specific performance thresholds for McGinty Creek groundwater. Various exceedances of AMP levels triggered a review of the groundwater data by the qualified professional. All groundwater data was forwarded to SRK Consulting for review and recommendations. See Appendix I, *2018 Minto Groundwater Quality AMP Review Memo - SRK*, for details.

10.5 Water Management AMP

Water storage capacity in the Main Pit Tailings Management Facility and the Area 2 Pit Tailings Management Facility exceeded 1,000,000 m³ during the operational period and as such, no responses from the adaptive management plan were applied.

10.6 Physical Monitoring Program AMP

During operations, the results of the Physical Monitoring Program are compared to the thresholds set out in the 2018 Adaptive Management Plan (AMP) on a weekly basis by the Geotechnical EIT. Since the site was placed on care and maintenance in November 2018, the thresholds are reviewed on a monthly basis by a Geotechnical Engineer. Tables 10-3 and 10-4 below, summarize the threshold statuses for the Category 1 and Category 2 facilities.

Category 1 facilities are those found in areas of ice-rich periglacial foundations that have previously experienced deep-seated foundation movement and include the Dry Stack Tailings Storage Facility, Mill Valley Fill Extension (Stages 1 and 2), Southwest Waste Dump, and South Wall Buttress/Main Pit Dump. Category 2 facilities are all other waste rock dumps, including the Main Waste Dump and Main Waste Dump Expansion, Reclamation Overburden Dump, and Ice-rich Overburden Dump.

Table 10-3: Category 1 Facilities – Threshold Status, December 2018

Specific Performance Thresholds	Thresholds Exceeded	Response
Specific Threshold 1 - Observation of unusual occurrence including: - tension cracks, settlement, or sloughing; - a seismic event that exceeds the 1:475 return period event¹; - abnormal seepage from any area of the slopes; - increased turbidity from seepage; - Physical damage.	none	n/a
Specific Threshold 2 One survey hub or inclinometer reading indicating an increase in the movement rate greater than the long-term trend and outside the range of instrumentation error.	none	n/a
Specific Threshold 3	DSP-07	December 2015: DSP-07 has displayed Ru values higher than 0.44 for sensors 2, 3, 4 and 5 since

¹ This size of a seismic event would be felt by most people on site. It would shake buildings, and rattle or break dishes, hanging objects, etc. Earthquake information may also be found online at: <http://www.earthquakescanada.nrcan.gc.ca/index-eng.php>

- For DSTSF and MVFE piezometers 13-DSP-05a, 13-DSP-06, 15-DSP-07, and 15-DSP-08, an increase in piezometric pressures under unfrozen or thawing conditions such that Ru^2 exceeds 0.44. - For MVFE2 piezometer 15-DSP-10, an increase in piezometric pressures under unfrozen or thawing conditions such that the equivalent water elevation is 3 m above the original ground surface. Or Temperature greater than zero at a depth of 2 m below original ground (<i>all SWD ground temperature cables, and DSTSF ground temperature cables DST-10, DST-11, and DST-14 only</i>)		installation. This piezometer is outside the MVFE2 footprint and is not considered a stability concern. Reading frequency was increased to every two weeks (from monthly). High initial values may have been due to grout curing or freeze-induced pressure. Current conditions: See Specific Threshold 4 for more details.
	DSP-08	April 2016: DSP-08 sensor 1 (@ 5m depth) displayed Ru values higher than 0.4. The design engineer was notified. No instability was noted during inspections. Reading frequency was increased to bi-weekly (from monthly) and increased to daily while dumping in the immediate vicinity. The Ru value reached a peak of 1.1 in June 30, 2016 and has since been decreasing. May 31, 2016: An additional spike was noted on sensors 2, 3, 5 and 6. Again, the design engineer was notified, and no instability was noted on inspection. Current conditions: See Specific Threshold 4 for more details.
	DSP-10	DSP-10 has displayed a water elevation >1m above ground surface depth since March 8th, 2016. The design engineer was contacted, and reading frequencies were immediately increased to weekly. to Specific Threshold 4 for more details. Current conditions: See Specific Threshold 4 for more details.

² Ru is the pore water pressure coefficient which is the ratio of piezometric pressure to the overburden pressure. A pore water pressure ratio of 0.5 would be similar to the effect of a groundwater table at surface. Conversions from Ru to equivalent water elevation are contained in Table 2-15 of the 2017 AMP.

Specific Threshold 4 - For DSTSF and MVFE piezometers 13-DSP-05, 13-DSP-06, 15-DSP-07, and 15-DSP-08, an increase in piezometric pressures under unfrozen or thawing conditions such that Ru exceeds 0.6. - For MVFE2 piezometer 15-DSP-10, an increase in piezometric pressures under unfrozen or thawing conditions such that the equivalent water elevation is 10 m above the original ground surface	DSP-07	Sensors 2 to 6 of DSP-07 have exceeded the 0.6 Ru threshold between December 2016 and December 2017. The current Ru values range from 0.4 to 2.3. The data was reviewed by the design engineer and a stability analysis was undertaken. The high pore pressures were deemed not to be a concern as the location is not located near a slope and is buttressed by the MVFE resulting in a high FOS despite the high pore pressure. Current conditions: no change, readings continue to slowly increase.
	DSP-08	Sensor 1 exceeded the threshold on Apr. 29/16. Sensor 2 exceeded the threshold on July 1/16. Sensor 3 exceeded the threshold on Feb. 25/17. Sensor 5 exceeded the threshold on Dec. 17/17. Data was reviewed, and site inspections were completed following the exceedances by the Geotechnical EIT and engineer of record. No signs of instability were observed. Since construction complete of the MVFE2 was complete visual inspections were reduced to monthly, with no signs of instability observed. Current conditions: Ru value for Sensor 1 has been decreasing since June 30, 2016. The remaining sensors continue to show an increasing trend but are lower than the peak Ru observed at Sensor 1.

	DSP-10	DSP-10 has displayed an equivalent water level >3m above ground surface depth since April 1st, 2016. Since September 2016 the equivalent water level has been >10m above ground surface. Summary of actions below: • April 1, 2016: Design engineer notified. Inspection frequency increased to daily. Dumping on the lower tier was suspended. • April 4, 2016: Two survey hubs were installed on the eastern slope to monitor for movement with a daily reading frequency. • April 5, 2016: The lower tier was re-opened for dumping after stabilization of piezometer values. Going forward, piezometer data was reviewed prior to dumping each subsequent lift. • May 3, 2016: Inspections were reduced to weekly, with a daily review of monitoring data. • When working along the eastern edge of the final lift, a daily inspection was conducted. • August 25, 2016: Survey hub reading frequency reduced to weekly as construction was complete. • Sept 1, 2016: Piezometer reading frequency was reduced to weekly as the data had stabilized and construction was complete. • Once the facility construction was complete, the inspections were reduced back to monthly. Current conditions: equivalent water level is >10m. No signs of instability have been observed. The slope continues to be monitored by two survey hubs (MV1 and MV2) with no significant movement observed.
Specific Threshold 5 • Three consecutive survey hub or inclinometer readings indicating an increase	none	n/a

in the movement rate movement greater than the long-term trend.		
Or		
Three consecutive survey hub readings indicating a change in horizontal direction of movement greater than 15 degrees from the long-term trend,		

Table 10-4: Category 2 Facilities – Threshold Status, December 2018

Specific Performance Thresholds	Thresholds Exceeded	Response
Specific Threshold 1 • Observation of unusual occurrence including: • tension cracks, settlement, or sloughing; • a seismic event that exceeds the 1:475 return period event; • abnormal seepage from any area of the slopes; • increased turbidity from seepage; • physical damage.	None	N/A
Specific Threshold 2 WSP Dam: • One survey hub reading indicating an increase of movement outside range of instrumentation error. All other Category 2 Facilities: Survey hub cumulative displacements between 150 mm and 500 mm.	None	N/A
Specific Threshold 3 WSP Dam: • One piezometer reading outside of its long-term trend (in comparison to the reservoir pond elevation). All other Category 2 Facilities: Survey hub cumulative displacements greater than 500 mm.	None	N/A
Specific Threshold 4 WSP Dam: • Three consecutive survey hub readings indicating increase in movement outside range of instrumentation error.	None	N/A

11 Aquatic Environmental Monitoring Program

The Aquatic Environmental Monitoring Program (AEMP) is composed of Minto's requirements under the MDMER and biological monitoring of sediment, benthic invertebrates, fish and fish habitat. Monitoring under the MDMER is presented in Section 11.1 and the biological monitoring of sediment, benthic invertebrates, fish and fish habitat is presented in Section 11.2.

11.1 Metal Mine Effluent Regulations Monitoring Programs

The Metal Mine Effluent Regulations (MDMER) outline requirements for monitoring and reporting of discharged effluent volume and quality under the MDMER to Environment Canada. Details of the Metal & Diamond Mine Effluent Program, including sampling station locations and monitoring frequency, are outlined in the EMSRP and the results are submitted on a quarterly and annual basis to Environment Canada.

11.1.1 Effluent Monitoring Program

The MDMER Program requires effluent monitoring and sampling at the final discharge point (FDP) station W3, downstream of the end of pipe discharge. The W3 sampling station is collected when there is a discharge of water at W3; testing occurs weekly for deleterious substances.

Weekly effluent monitoring samples are tested for the deleterious substances as described in the MDMER including total metals (arsenic, copper, lead, nickel and zinc), total suspended solids (TSS), and pH. Weekly samples are collected at least 24 hours apart and not more than 7 days apart. Minto is striving for consistency and has internally scheduled MDMER sampling to occur on Tuesdays.

Radium 226 and acute lethality tests are conducted quarterly due to the reduced frequency guidelines outlined in the MDMER. As the Ra226 sample was lost following sampling in the fourth quarter, an increased sampling frequency was initiated in 2019, as per MDMER.

The Effluent Monitoring Program results are submitted to Environment Canada quarterly and are presented in Appendix J.

11.1.2 Environmental Effects Monitoring Water Quality Monitoring

The EEM Water Quality Monitoring Program is designed to characterize water quality at the exposure area, the receiving environment and in reference (un-impacted) area. Water quality samples must be collected four times a year, not less than one month apart, while the mine is discharging effluent at the Final Discharge Point (FDP) of W3. Samples are collected at the exposure area (W3), receiving environment station (W2) and reference station (W7). Effluent toxicity testing is required annually using a total of four tests; one each of a fish, invertebrate, algae and plant species.

The EEM Water Quality Monitoring Program results submitted to Environment Canada annually, are presented in Appendix J.

11.1.3 Environmental Effects Monitoring Biological Monitoring

The EEM Biological Monitoring Program outlines fish population, fish tissue and benthic invertebrate tests conducted under Schedule 5, Part 2 of the MDMER. Minto Mine submitted the report for the Phase IV biological monitoring study in January 2018.

11.2 Biological Monitoring Program

Clause 71 and 72 of the WUL requires an Annual Biological Monitoring Program that includes monitoring of sediment, periphyton, benthic invertebrates, fish, and fish habitat. The following sections summarize the monitoring programs and more detailed reports can be found in Appendix K and Appendix L. Appendix K contains information with respect to the sediment, periphyton, and benthic invertebrate monitoring programs and Appendix L contains information relative to the fish monitoring programs.

11.2.1 Sediment Monitoring Program

The objectives of the sediment monitoring program were to characterize particle size, total organic carbon content, and concentrations of metals, metalloids, and nutrients in sediments. A 10-day *Chironomus dilutus* and a 14-day *Hyalella azteca* sediment toxicity test were conducted in 2018 to evaluate survival and growth.

Sediments collected in 2018 were largely composed of fine particles in the silt and sand size categories (Table 11-1). Mean total organic carbon (TOC) content of sediment collected from upper Minto Creek (2.9%) was slightly lower (but not significantly) than at the upper McGinty Creek reference area (3.8%; Table 11-1). Lower Minto Creek had lower (but not significantly) TOC (4.1%) than the lower Wolverine Creek reference area (6.4%; Table 11-1). Arsenic and copper were the only analytes with mean concentrations greater than Interim Sediment Quality Guidelines (ISQG) for the protection of aquatic life (CCME 1999) in an effluent-exposed area (Table 11-1). However, mean arsenic concentration in upper Minto Creek was below ISQG and lower than the reference area, upper McGinty Creek (which was greater than ISQG). This suggests that arsenic concentrations were unrelated to the mine. Mean copper concentration in upper Minto Creek was above the Probable Effect Level (PEL) and lower Minto Creek was greater than the ISQG. Concentrations of copper at lower Wolverine Creek were also above the ISQG (Figure 11-1). With progression from upper to lower Minto Creek, sediment copper concentrations decreased from a mean of 210 to 45 mg/kg, respectively, indicating improvement with distance downstream. Due to the predominantly erosional habitat in upper Minto Creek, relatively few areas had deposited sediment and even this occurred only in small quantities that likely wash away each year during freshet. Therefore, elevated sediment copper in fine sediment in the upper reaches of Minto Creek may be of limited importance in terms of exposure and potential effects to biota. In lower Minto Creek, fine sediment deposits are somewhat more common and therefore more relevant to aquatic life.

No effects to *H. azteca* survival or growth were observed during the sediment toxicity testing (Table 11-2). *H. azteca* results (no effects in 2018) were similar to those of 2011 and 2015 to 2017 (Minnow 2012, 2016, 2017, 2018). Survival of *C. dilutus* was significantly lower in sediment collected from lower Minto

Creek than in laboratory control sediment (sand) and field reference sediment (lower Wolverine Creek; Table 11-2). Survival at lower Minto Creek was leveraged by one station that had higher mortalities (50%) than the remaining four stations with lower mortalities (20% to 30%). Growth of *C. dilutus* was not significantly different between lower Minto Creek and the reference sediment. In previous years, growth was only significantly different in 2017, whereas survival was significantly different between areas in 2017 and 2018 but not in 2011, 2015, and 2016. Temporal comparisons show differences in responses despite similar sediment chemistry.

Table 11-1: Summary of Sediment Chemistry Data Collected at Exposed and Reference Areas, Minto Mine, 2018

Analytes		Units	CSQG ^a		Upper McGinty Creek (Reference)				Upper Minto Creek (Exposed)				Lower Wolverine Creek (Reference)				Lower Minto Creek (Exposed)			
			ISQG	PEL	Mean	Standard Deviation	Minimum	Maximum	Mean	Standard Deviation	Minimum	Maximum	Mean	Standard Deviation	Minimum	Maximum	Mean	Standard Deviation	Minimum	Maximum
Particle size, TKN, carbon analytes and pH	Loss on Ignition	%	-	-	8.4	4.3	4.0	13	7.4	2.3	4.0	10	14	2.5	11	18	8.6	4.0	3.0	13
	pH (1:2 soil:water)	pH units	-	-	7.00	0.42	6.59	7.66	8.10	0.16	7.83	8.23	6.76	0.45	6.50	7.57	7.78	0.12	7.66	7.95
	% Gravel (>2 mm)	%	-	-	-	-	-	-	-	-	-	-	1.3	0.72	<1.0	2.6	1.7	1.5	<1.0	4.3
	% Sand (2.0 mm - 0.063 mm)	%	-	-	-	-	-	-	-	-	-	-	22	5.2	18	31	40	18	23	68
	% Silt (0.063 mm - 4 µm)	%	-	-	-	-	-	-	-	-	-	-	70	5.4	62	75	51	15	28	65
	% Clay (<4 µm)	%	-	-	-	-	-	-	-	-	-	-	7.4	1.8	5.7	11	8.3	2.6	3.8	10
	Total Kjeldahl Nitrogen	%	-	-	0.20	0.12	0.098	0.37	0.18	0.049	0.090	0.21	0.39	0.065	0.29	0.47	0.20	0.086	0.086	0.30
	Inorganic Carbon	%	-	-	0.099	0.034	0.071	0.15	0.12	0.033	0.071	0.15	0.15	0.013	0.13	0.17	0.15	0.049	0.076	0.21
	Inorganic Carbon (as CaCO ₃ Equivalent)	%	-	-	0.82	0.28	0.59	1.3	1.0	0.28	0.59	1.3	1.2	0.11	1.1	1.4	1.2	0.41	0.63	1.7
	Total Carbon by Combustion	%	-	-	3.9	2.0	2.1	6.5	3.0	1.1	1.5	4.1	6.5	0.90	5.1	7.5	4.2	2.1	1.6	6.6
Total Organic Carbon	%	-	-	3.8	1.9	2.0	6.3	2.9	1.1	1.4	4.0	6.4	0.90	5.0	7.3	4.1	2.0	1.5	6.4	
Total Metals	Aluminum (Al)	mg/kg	-	-	10,300	2,608	6,770	13,100	12,280	1,921	10,600	15,400	17,620	2,338	14,100	20,000	13,820	1,993	11,000	15,800
	Antimony (Sb)	mg/kg	-	-	0.34	0.058	0.27	0.42	0.48	0.18	0.34	0.79	0.49	0.11	0.39	0.68	0.49	0.082	0.36	0.57
	Arsenic (As)	mg/kg	5.9	17	7.7	1.7	5.3	10	5.9	1.1	4.8	7.6	6.8	2.2	5.2	10	7.7	1.4	5.8	9.1
	Barium (Ba)	mg/kg	-	-	183	53	113	254	255	86	159	333	264	65	201	367	237	49	175	299
	Beryllium (Be)	mg/kg	-	-	0.30	0.075	0.21	0.39	0.44	0.082	0.37	0.57	0.73	0.10	0.63	0.87	0.48	0.074	0.39	0.58
	Bismuth (Bi)	mg/kg	-	-	<0.2	0	<0.20	<0.20	<0.2	0	<0.20	<0.20	<0.2	0	<0.20	<0.20	<0.2	0	<0.20	<0.20
	Boron (B)	mg/kg	-	-	<5.0	0	<5.0	<5.0	<5.0	0	<5.0	<5.0	5.0	0.045	<5.0	5.1	<5.0	0	<5.0	<5.0
	Cadmium (Cd)	mg/kg	0.60	3.5	0.14	0.055	0.086	0.20	0.25	0.10	0.13	0.37	0.27	0.063	0.22	0.37	0.21	0.040	0.17	0.27
	Calcium (Ca)	mg/kg	-	-	7,380	2,287	5,250	10,700	8,818	1,564	7,590	11,500	10,808	3,064	7,850	15,900	9,654	1,697	7,770	11,900
	Chromium (Cr)	mg/kg	37	90	21	4.6	16	27	30	1.6	28	32	47	6.7	40	56	32	4.8	24	37
	Cobalt (Co)	mg/kg	-	-	8.3	1.9	6.2	11	11	2.2	8.9	14	14	1.1	13	16	11	0.88	9.9	12
	Copper (Cu)	mg/kg	36	197	18	5.7	11	24	210	136	72	403	38	20	25	74	45	16	20	60
	Iron (Fe)	mg/kg	-	-	23,640	4,191	17,800	29,500	25,140	3,424	21,600	29,900	29,840	3,208	25,700	33,800	26,320	2,296	23,500	29,100
	Lead (Pb)	mg/kg	35	91	3.9	0.83	2.9	4.9	5.7	0.86	4.8	7.0	6.7	0.82	5.7	7.7	5.6	0.59	4.9	6.3
	Lithium (Li)	mg/kg	-	-	6.0	1.4	4.1	7.7	8.2	1.4	6.9	10	11	1.3	9.0	12	9.2	0.97	7.9	10
	Magnesium (Mg)	mg/kg	-	-	4,106	802	3,030	5,070	6,996	984	5,980	8,620	9,746	813	8,670	10,700	7,436	994	5,910	8,610
	Manganese (Mn)	mg/kg	-	-	570	258	280	953	2,855	1,912	897	4,830	718	732	243	1,980	1,106	322	619	1,500
	Mercury (Hg)	mg/kg	0.17	0.49	0.056	0.050	0.022	0.14	0.025	0.0086	0.018	0.039	0.051	0.0069	0.043	0.059	0.044	0.016	0.032	0.071
	Molybdenum (Mo)	mg/kg	-	-	0.57	0.074	0.45	0.64	1.9	0.96	0.86	2.8	0.70	0.20	0.49	1.0	0.71	0.14	0.49	0.84
	Nickel (Ni)	mg/kg	-	-	16	3.1	12	20	29	3.8	25	35	39	2.7	36	43	29	3.7	23	32
	Phosphorus (P)	mg/kg	-	-	903	159	638	1,040	1,022	55	979	1,100	1,124	155	1,010	1,390	879	87	770	976
	Potassium (K)	mg/kg	-	-	664	130	490	820	1,366	334	1,020	1,840	1,162	237	850	1,500	1,154	257	760	1,410
	Selenium (Se)	mg/kg	-	-	0.54	0.21	0.35	0.87	0.60	0.28	0.33	0.99	0.51	0.29	0.28	1.0	0.53	0.19	0.28	0.80
	Silver (Ag)	mg/kg	-	-	<0.10	0	<0.10	<0.10	0.13	0.037	<0.010	0.19	0.12	0.021	<0.10	0.15	0.10	0	<0.10	0.10
	Sodium (Na)	mg/kg	-	-	202	37	149	240	350	45	312	426	405	54	339	455	308	30	261	342
	Strontium (Sr)	mg/kg	-	-	62	14	48	85	96	22	73	128	116	38	82	180	107	22	81	133
	Thallium (Tl)	mg/kg	-	-	0.060	0.010	<0.050	0.075	0.088	0.017	0.072	0.11	0.098	0.021	<0.050	0.12	0.085	0.019	0.057	0.10
	Tin (Sn)	mg/kg	-	-	<2.0	0	<2.0	<2.0	<2.0	0	<2.0	<2.0	<2.0	0	<2.0	<2.0	<2.0	0	<2.0	<2.0
	Titanium (Ti)	mg/kg	-	-	639	101	507	750	705	75	636	824	860	107	720	969	730	77	626	808
	Uranium (U)	mg/kg	-	-	1.2	0.71	0.59	2.4	0.92	0.36	0.68	1.5	2.5	0.42	1.9	3.0	1.2	0.29	0.86	1.6
	Vanadium (V)	mg/kg	-	-	46	6.5	40	55	57	6.2	50	63	69	5.4	62	75	57	4.6	52	62
	Zinc (Zn)	mg/kg	123	315	41	8.3	30	51	66	14	51	85	69	5.0	63	75	59	6.4	53	66

- Indicates sediment concentration exceeding CSQG ISQG.
- Indicates sediment concentration exceeding CSQG PEL.
- Indicates sediment concentration exceeding higher reference mean by more than two times.
- Indicates sediment concentration exceeding higher reference mean by more than two times and higher than CSQG ISQG and/or PEL.

^a Canadian Sediment Quality Guidelines: ISQG = interim sediment quality guideline; PEL = probable effect level (CCME 1999).

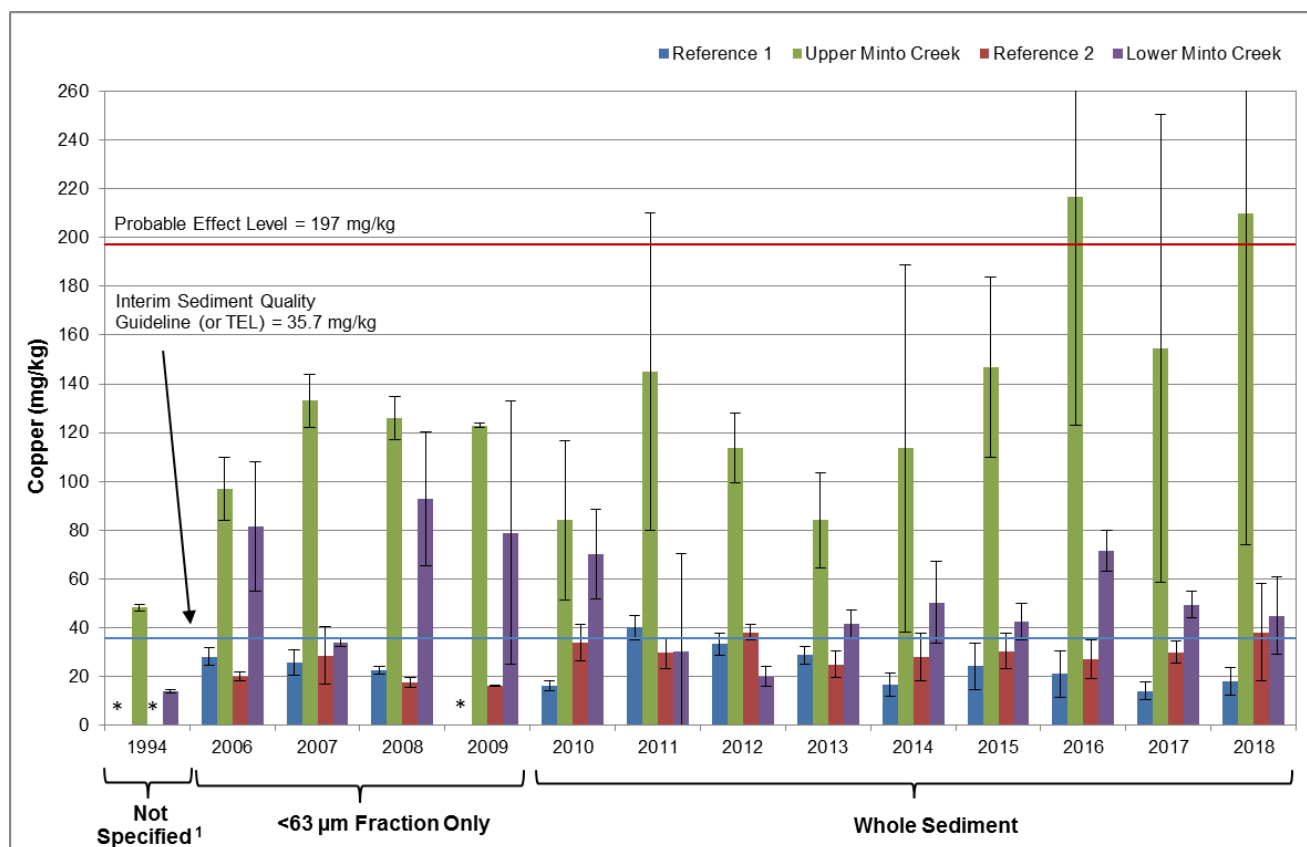


Figure 11-1: Copper Concentrations (Mean ± Standard Deviation) in Sediment Collected in Minto Creek and Reference Locations, 1994 to 2018 ²

Notes: * = no data, TEL = Threshold Effect Levels.

¹ Methods were not specified, fine sediment was collected in triplicate in the mainstem of Minto Creek (HKP 1994).

² Reference 1 = Station W6 (south-flowing tributary) in 2006 to 2008 and McGinty Creek in 2010 to 2018; Reference 2 = Station W7 (north-flowing tributary) in 2006 to 2009 and Wolverine Creek in 2010 to 2018.

Table 11-2: Minto Mine Sediment Toxicity Test Results Collected for Lower Wolverine and lower Minto Creeks, September 2018

Area	<i>Hyalella azteca</i>		<i>Chironomus dilutus</i>	
	Survival (%)	Dry Weight (mg)	Survival (%)	Dry Weight (mg)
Control Sediment	96 ± 5.5	0.21 ± 0.020	92 ± 4.5	2.20 ± 0.090
Lower Wolverine Creek (Reference)	100 ± 0	0.26 ± 0.060	88 ± 8.4	2.64 ± 0.51
Lower Minto Creek (Exposed)	94 ± 5.5	0.27 ± 0.020	70 ± 12.2	2.98 ± 0.31

Note: Data presented as mean ± standard deviation.

 Significantly different than control sediment.

 Significantly different than reference sediment.

 Significantly different than reference and control sediment.

5.7.1 Periphyton Monitoring

Periphyton production and community data were collected at lower Minto and lower Wolverine creeks. Productivity was assessed through measurements of chlorophyll-a in periphyton (used as a surrogate for the productivity of photosynthetic organisms).

Concentrations of periphyton chlorophyll-a were not significantly different between lower Minto Creek (55 mg/m²) and lower Wolverine Creek (43 mg/m²) but were below the British Columbia Water Quality Guideline (BCWQG) of 100 mg/m² for the protection of aquatic life (BCMOE 1985; Figure 11-2). Station LWC-5 (reference) had higher concentrations of chlorophyll-a compared to guidelines, but overall both areas were below guidelines and did not differ significantly. Production was classified based on the system of Dodds et al. (1998), which sets the oligotrophic-mesotrophic boundary for benthic chlorophyll-a at 20 mg/m² and the mesotrophic-eutrophic boundary was set at 70 mg/m². Previously, production of both creeks has been classified as low (oligotrophic) but this has varied. Lower Minto Creek has previously been classified as eutrophic (2016) and mesotrophic (2017) and lower Wolverine Creek has been classified as mesotrophic (2016) but in 2018 both creeks were classified as mesotrophic. Based on total phosphorus only, both creeks would be defined as oligotrophic as was observed in previous years (Dodds et al. 1998).

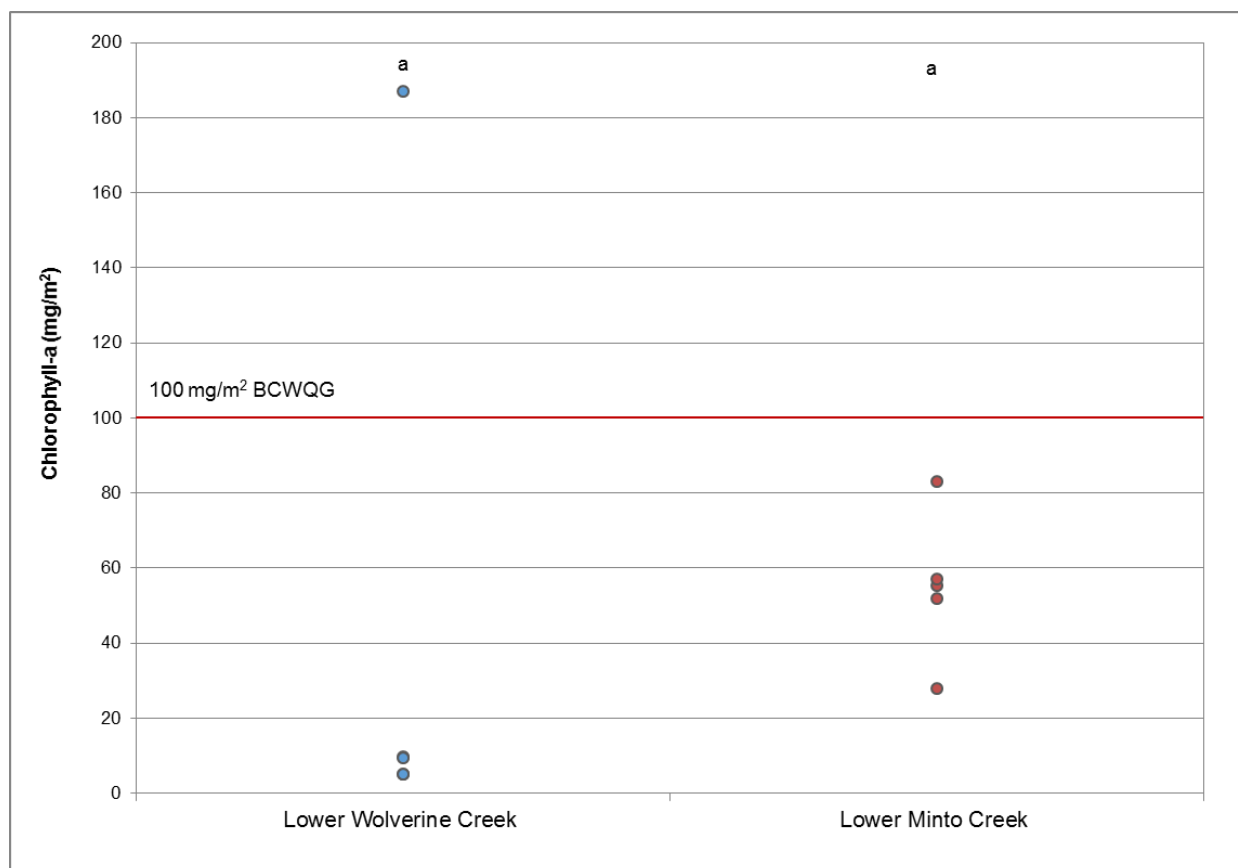


Figure 11-2: Concentration of Chlorophyll-a in Periphyton Measured at Five Benthic Invertebrate Stations in Lower Wolverine and lower Minto Creeks, Minto Mine WUL, 2018

Note: Different letters represent significant differences between areas.

The periphyton community of lower Minto Creek was evaluated and compared to that of lower Wolverine Creek in order to evaluate any potential mine-related effects. Dominant phyla in lower Minto and Wolverine creeks were Bacillariophyceae (diatoms) and Cyanophyta (blue-green algae). Bacillariophyceae was dominant at lower Minto Creek (85% of community) and lower Wolverine Creek (82% of the community; Figure 11-3). Temporal variability in community composition has been high in both exposure and reference areas (Figure 11-3). For example, at lower Minto Creek, Bacillariophyceae were dominant in 1994, 2013, 2014, and 2016, and 2018, Rhodophyta (red algae) in 2012, and Cyanophyta in 2011, 2015, and 2017 (Figure 11-3). This lack of temporal consistency was also observed at lower Wolverine Creek, with Cyanophyta dominant in 2011 and 2013 and Bacillariophyceae in 2012, 2014 to 2018 (Figure 11-3; e.g., Minnow 2016, 2017, 2018).

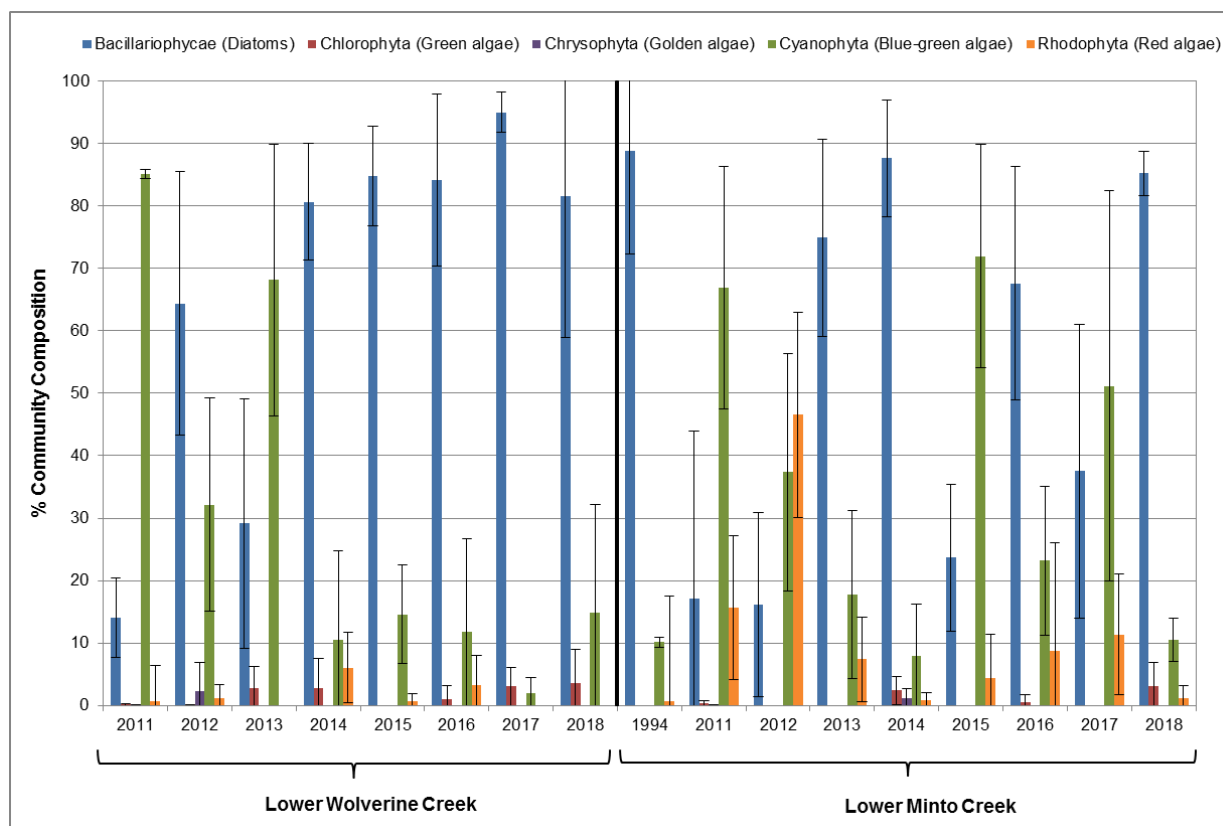


Figure 11-3: Periphyton Community Composition in Lower Minto Creek (1994, 2011 to 2018) and Lower Wolverine Creek (2011 to 2018), Minto Mine WUL, 2018

Note: Data presented as mean $\pm$ standard deviation.

5.7.2 MIBenthic Invertebrate Community Monitoring

Benthic invertebrate communities at erosional areas of lower Minto Creek were summarized and compared to erosional areas of lower Wolverine Creek and lower Big Creek in order to evaluate any potential mine-related effects.

Benthic invertebrate community metrics of density, number of taxa, and Simpson's Diversity and Evenness were not significantly different among areas (Table 11-3). Bray-Curtis index was significantly higher at lower Minto Creek than both reference areas (Table 11-3). The primary metrics suggests a limited mine influence. Percent EPT was significantly higher and percent chironomids was significantly lower at lower Minto Creek compared to lower Wolverine Creek (Table 11-3). The significantly higher proportion of EPT and lower proportion of chironomids suggests limited mine influence on benthic invertebrate community (Chapman et al. 1982a,b, Rosenberg and Resh 1993, Taylor and Bailey 1997). A potential decrease in number of taxa from 2012 to 2014 was not supported by the 2015 to 2017 data and appears to represent natural variability (Minnow 2015, 2016, 2017). The similarity of the benthic community of lower Minto Creek to reference communities and the temporal stability in the benthic community of lower Minto Creek suggest limited mine influence.

Table 11-3: Statistical Comparisons of Benthic Invertebrate Community Metrics, Minto Mine WUL, 2018

Metric	Comparison		Area Mean or Median ^a		Statistical Contrasts		
	Exposure Site	Reference Site			Significant Difference between areas?	Direction	P-value ^b
Density (organisms/m ²)	lower Minto Creek	lower Wolverine Creek	1,382	501	NO	-	0.106
		lower Big Creek		782	NO	-	
Number of Taxa	lower Minto Creek	lower Wolverine Creek	15.8	15.2	NO	-	0.422
		lower Big Creek		18.6	NO	-	
BC Index to Combined Reference Median	lower Minto Creek	lower Wolverine Creek	0.905	0.356	YES	Minto > Wolverine	0.007
		lower Big Creek		0.392	YES	Minto > Big	0.014
Simpson's Diversity ^c	lower Minto Creek	lower Wolverine Creek	0.785	0.722	NO	-	0.157
		lower Big Creek		0.669	NO	-	
Simpson's Evenness ^c	lower Minto Creek	lower Wolverine Creek	0.315	0.269	NO	-	0.134
		lower Big Creek		0.168	NO	-	
Ephemeroptera (%)	lower Minto Creek	lower Wolverine Creek	8.24	11.4	NO	-	0.558
		lower Big Creek		24.8	YES	Minto < Big	0.010
Plecoptera (%)	lower Minto Creek	lower Wolverine Creek	28.4	3.66	YES	Minto > Wolverine	<0.001
		lower Big Creek		7.46	YES	Minto > Big	0.007
Trichoptera (%)	lower Minto Creek	lower Wolverine Creek	0.0548	0.225	NO	-	0.722
		lower Big Creek		0.394	NO	-	
EPT (%) ^d	lower Minto Creek	lower Wolverine Creek	42.4	19.2	YES	Minto > Wolverine	0.069
		lower Big Creek		34.1	NO	-	0.660
Chironomids (%)	lower Minto Creek	lower Wolverine Creek	33.1	61.1	YES	Minto < Wolverine	0.068
		lower Big Creek		55.8	NO	-	0.149
Oligochaetes (%)	lower Minto Creek	lower Wolverine Creek	3.74	7.55	NO	-	0.526
		lower Big Creek		5.18	NO	-	
Acari (%)	lower Minto Creek	lower Wolverine Creek	2.58	0.326	NO	-	0.468
		lower Big Creek		1.61	NO	-	
CA Axis-1 (42.3%)	lower Minto Creek	lower Wolverine Creek	-1.07	0.539	YES	Minto > Wolverine	<0.001
		lower Big Creek		0.534	YES	Minto > Big	<0.001
CA Axis-2 (14.7%)	lower Minto Creek	lower Wolverine Creek	0.0205	0.302	NO	-	0.358
		lower Big Creek		-0.468	YES	Minto < Big	0.028

Indicates a statistically significant difference between exposed and reference areas, $p = 0.10$.

^a For transformed data, the back-transformed mean is reported; for ranked data, the median is reported.

^b The overall p-value of the 3 group comparison used if there were no significant differences between all areas.

^c Calculated as recommended by Environment Canada 2012.

^d Percent Ephemeroptera (mayfly), Plecoptera (stonefly), Trichoptera (caddisfly).

Comparisons of benthic invertebrate community metrics in 2018 to those documented in previous years indicated substantial temporal variability (also observed with periphyton communities) at both the receiving environment and reference areas. Benthic invertebrate density at lower Minto Creek in 2018 was the highest observed over the 2012 to 2018 period (500 μm) and within the natural variability (Figure 11-4). Number of taxa at lower Minto Creek in 2018 was lower than in 1994 and within the historical range from 2006 onwards (Figure 11-4).

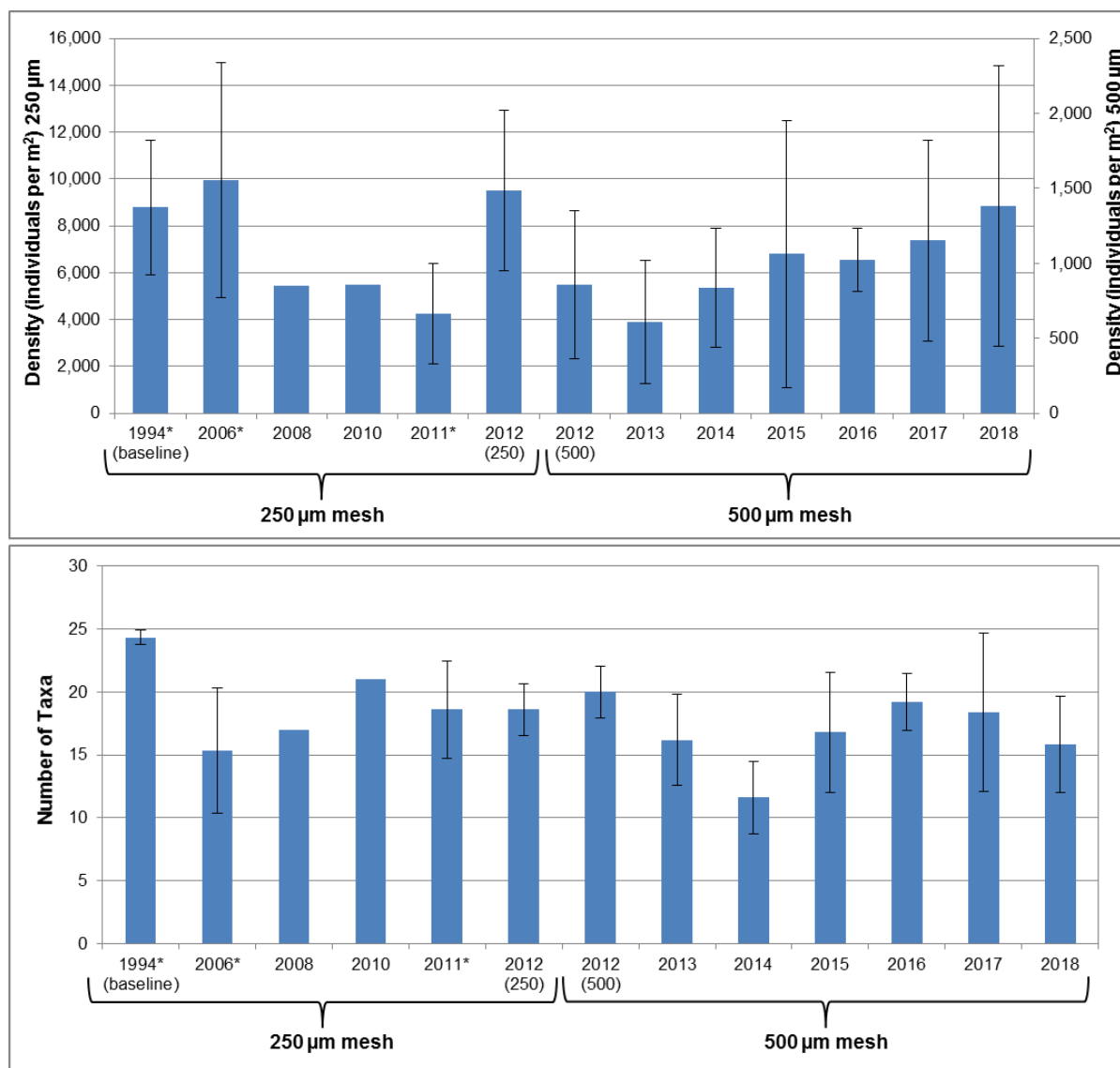


Figure 11-4: Primary Benthic Invertebrate Community Density and Taxon Richness at Lower Minto Creek, 1994 to 2018

Notes: Data presented as mean $\pm$ standard deviation where replicated. Asterisk (*) indicates a year the mine was not discharging.

11.2.2 Fisheries Monitoring Program

The objectives of the 2018 Fisheries Monitoring Program were to monitor, assess and characterize fish usage in Minto Creek during open water season, and to provide data allowing interpretation of the potential role and influence of the Minto Mine on the fish community. The 2018 fisheries program was a continuation of the previous year's components and targeted all species that have previously been encountered as well as any new species. As part of the 2018 monitoring program, assessments at Big Creek were made concurrently with sampling in Minto Creek, to compare fish use in a neighbouring system relative to Minto Creek. Fish monitoring studies were conducted as per the EMSRP.

Fish monitoring of Minto Creek and Big Creek was conducted monthly during open water season, from June to September 2018, at trapping sites consistent with the 2010 mark-recapture study and the 2011 to 2017 fish monitoring programs. Capture effort included the use of Gee-type Minnow traps with 0.635 cm wire mesh size baited with Yukon River origin Chinook salmon roe. A total of six to fourteen minnow traps were set each time in Minto Creek, depending on water levels and availability of pools and backwater areas. Three to four traps were set each time in Big Creek, near the Minto road bridge.

All fish captured were identified, enumerated and measured for fork length or total length (± 1 mm), inspected for abnormalities, and released near their trapping location. Juvenile Chinook Salmon were also weighed (± 0.1 g) prior to being released.

Additional supporting information collected included photo documentation of the creek, water level readings at W1 staff gauge, in situ water parameters in Minto Creek, Big Creek and the Yukon River (temperature, dissolved oxygen, conductivity, pH, Oxidation-Reduction Potential), discharge at W1, as well as weather conditions at time of sampling. Supporting variables also included monitoring of the previously identified fish barrier (1.2 km upstream of the Yukon River confluence) and/or any new barriers that may have developed.

For details on the 2018 results of Fisheries Monitoring Program see Appendix L.

11.3 Copper Toxicity Study

The copper toxicity study was initiated in 2015, due to a mild freshet and no major rainfalls, a turbid flow sampling could not be completed in 2016. The turbid flow sample was successfully collected and this program was completed in 2017.

11.4 Aquatic Environmental Monitoring Program (AEMP) Review

As required by clause 102 of the WUL, a review and evaluation of the AEMP program was conducted in 2016. The next review is not required until 2019.

12 Meteorological Monitoring Program

Meteorological monitoring at the Minto Mine consists of data collection for the following parameters: rainfall, snowfall, temperature, evaporation, wind speed and direction, barometric pressure, relative humidity, and solar radiation (incoming and reflected). The Meteorological Monitoring Program includes the Climate Monitoring Program (EMSRP Section 4.1) and the Snow Survey Program (EMSRP Section 4.2). Data collected under the Meteorological Monitoring Program, along with baseline climatic data, provides input for the following mine projects:

- Site water management;
- Prediction for yearly water events (e.g. freshet);
- Design of water storage, conveyance and discharge systems; and
- Design of flood control structures on the road network.

12.1 Climate Monitoring Program

The 2018 Climate Monitoring Program data are presented below in Figure 12-1 through Figure 12-7. During 2018, Minto Mine had one meteorological station located approximately 70 m northeast of the north end of the airstrip, in an area that allows ample meteorological exposure from all directions. Trees are cleared for a radius of 30 m from the meteorology station and beyond that radius is a sparse growth of 2 m tall conifers.

The meteorology station is a research grade Campbell Scientific station that records the following parameters: maximum wind speed, minimum wind speed, average wind speed, wind direction, precipitation (rain and snow), temperature, relative humidity, pan evaporation, barometric pressure, solar radiation, and calculated evapotranspiration. Data are averaged over the one-hour archiving period and then saved to the datalogger.

Some data were unavailable for June 29th and 30th while new hardware was being installed, and the relative humidity sensor stopped working on September 29th. The outgoing short wave radiation sensor and evaporation pan were operational in 2018, however the outgoing radiation data from January 1st to July 3rd were deemed inaccurate due to significant deviation from previous years' records and have therefore been omitted. Readings following July 3rd are believed to be more accurate and have been included in this report.

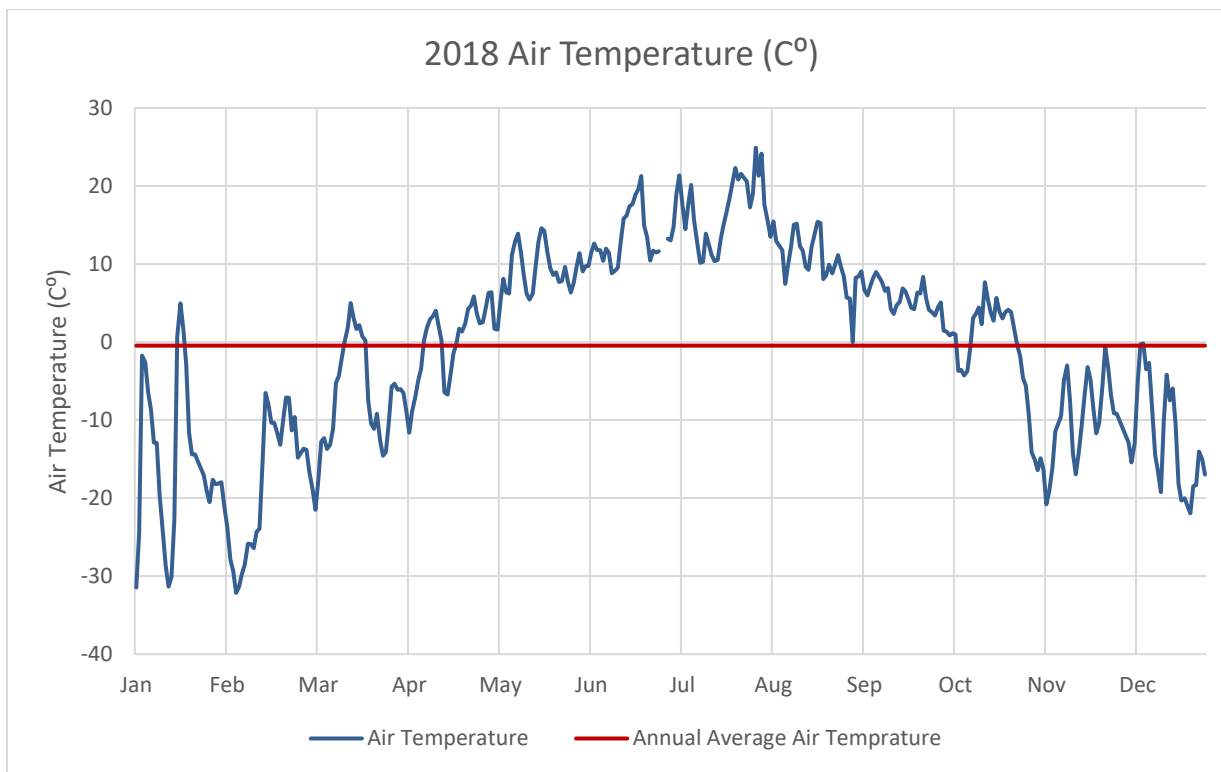


Figure 12-1: Annual Air Temperature (2018)

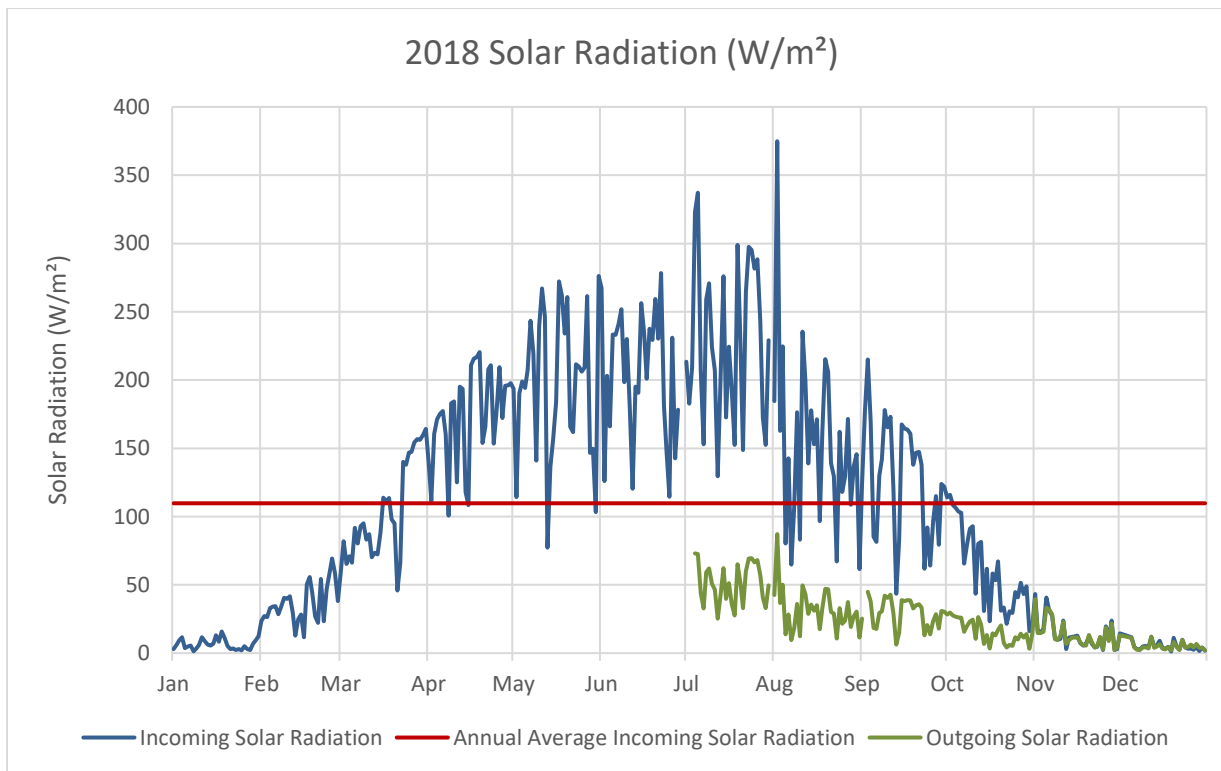


Figure 12-2: Annual Solar Radiation (2018)

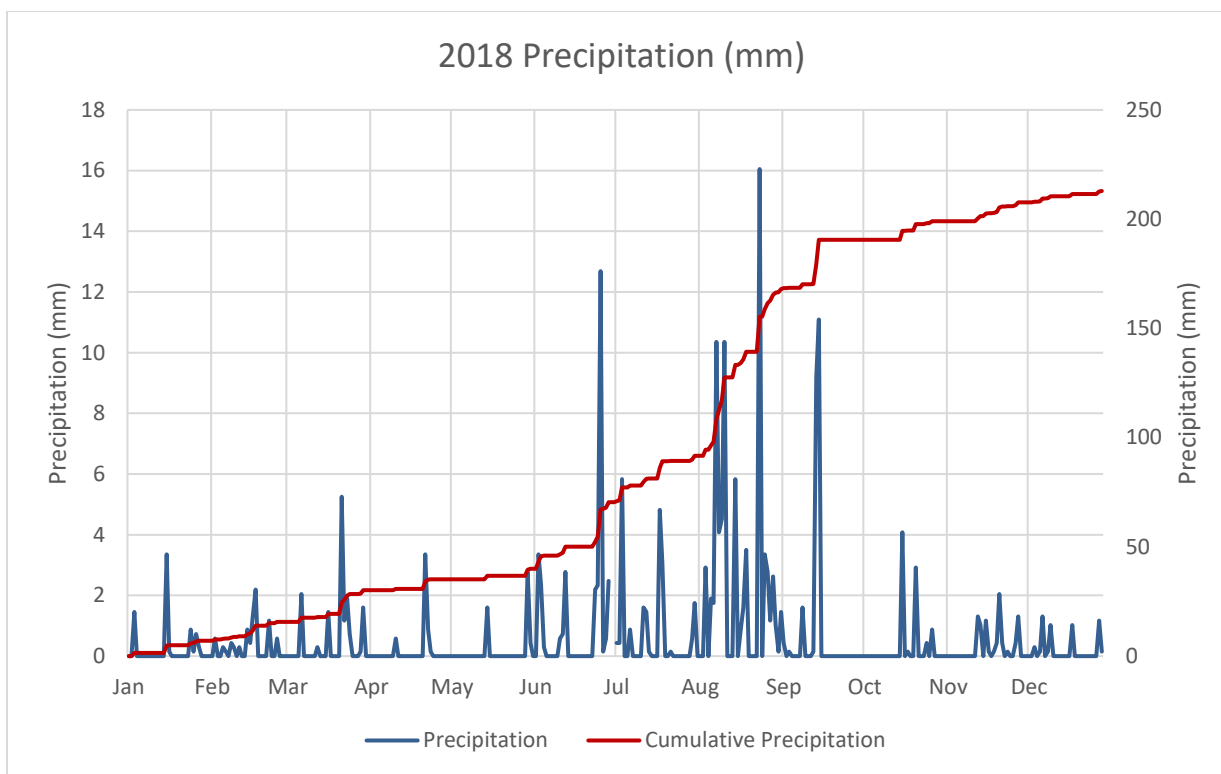


Figure 12-3: Annual Precipitation (2018)

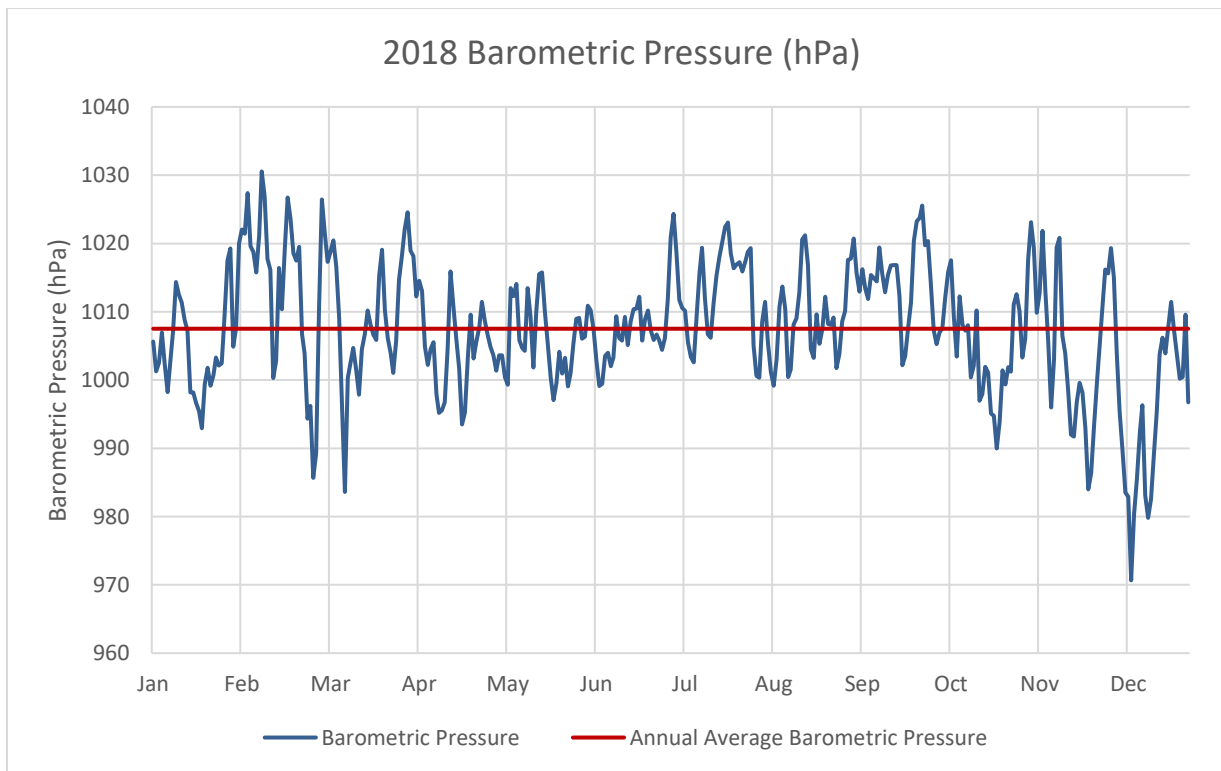


Figure 12-4: Annual Barometric Pressure (2018)

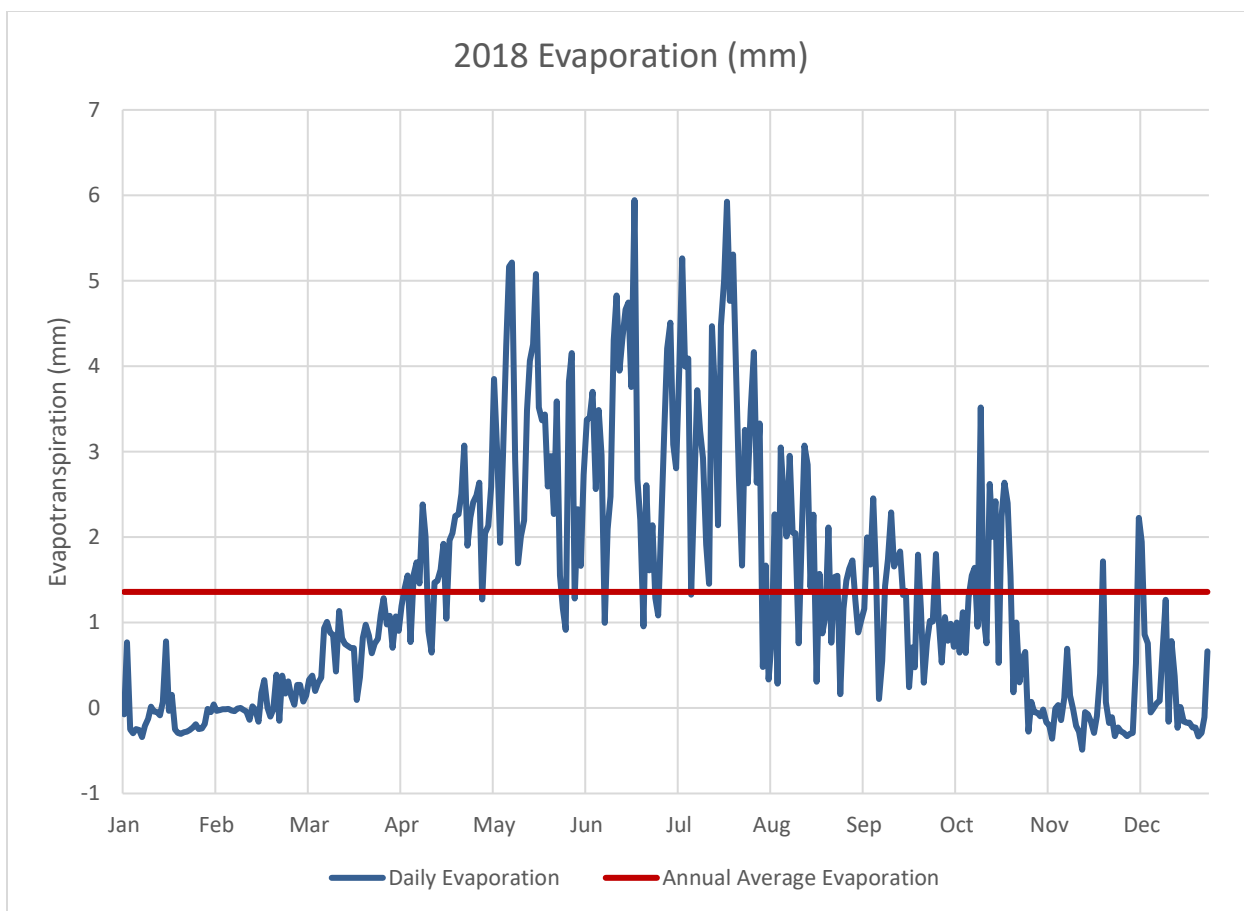


Figure 12-5: Evaporation (2018)

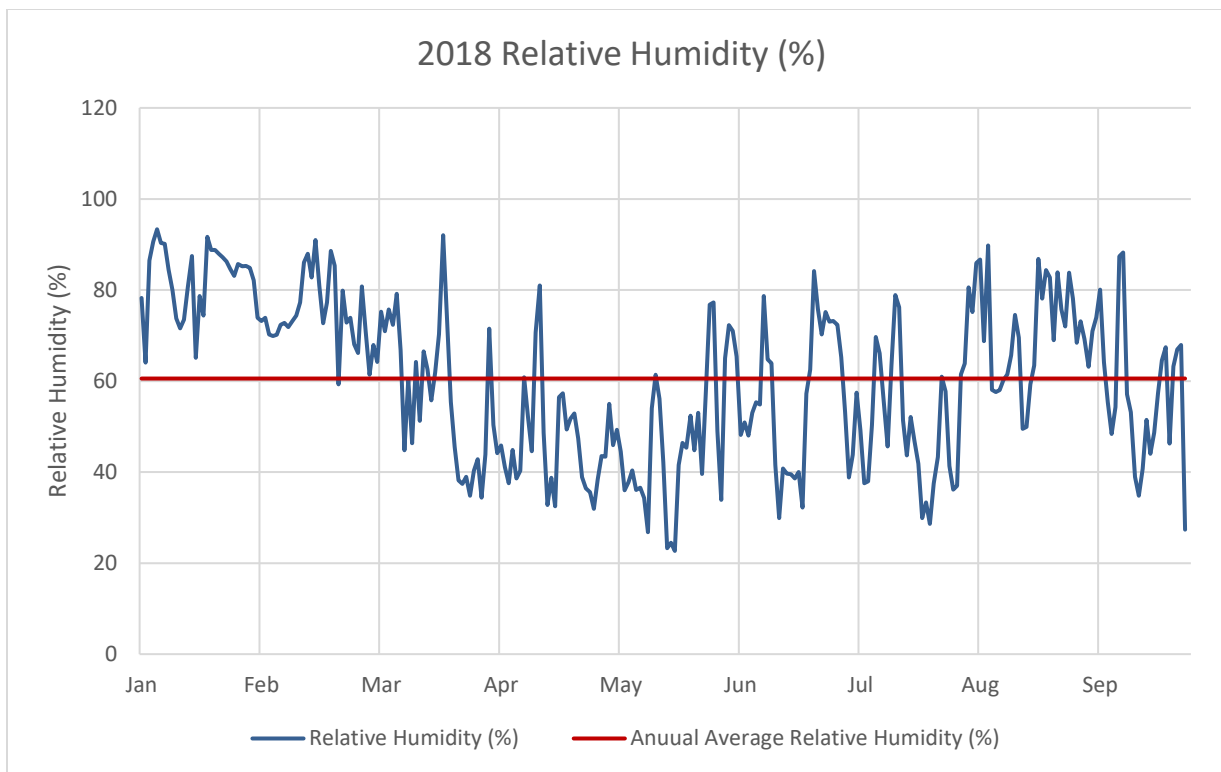


Figure 12-6: Annual Relative Humidity (January 1st – September 29th, 2018)

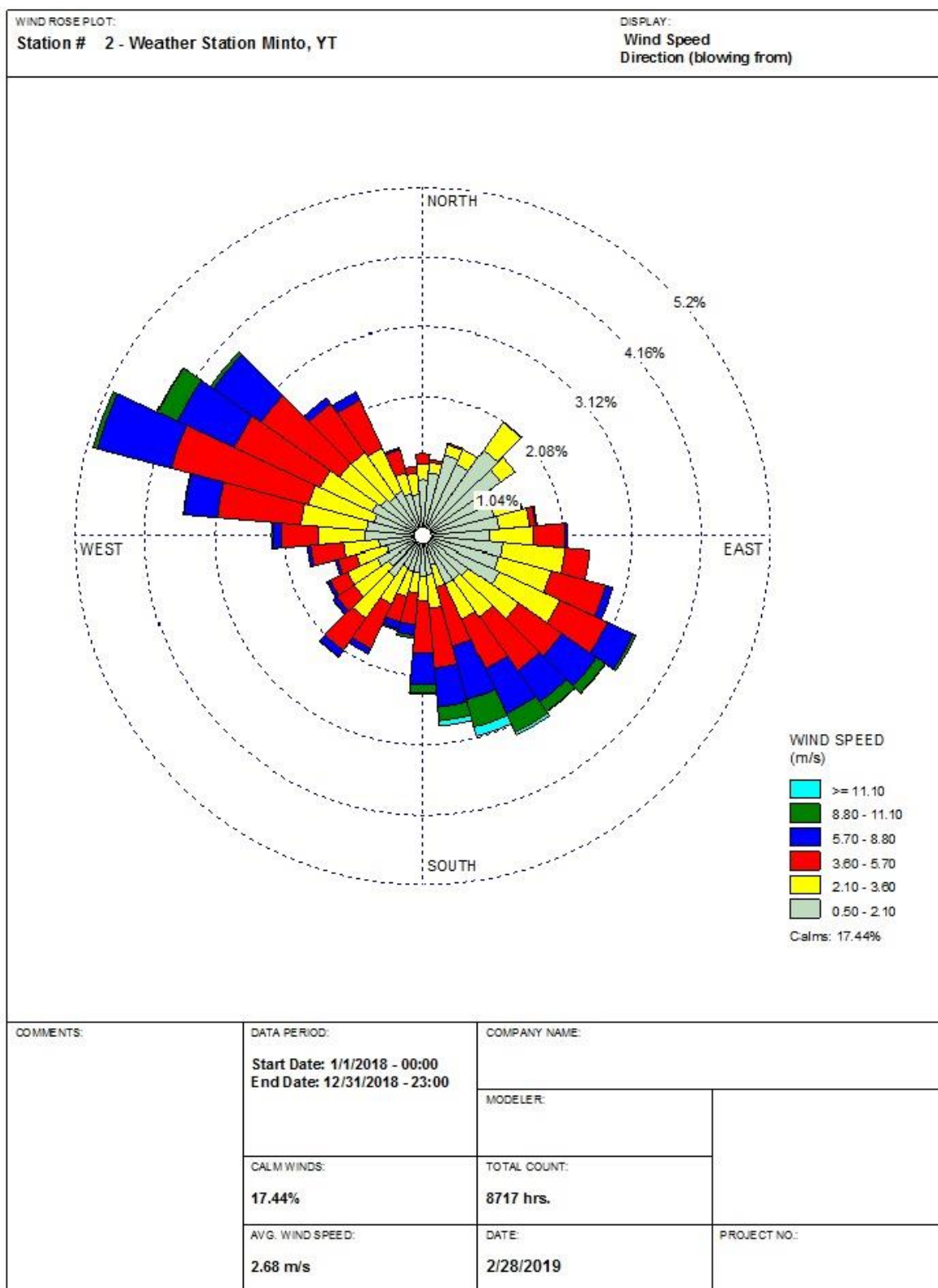


Figure 12-7: Wind Speed and Direction Events (2018) – WRPLOT View – Lake Environmental Software

12.2 Snow Survey Program

As required by the WUL Clause 96 and as part of the EMSRP, Minto collects snow data at the mine. The objective of the Snow Survey Program is to collect data used for calculating the snow water equivalent at the Minto Mine site. Snow water equivalents are inputs for the Minto Mine Site Water Balance models. Three courses are surveyed during the first week of February, March & April each year, a new course was added on the Dry Stack Tailings facility in 2017. If conditions permit, Minto will additionally survey the snow courses in May. These courses are East-facing (near the Dyno compound), North-facing (near the airstrip) and South-facing (above the Tank Farm), as detailed in Table 12-1. Along each course, ten stations are sampled using a machined core tube with cutting end and scale assembly. The parameters collected during the surveys include snow depth, core length, core weight, snow density, weather, site conditions, snowpack conditions, crust layers, and snow temperature. Multi-year results to 2018 (averaged across the three snow courses) are presented in Appendix E – 2018 Water Balance and Water Quality Model Summary for the Minto Mine.

Table 12-1: Snow Survey Course Locations

Course Location	Description	Aspect	UTM	
			Easting	Northing
Dyno	East of the Dyno compound on an east facing slope along a cut line surrounded by moderately densely tree area.	East Facing	8V 383 594	694 3377
Fuel Farm	North of the Minto Mine fuel farm on a south facing slope in a sparse to moderately densely treed area.	South Facing	8V 385 061	694 5318
Airstrip	Northeast of the Minto Mine airstrip on a north facing slope in a sparsely treed area.	North Facing	8V 386 255	694 4284
Dry stack Tailings facility	Directly on top of the Dry stack storage facility.	Flat	8V 385 525	694 4786

12.3 Meteorology QA/QC

Procedures for meteorology monitoring at the Minto Mine are detailed in the Meteorology Station Standard Operating Procedures. Minto has installed a satellite connection to the Met Station 2 to enable real time viewing of the weather station data. The meteorology data is downloaded and reviewed twice monthly by Environmental Department staff and routine visual inspections of the monitoring stations occur on a weekly basis.

13 Geochemistry

13.1 Waste Rock Verification Program

The Waste Rock Verification Program was initiated in 2014 to support and monitor waste rock handling procedures at the Minto Mine. The program was developed to address Clause 95 of the WUL, with the results of the program to be included in the Annual Report. The program consists of detailed record keeping on the type and quantity of waste rock placed at each location, and monitoring and verification of the characteristics of the waste rock stored at each location as per the Waste Rock and Overburden Management Plan.

Minto's Technical Services Department tracks all waste dispatched between the source and the destination using the mine's computer database system. The dispatch data are based on load count sheets compiled by the mining contractor.

Samples are taken by Minto geology personnel on dump crests that had been active in the previous month as determined by the production tracking database. The grab sample consists of one shovel full of material taken at twenty-five individual one-meter intervals over the distance of the recently placed waste. Particles greater than a pebble (64-80 mm) in size are manually rejected, the sample is then labelled and delivered to Minto's onsite assay lab.

Each sample is analyzed for total copper (Cu (T)), total sulfur (S (T)), and total carbon (C (T)) content using an Eltra CS-800 induction furnace. S (T) and C (T) values are converted into equivalent Acid Potential (AP-S (T)) and Neutralization Potential (NP-C (T)) values, and NP-C (T): AP-S (T) ratios (NP/AP) are calculated for each sample. The resulting (NP-C (T)): (AP-C (T)) ratios are compared to the segregation criteria and assigned "pass" or "fail" designations, which is a 3:1 ratio at Minto.

The Area 2 Stage 3 pit was only operational until April of 2018 when mining was complete. Waste was still blasted in the underground operation after April, but all underground waste was treated as SAT, and deposited in the Area 2 pit. Consequently, during the year 2018, forty-seven grab samples of waste (WST) were collected from the Main Pit Waste Dump (MPD) and twenty-four samples were collected from the Main Waste Dump Wrap (MWDW).

Of the seventy-one samples taken from the two destinations, seventy met the pass criteria based on the NP/AP segregation criteria. The one failure, which occurred in February in the MPD, was just below the failure criteria at 2.7. It was therefore determined to be an isolated event and no additional sampling was required. The average monthly values of the Acid-Base Accounting (ABA) parameters for each dump location are summarized in Table 13-1, below. For a complete summary of the sample results, please refer to Appendix M.

Table 13-1: Waste Rock Management Verification Program Summary (2018)

Average ABA Parameter Values: Month by Location								
Location	Month	Waste Type	Cu%	C% (Tot)	S% (Tot)	NP	AP	NP/AP
MPD	Jan	WST	0.168	0.337	0.070	28.08	2.18	13
	Feb	WST	0.130	0.528	0.142	43.95	4.42	10
	Mar	WST	0.280	0.840	0.232	69.97	7.26	10
MWDW	Jan	WST	0.118	0.557	0.203	46.44	6.36	7
	Feb	WST	0.218	0.818	0.257	68.10	8.04	8
	Mar	WST	-	-	-	-	-	-

13.2 Acid-Base Accounting Program

The EMSRP commits to the submission of results of the ABA Program that was conducted during the reporting year. The ABA program determines the Neutralizing Potential Ratio ((defined as Neutralizing Potential divided by Acid Potential [NP/AP]) (NPR)) for overburden and waste rock to confirm that the NPR is greater than three. An NPR value of three or greater is generally considered indication of non-acid generating material. A separate, parallel program was initiated to determine the NPR of the tailings solids.

The following is a summary of results from the ABA program for the monitoring period of January to October 2018.

A total of 116 samples were collected from the Area 2 Stage 3 (A2S3), Copper Keel Underground (CK UG) and the Minto East Underground (ME UG) deposits and sent to an accredited laboratory (ALS Minerals) during the 2018 monitoring period. The samples were analyzed according to the MEND Modified NP Method as noted in the EMSRP.

The meanNP:meanAP results for waste rock samples was 6.13 for the duration of the monitoring period. 17 samples during the 2018 monitoring period were below the NPR threshold of 3 for waste rock. The mean paste pH values for all samples tested in 2018 was 8.90. The mean sulfide sulfur ($S(S^{-2})$) content for waste rock samples during the 2018 monitoring period was 0.124%. In 2018, 14 samples exceeded the $S(S^{-2})$ content threshold of 0.30% for construction grade waste rock.

9 tailings samples were analyzed in this period and had a meanNP:meanAP of 19.15. All tailings samples were well above an NPR of 4. All 9 samples of tailings were also below 0.30% $S(S^{-2})$ content and had a paste pH between 7.9 and 8.5.

A full report including lab results and analysis can be found in Appendix N.

13.3 Leach Pads

In 2017, two field scale leach pads were constructed and filled with Partially Oxidized Ore (POX – Leach Pad #1) and Low-Grade Sulfide Ore (Green sulfide ore – Leach Pad #2), as per the EMSRP. The Pads were constructed in October 2017, and the first leachate samples were collected in May 2018. Samples were collected bi-monthly when water was available, resulting in 9 sampling events through the non-frozen months of 2018. Results from the leach pad samples are provided in the monthly reports. A summary report including the sampling methodology and sample results, will be compiled following the 2019 sampling season.

14 Terrestrial Monitoring Programs

14.1 Wildlife Monitoring Program

The *Minto Mine Wildlife Protection Plan* (a component of the EMSRP) establishes guidelines for minimizing wildlife disturbance at the Minto Mine site and along the development corridor and includes a monitoring program to yield information about wildlife use in the area. The 2018 activities under the Wildlife Monitoring Program including the area and frequency of monitoring, are summarized in Table 14-1, below.

Table 14-1: Wildlife Monitoring Activities (2018)

Area Monitored	Monitoring Activities	Frequency
Wildlife Monitoring	Wildlife monitoring consists of maintaining a wildlife observation log onsite and reporting wildlife encounters, as per the Wildlife Act. Environmental personnel on site will monitor project activities and modify operations to address wildlife concerns.	Ongoing
Migratory Birds	Monitoring to determine if waterfowl and shorebirds settle on impacted water bodies, such as the Main or Area 2 Pits. Environmental personnel on site will monitor project activities and modify operations to address wildlife concerns.	Seasonal, Daily during migratory periods
Species at risk/ of concern	Any caribou observations will be reported to the Conservation Officer in Carmacks. Bank swallows have been observed to nest in residuum piles in the summer months, in which case these piles are cordoned off and left undisturbed until after the late summer migration, or resloped prior to nesting season to deter nesting.	As necessary

In addition to the Wildlife Monitoring Activities listed in Table 14-1, the Minto Environmental Department gathered observations from mine site staff with Wildlife Observation forms. These forms were posted at many accessible locations around site and employees were encouraged to record all wildlife observations. The forms were collected periodically, and the sightings entered in a wildlife tracking sheet, which is included in Appendix O.

In 2018, 117 wildlife sightings were recorded, with sixty-three sightings involving bears, fourteen involving foxes, twenty-three involving deer, seven involving moose, two involving wolves, and 5 involving lynxes. Other animals observed on site included but were not limited to, hares, ermine, grouse, ptarmigan, sheep, dunlin, eagles, ducks and geese.

The most active month of the year for wildlife observations was May, with twenty-nine reportable sightings. April was our busiest month when it came to incidents involving active hazing, which could be connected to the abnormally long winter season that occurred in 2018.

Additional activities that took place on site included wildlife education (including bear awareness training) and the sending of safety flashes concerning the prevention of wildlife habituation to all staff working on site.

Incidents involving wildlife are documented in Section 2.5.2

14.2 Erosion and Sedimentation Monitoring Program

As part of the EMSRP, Minto has developed and implemented a *Sediment and Erosion Control Plan* (SECP). The objective of the SECP is to minimize local site impacts from erosion and prevent sedimentation to the receiving environment of Minto Creek. The 2018 activities associated with the Erosion and Sedimentation Monitoring Program are identified in Table 14-2, below.

Table 14-2: Erosion and Sedimentation Monitoring Activities (2018)

Activity	Location	Frequency
Visual inspections	Bottoms of slopes and depressions of large structures.	As needed following heavy rain events, and during freshet.
	Road routes: ditches and outlets of culverts and pipes.	As needed following heavy rain events, and during freshet.
Water quality monitoring for total suspended solids (TSS)	Water quality monitoring stations W2, W3, W50 and W17	Weekly and during heavy runoff periods.
Physical inspection of surface facilities by a Yukon registered Engineer.	Water Storage Pond Dam, Mill Water Pond, all waste rock and overburden dumps, all water diversion and conveyance structures and the dry stack tailings storage facility.	After the spring thaw period in May/June of each year and again prior to the on-set of winter in September of each year

There were no significant issues, however three minor issues were addressed during 2018.

In the third week of March, due to warming temperatures, runoff from the portal road was running over the bank to A2S3 pit causing issues with the mining below. Additional piping and hoses were able to control and direct the water as needed.

In late August during heavier precipitation the swale at the diversion ditch required some minor maintenance to prevent deteriorating road conditions. The landscaping work resolved the issue, ensuring the water was directed to the appropriate ditching.

In August following the geotechnical inspection, the camp area was re-graded to prevent water from flowing over the berm and causing isolated erosion. The re-grading was successful.

14.3 Invasive Plant Species Monitoring Program

As part of the EMSRP, Minto developed an Invasive Species Monitoring Standard Operating Procedure in 2015. The Invasive Species Monitoring Plan, created in 2014, was the basis for the SOP. The SOP details how the monitoring program will be conducted.

The 2018 invasive species program took place between August 2nd and August 4th. The program consists of surveys in areas on site which are affected by high traffic such as the Waste Management Area, the Dry Stack Tailing Facility (by the haul road), the Fuel Farm, the road towards the Dyno plant and the Pelly Yard. Areas with lower visitor traffic such as the newly covered Southwest Dump, the Minto North road, the W15 wetland area. The access road was surveyed for consistency and continuation in this monitoring. The survey focused on the high-risk species as listed by the Yukon Invasive Species Council (YISC) (Table 14-3). During the survey, a few high-risk species were observed growing along the access road and sparsely on site in surveyed areas. As per the EMSRP, the observed high-risk species were reported to the YISC Spotter's Network.

In accordance with the EMSRP, invasive plant surveys will be continuing through 2019, particularly along invasive species pathways such as roads with high visitor traffic, recently exposed areas, and areas that have been recently reclaimed. Coordinated photos for long term photographic monitoring will be continued.

Table 14-3: High Priority Invasive Species as determined by the Yukon Invasive Species Council, 2018

Common Name	Latin Name
Bird vetch	<i>Vicia cracca</i>
Dalmatica toadflax	<i>Linaria dalmatica</i>
Smooth brome	<i>Bromus inermis</i>
Crested sweetgrass	<i>Agropyron pectiniforme</i>
Quackgrass	<i>Elytrigia repens</i>
Altai wild rye	<i>Leymus angustus</i>
Reed canary grass	<i>Phalaris arundinacea</i>
Narrowleaf hawksbeard	<i>Crepis tectorum</i>
Common tansy	<i>Tanacetum vulgare</i>
Creeping thistle	<i>Cirsium arvense</i>
Hawkweeds	<i>Crepis tectorum</i>
Lucerne	<i>Medicago falcata</i>
Yellow & White sweetclover	<i>Melilotus</i>
Leafy spurge	<i>Euphorbia esula</i>
Oxeye daisy	<i>Leucanthemum vulgare</i>
Perennial sow-thistle	<i>Sonchus arvensis</i>
Scentless chamomile	<i>Tripleurospermum perforata</i>
Greater butter and eggs	<i>Linaria vulgaris</i>
Spotted knapweed	<i>Centaurea stoebe</i>

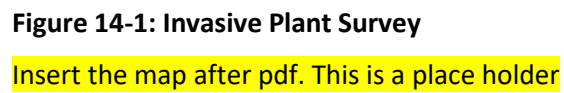
14.3.1 Meandering surveys

Meandering surveys consist of a walk around in high visitor traffic areas and identification of invasive species observed during each survey. Each area surveyed was also set up with a long-term coordinate to allow for photos to be taken annually for long term observation. All soil texture was coarse, no overburden piles or organic materials were surveyed and all proposed activities were human-related activities. The area and density of each plot was categorized per cubic meter. For species identified in each area, see Table 14-4 below and each route mapped can be observed in Figure 14-1.

Table 14-4: Meandering Survey Results

Area	Invasive Species	Waypoint Number	Area (% coverage)	Distr. Code	Density Code	Abundance
Minto North	White Sweetclover	N62° 37.674' W137° 15.385'	0-10	2	1	Sporadic
Pelly Yard	White Sweetclover	N62° 37.640' W137° 15.300'	0-10	3	2	Sporadic
Pelly Yard	White Sweetclover	N62° 36.976' W137° 15.886'	0-10	2	1	Rare
Dyno Road	Narrowleaf Hawksbeard	N62° 36.723' W137° 16.289'	0-10	4	1	Sporadic
Southwest Dump	Narrowleaf Hawksbeard	-	0-10	2	1	Rare
Southwest Dump	Smooth brome	N62° 36.325' W137° 16.028'	0-10	4	3	Sporadic
Fuel Farm	Narrowleaf Hawksbeard	N62° 36.480' W137° 15.801'	0-10	2	1	Rare
Waste Management Area	Narrowleaf Hawksbeard	N62° 36.291' W137° 13.499'	0-10	2	1	Sporadic
DSTF*	Narrowleaf Hawksbeard	N62° 36.878' W137° 13.943'	0-10	2	1	Sporadic
DSTF*	Smooth brome	N62° 36.873' W137° 13.925'	0-10	2	1	Sporadic
Access Road (barge parking)	White Sweetclover	N62° 35.231' W136° 52.804'	0-10	2	1	Sporadic
Access Road (barge parking)	Narrowleaf Hawksbeard	N62° 35.231' W136° 52.809'	0-10	2	1	Continuous

*Note: DSTF is the Dry Stack Tailing Facility



14.3.2 Access Road survey

For this continuous survey, Minto Environment staff drove the length of the access road (27km) at low speed to observe any invasive species growing on the road. In addition, coordinated photos for long term photographic monitoring were done at kilometers 3.5, 7.5, 12, 14, 16, 18, 20, 22, 24 and 26.

Narrowleaf Hawksbeard was visible throughout the length of the road in single plants. White Sweetclover was also visible in sporadic yet continuous from kilometre 12 to 27, and most notably a heavily dense patch from kilometre 15.5 to 16.5 from which photographs were taken and GPS track was recorded to capture the area most populated.

14.4 Vegetation Metal Uptake Plan

The Vegetation Metal Uptake (VMU) program was not required in 2018. The next scheduled program is in 2019.

15 Site Characterization Report

The Site Characterization Report was submitted to EMR in January 2018. As per Clause 13.1 of the QML, the report will be updated in three years from the effective date of the licence. The submission date for the update was December 2017. An extension was granted to January to ensure a comprehensive report was completed. This report was also submitted to the Yukon Water Board in February 2018 with the amendment application.

16 Reclamation

Reclamation activities at Minto Mine progressed throughout the monitoring period with the primary progressive reclamation focused on the following facilities:

- Mill Valley Fill Stage 2 (MVFE2); and
- Dry Stack Tailings Storage Facility (DSTSf);

Reclamation research regarding the use of constructed wetland treatment systems as a closure water treatment option continued throughout the year. Details regarding the program for 2018 can be found in Section 16.2 or Appendix P.

16.1 Progressive Reclamation Activities on MVFE2 and DSTSF

As seen in Figure 16-1, the MVFE2 was completed in summer 2016, in 2017 Minto contoured the area with closure in mind, the slopes were generally graded to shed water towards the north as seen in figure 16-2. The final contouring, cover specifications and revegetation objectives of the Mill Valley Fill Extension

2 (MVFE2) and part of the Dry Stack Tailing Storage Facility (DSTSF) were met in 2018, both areas of concern are visible in Figure 16-3. The west end of the DSTSF was partly covered in fall 2018 but no final cover specifications were verified.

During the overburden and recontouring activities of 2017, some of the areas not meeting the required minimum 0.5m soil cover thickness had been identified, additionally, material settling occurred over the year on both the MVFE2 and DSTSF. To confirm which areas needed more overburden material and how much they needed, a survey and confirmation depth test pitting was undertaken in May 2018. A 45m grid of the slopes and the terrace areas was laid out and areas having less than 0.5m of overburden were identified by way of a 1m² pit excavated into the cover. The overburden layer was manually measured, as seen in figure 16-4, and the top and bottom of the overburden layer was surveyed. Photo and survey elevations were recorded at each test pit. Overburden material was added to areas measured at less than 0.5m overburden-soil cover and re-surveyed to ensure minimum cover requirements were met. The overburden material used was material stockpiled from the 2017 Area 2 Stage 3 pit stripping, stored on the facilities. The western section of the DSTSF was not completed in 2018.

Furthermore, both areas had the fine grading and phase 1 seeding completed in October 2018, on the DSTSF slopes and the north-facing slope of the MVFE2 as seen in figure 16-5. Figure 16-6 presents the site overview and facilities in the southeast of Minto Mine site.



Figure 16-1: Minto Mine – Mill Valley Fill Extension Stage 2 completed in 2016.



Figure 16-2: Minto Mine – Overburden cover pushed into place on the MVFE and DSTSF (2017).



Figure 16-3: 2018 Progressive Reclamation Areas, MFVE2 (foreground) and DSTSF (top of photo)



Figure 16-4: Test Pit TH-29 Measurement May 12, 2018 (0.35m depth)



Figure 16-5: MVFE and DST fine grading completed (September 2018)



Figure 16-6: Minto Mine – Site overview.

16.2 2018 Reclamation Research

Reclamation research in 2018 focused primarily on carryover research of passive treatment technologies which started in 2014 and carried through 2018. Small-scale experiments were undertaken to provide an in-pit treatment biological solution to the higher levels of nitrogen species, specifically nitrite, in the main pit.

16.2.1 Passive Water Treatment

The demonstration-scale constructed wetland treatment system (CWTS) was constructed at Minto in 2014 and commissioned from 2015 through mid-2017 during which time the system matured, and operational adjustments were made. In 2018, it was anticipated that the CWTS would continue with the operational period; however, due to the unintentionally imposed stresses of drying out of the CWTS and the elevated nitrate concentrations in the spring (May to mid-June), an opportunity arose to determine the effects these stresses on CWTS performance and assess the amount of time needed for the CWTS to recover. Beginning of the operational period (and, therefore recovery from the double stress test) was marked by meeting the same criteria used to determine the end of commissioning period in 2017 and by achieving consistent extent of removal of COCs, comparable or better removal than what was observed during the operational period in 2017 (Contango, 2017b). Recovery period from the double stress test in 2018 was variable for each series and COC. Additional recovery strategies were attempted on the systems, including stagnation, and addition of iron. Recovery periods ranged from 0 days to 54 days for Series 1 and 0 days to 93 days for Series 2. For consistency of data analysis and comparison of performance between series, only data from when recovery criteria were met for all COCs in both series, and flows were at target levels was used. This 24-day period will be referred to as the 2018 operational period.

Various aspects of the system were measured in 2018 and have been detailed under a separate report including operating conditions, water treatment performance, fate and distribution of treated metals, evapotranspiration, detritus decomposition rates, microbial community characterization (catalyzing treatment reactions), and pest control. The key findings of each phase of this research project are presented in table 16-2 below. A full detailed report can be found in Appendix P.

Table 16-1: Demonstration Scale Constructed Wetland 2018 Work Summary

Item	Date	Activities	Actual
Construction	2014	Identify potential location for demonstration scale CWTS (Contango site visit – 1 scientist)	Completed June 2014
		Engineering and geotechnical (Minto)	Completed July 2014
		Construction (Minto)	Completed July 2014
		Planting and bringing system online (Contango site visit – 1 scientist, 1 technologist), coordinate for local students to assist	Completed August 2014 (no students available, brought 2 technologists)
Commissioning	2014	Acclimation and maturation at constant flow rate, ~20 hr HRT	Completed
		September - Contango site visit/checkup (1 technologist, 1 scientist)	Did not occur because construction was last week of August
	2015	Continued commissioning. Operation at constant flow rate, ~20 hr HRT	Completed (at shorter HRT)
		Spring – Contango site visit/checkup (1 technologist, 1 scientist), includes micro sampling	Completed
		Summer - Increase depth from 10 cm to 20 cm (1 technologist), includes micro sampling	Completed (scientist)
		Fall – Contango site visit/checkup (1 technologist), includes micro sampling	Completed (scientist)
	2016	Minto to add sandbags prior to first site visit and begin W15 creek monitoring	Completed May/June 2016
		Spring – Contango site visit (1 scientist, 1 technologist), includes microbial sampling and tasks outlined in Table 5 of report. HRT tracer study completed, outlined in section 7 of report.	Completed June 2016
		Summer - Contango site visit/checkup (1 scientist, 1 technologist), includes microbial sampling and tasks outlined in Table 5 of report. Evapotranspiration study completed as outlined in section 9 of report. Organics were added to the CWTS as outlined in section 5.1 of report.	Completed July 2016
		Fall - Contango site visit/checkup (1 technologist), includes microbial sampling and tasks outlined in Table 5 of report	Completed September 2016
		Continued commissioning operations at constant flow rate.	Completed May 2017
	2017	Two evapotranspiration studies were completed	Completed May/June 2017
		Spring – Contango site visit (1 scientist, 1 technologist), includes microbial sampling and tasks outlined in Appendix A of report. Completed HRT tracer study. Sample for AVS to assess if the added organics are having the desired effect.	Completed June 2017
		Summer - Contango site visit/checkup (1 scientist), includes microbial sampling and tasks outlined in Appendix A of report.	Completed July 2017. Seasonal water sampling was not completed due to flow interruptions. Seasonal water sampling was completed by Minto in August.

Item	Date	Activities	Actual
Commissioning		Minto added sandbags to outflows of CWTS cells to increase water depth	Completed August 2017
		Commissioning completed and beginning of operational period	Completed August 2017
Operations		Fall – Contango site visit/checkup (1 scientist), includes microbial sampling and tasks outlined in Table 5 of report.	Completed by Minto, after being taught microbial sampling by Contango. No site visit needed by Contango.
		Monitor soil redox. Determine when it consistently reaches targeted range.	Completed throughout 2017
Performance monitoring	2018	Develop a sampling plan, and aphid control and monitoring plan for 2018	Completed March, 2018
Drought recovery		Start water flow to CWTS; add sandbags to end and along perimeter of each CWTS cell to increase water depth by 1 to 5 cm; aphid control using more powerful insecticide on a routine schedule	Completed May 2018
		Assess recovery of CWTS from drought	Completed throughout 2018
		Summer – Contango site visit (1 scientist); conduct a vegetation plot harvest and assessment of biomass produced; collect one bag of <i>C. aquatilis</i> and one bag of polyester filter foam from each CWTS cell; replant <i>C. aquatilis</i> in areas with sparse vegetation	Completed July 2018
		Iron added to Series 1	Completed July 2018
		Two evapotranspiration studies were attempted (were not informative due to precipitation during trials)	Completed July/August 2018
Performance monitoring	2019	Fluctuate flow rates, based on expected amount of water for full-scale wetland (scaled to size). Evaluate performance of CWTS at different key periods. Fertilize plants (if necessary).	Throughout 2019
Operations		Develop a flow rate schedule and sampling plan for 2019	April 2019
		Provision of updated standard operating procedures for new staff responsible for monitoring and sampling CWTS	
		Start water flow to CWTS; continue aphid control using insecticide on a routine schedule	April/May 2019
		Spring – Contango site visit; training of new staff responsible for monitoring and sampling CWTS, monitor for presence of aphids, add iron to Series 1, collect one bag of <i>C. aquatilis</i> and one bag of polyester filter foam from each CWTS cell	May/June 2019
		Summer – Contango site visit; conduct a vegetation plot harvest and assessment of biomass produced; conduct evapotranspiration trial for warmer months	July/August 2019
		Fall – Contango site visit (if necessary), replanting if needed, soil harvesting for additional off-site stress tests, final sampling event.	September, 2019
Reporting	2014-2020	Reporting will be performed annually, with verbal and/or emailed interim updates	On Schedule

Table 16-2: Passive Water Treatment Research Key Findings (2018)

Key Findings
• Dissolved oxygen (DO) increased during the double stress test period and operations in 2018. Elevated DO is likely the result of photosynthesis of algae, which had increased growth due to fertilizer addition. Despite the DO levels being in aerobic ranges, stable reducing conditions were achieved in CWTS soils within the targeted range. • Other than the day that the CWTS was refilled (May 14, 2018), soil redox was unaffected by the drought. Average soil redox values were more reducing (and stable in the targeted range) in 2018 than 2017.
• While leaching of copper from substrates used in construction was remedied by the end of the commissioning-B period in 2017, copper leached from the soils into the water in early 2018, likely due to the drying out of the CWTS in the early spring/freshet of 2018. However, leaching had subsided by July 8, 2018 as the rate of treatment exceeded the rate of leaching. Copper is not expected to leach in 2019 operations provided that the CWTS remains flooded. • Stagnation and iron addition can be used at full-scale to mitigate recovery length after periods of drought (or stagnation/slower HRT for high nitrate concentrations). • During the 2018 operational period the demonstration-scale CWTS successfully treated all COCs.
• The lowest concentrations consistently achievable for the treatment design (performance limits confirmed by t-test) were reached for cadmium after 3.80 days for Series 1 and 3.54 days for Series 2 and for copper after 3.54 days (Series 2 only). • Removal rate coefficients (RRCs, k) have been developed that can be used for full-scale sizing. • Copper leaching from soils decreased from the drought recovery period but is still likely making the RRC artificially low in this CWTS; however, the RRC is expected to improve in 2019 as leaching continues to decrease.
• The 2018 evapotranspiration trials were unsuccessful due to precipitation throughout each trial; however, the 2017 trials revealed a significant loss of water, which will impact calculations of loads to the receiving environment (making them lower than previously estimated). • Unlike 2017 trials, leaching of copper was not observed during periods of no flow in 2018, indicating copper leaching has improved.
• In 2018, leachable copper concentrations in soils decreased in the top 0-10 cm while total copper concentrations were within ranges previously measured. • Most constituents, including copper, have shifted primarily into stable reduced and residual minerals fractions in the soil. • Acid volatile sulphides (AVS) provide buffering capacity to the soils and continued treatment through cold temperatures. AVS concentrations have been non-detectable in the CWTS due to low iron concentrations in substrates and water. While a small amount was detected in 2017 and 2018, Series 1 was amended with iron in attempt to improve AVS concentrations. • While Series 1 was amended with iron, it is unclear if the addition of iron was sufficient to increase AVS concentrations, but it is planned to add more in 2019.
• Overall, uptake of metals in <i>C. aquatilis</i> was low and generally lower in 2018 than in 2017 demonstration-scale CWTS, with the exception of selenium in cell 1A which was slightly higher in 2018.

Key Findings
Targeted treatment mechanisms are becoming more robust, rendering elements non-bioavailable.
- An aphid infestation occurred in 2016 and 2017. While some efforts were made in 2017 to control the aphid population, the spraying regimen was not maintained and, therefore, aphids remained. However, no long-term detrimental effect on <i>C. aquatilis</i> viability was observed, despite the persistence of aphids. - In 2018, early and consistent application of insecticidal soap greatly reduced the abundance and length of an aphid infestation as well as improved containment of the aphids. - Pesticide application is not expected to be needed in the full-scale CWTS as it will not be in an isolated location (Contango, 2017b).
- Decomposition of <i>C. aquatilis</i> is occurring in the CWTS and contributing to reducing conditions. - Only partial decomposition of total <i>C. aquatilis</i> biomass from the previous year is occurring in an operational season, resulting in an accumulation of organic matter over time (accretion) which is an important process in the CWTS as it buries treated minerals making them more stable. - Decomposition of <i>C. aquatilis</i> occurs quickly when initially submerged in the CWTS with 56% decomposition occurring after 34 days. Decomposition slows overtime with an average of 85% decomposition occurring after 446 days (including one winter season/freezing period).
- The <i>C. aquatilis</i> in the CWTS produced 0.802 kg/m² (dry weight) of above water biomass per year. - This same amount of dry biomass should be supplemented to the full-scale CWTS (e.g., as straw) while going through maturation and filling in with vegetation for first 1-3 years after initial planting to expedite commissioning.
- Similar to 2017, root samples harboured the highest abundances of sulphide-producing bacteria (SPB), selenium-reducing bacteria (SeRB), and denitrifying bacteria in 2018. - Microbial communities were not affected by the double stress test period, with the exception of SPB in roots, where proportions were lower following the drought. However, by the end of 2018, proportions of SPB in roots increased to levels measured in the 2017 operational period.

16.2.2 In-pit Treatment Research

In pit treatment research has been ongoing at Minto Mine between 2012 to 2014. No experimentation took place between 2015 to 2016, partly due to the less immediate need for a natural water treatment since the water treatment plant was operating and the excavation of the newer open pits offered water storage volumes. In 2017-2018, two small scale bench top experiments were conducted. This was to investigate if the assimilation of ammonium, and to a lesser extent nitrate and nitrite, in the rapid growth of algae would work as an effective means of nitrogen removal in the water from the Main Pit.

Preliminary experiments took place during November and December 2017 to identify monobasic potassium phosphate (MKP) concentrations that would yield the ideal algae growth, which in turn would feed on the nitrogen species. Seven different concentrations were used in 20L pails under a 16-hour active

UV light in a temperature-controlled environment for 6 weeks, reproducing early August site conditions. Additionally, there was a control pail containing no MKP as seen in figure 16-7. Weekly samples were collected for chlorophyll concentration, dissolved metals, total and dissolved carbon and nutrients (ammonia, nitrite and nitrate). This experiment determined that 50% and 100% stoichiometric MKP ratio had the most promising results. The nitrogen species saw a rise in concentration in the second half of the experiment due to the lack of oxygen and circulation in the systems, ultimately the experiment failed to show that algae growth alone would be sufficient for in-pit treatment of nitrogen species.



Figure 16-7: Ammonia Attenuation Experiment (November 2017)

During summer 2018, three 1m³ totes (1000L) were filled with pit water and set outside on the west side of the Minto Water Treatment Plant, water circulation through sprinklers was installed to remedy the oxygen deficiency identified in the previous experiment. The totes MKP concentrations were 0%, 50% and 100% stoichiometric ratio to ammonia concentrations in the Main Pit as seen in figure 16-8. Samples were collected weekly, along with water levels for an estimate of natural evaporation rates which were accelerated with the sprinkling water system. Analyzed parameters were the same as the first experiment except for chlorophyll, quantification of the algae bloom was not necessary. The experiment ran for 10 weeks and showed positive nitrite removal rates.



Figure 16-8: Ammonia Experiment (July 2018)

The next phase would be a trial in an enclosed container within the Main Pit. This would allow for realistic evaporation rates, solar radiation effects and temperature gradients that would reflect real pit conditions for biological treatment. Further trials and work with consultants will be conducted before a full report with data will be released.

16.3 Proposed Reclamation for 2019

Proposed reclamation for 2019 includes the following:

- Finalize contouring work on soil cover on the top of the Dry Stack Tailings Storage Facility;
- Contouring work on soil cover on the Southwest Waste Rock Dump;
- Contouring work on soil cover on the Main Waste Dump Expansion;
- Completion of Main Waste Dump Wrap;
- Minor recontouring work as required;
- Phase 1 seeding of additional areas of soil cover; and
- Continuation of the Passive Water Treatment Research.

17 Socio-Economic Monitoring Program

The Minto Mine Socio-Economic Monitoring Program defines a framework for monitoring direct and indirect socio-economic effects from the Minto Mine. In 2018, as per the framework, Minto tracked and collected administrative data and other information relating to the mine's direct employment, training and procurement; worker safety; and Minto contributions to cultural well-being and community wellness. The 2018 socio-economic data which Minto tracked is summarized in Appendix Q.

18 Closure

Minto trusts this document fulfills the 2018 annual reporting requirements of Minto Mine's WUL and QML.

As Minto enters a period of temporary closure, the Care & Maintenance team will continue all environmental monitoring and programs and the associated reporting.

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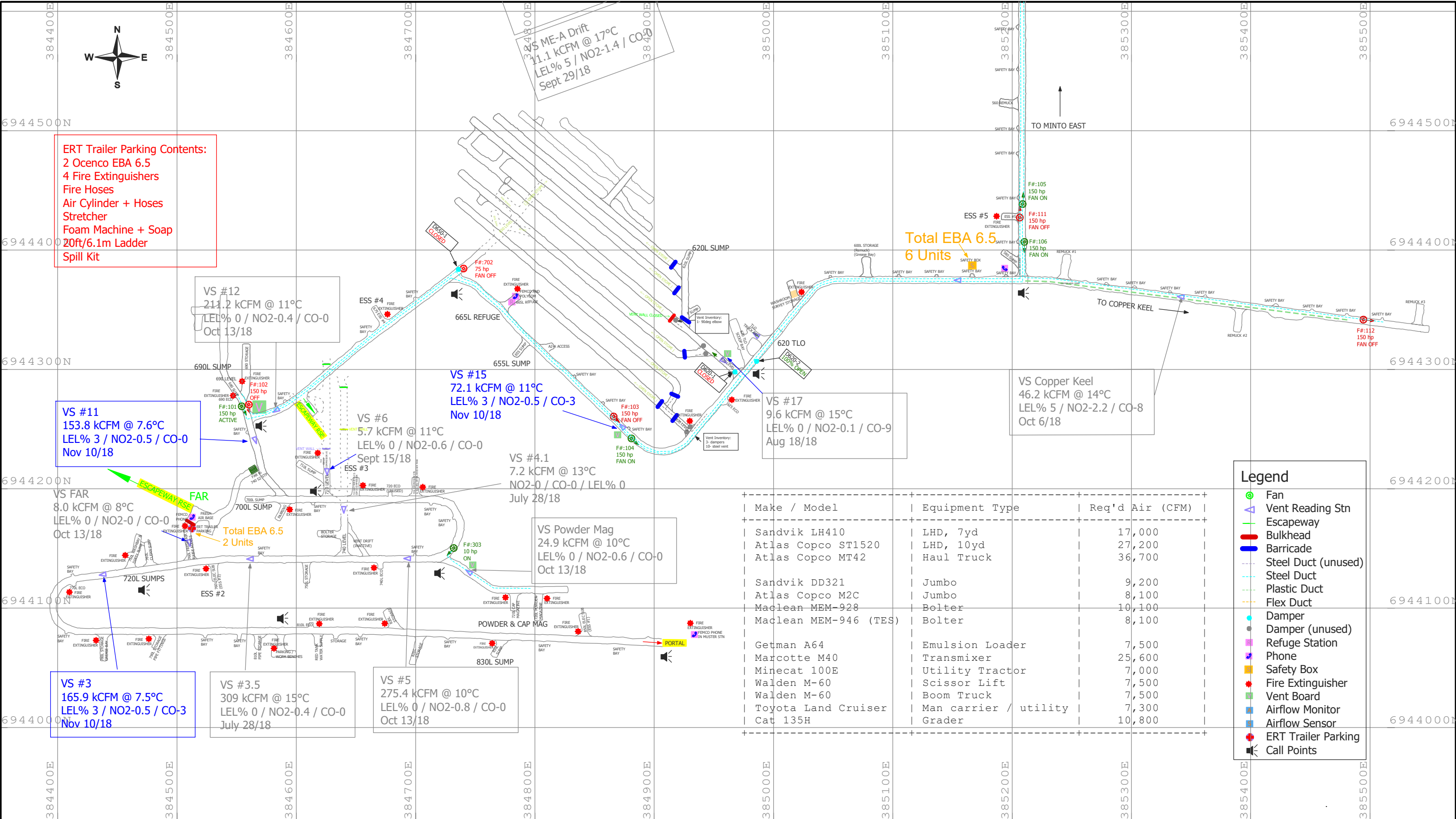
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Appendix A – Minto Mine Underground Development Map



Appendix B – Minto Mine Spill Contingency Plan



Minto Mine
Care and Maintenance (C&M)
Spill Contingency Plan

Prepared by:
Minto Explorations Ltd.
Minto Mine
March 2019

Summary of Revisions (2019)

Section Revised	Description of Revision	Reason for Revision
All	Updated dates and references to previous years SCP.	Annual review and update
All	Updated operational Status to reflect care and maintenance	Change in operational status
3.0	Updated wording regarding changes to Metal and Diamond Mine Effluent Regulations	New MDMER
4.2	Updated internal and external contact information	Contact info changes
6.0	Updates to Spill Response Supplies list due to contractor demobilization	Change in operational status
7.1.6	Updated Emergency Spill Response section with 2018 Drill	Annual Review and Update
8.0	Updated Routine Maintenance and Monitoring to align with reduced scope and frequencies due to care and maintenance status.	Change in operational status

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1 Introduction

Minto Mine (administered by Minto Explorations Ltd. (Minto)) is a high-grade copper and gold mine that is located 240 km north of Whitehorse, Yukon. Operations started in October 2007. The mineral deposits mined at the site were identified during exploration programs occurring in the area in the 1970's; exploration activities occurred sporadically since that time until construction of the mine and related facilities began in earnest in 2006.

This Spill Contingency Plan (SCP) is an update to the previous SCP, drafted in March 2018. The content of this SCP is derived from the *Plan Requirement Guidance for Quartz Mining Projects* (Yukon Government, 2013). The SCP has been updated annually and submitted as part of Minto's Water Use Licence and Quartz Mining Licence annual reports.

The purpose of the SCP is to establish guidelines for staff, contractors and suppliers working at the site with a formal framework of actions to be taken when responding to spills during mine operation. The SCP includes practices and planning of future efforts to further reduce the potential for environmental contamination and other spill-related impacts. The SCP describes the fuels, chemicals and other materials used at the Minto Mine, reporting thresholds for those materials, a spill action plan for responding to unintentional spills of those materials, reporting sequences and forms, training requirements, spill prevention activities and routine monitoring and maintenance.

1.1 Project Description

Minto Explorations Ltd. (Minto), a wholly owned subsidiary of Capstone Mining Corporation (Capstone), owns and operates the Minto Project located 240 km (150 miles) northwest of Whitehorse, Yukon. The Minto Mine is a high-grade copper and gold mine with ongoing operations since October 2007. The Project area encompasses the Minto Creek Valley which collects and drains in to the Yukon River (Figure 1-1). The Minto Mine is currently in Temporary Closure and Care and Maintenance. An overview of major infrastructure at the Minto Mine is shown on **Error! Reference source not found..**

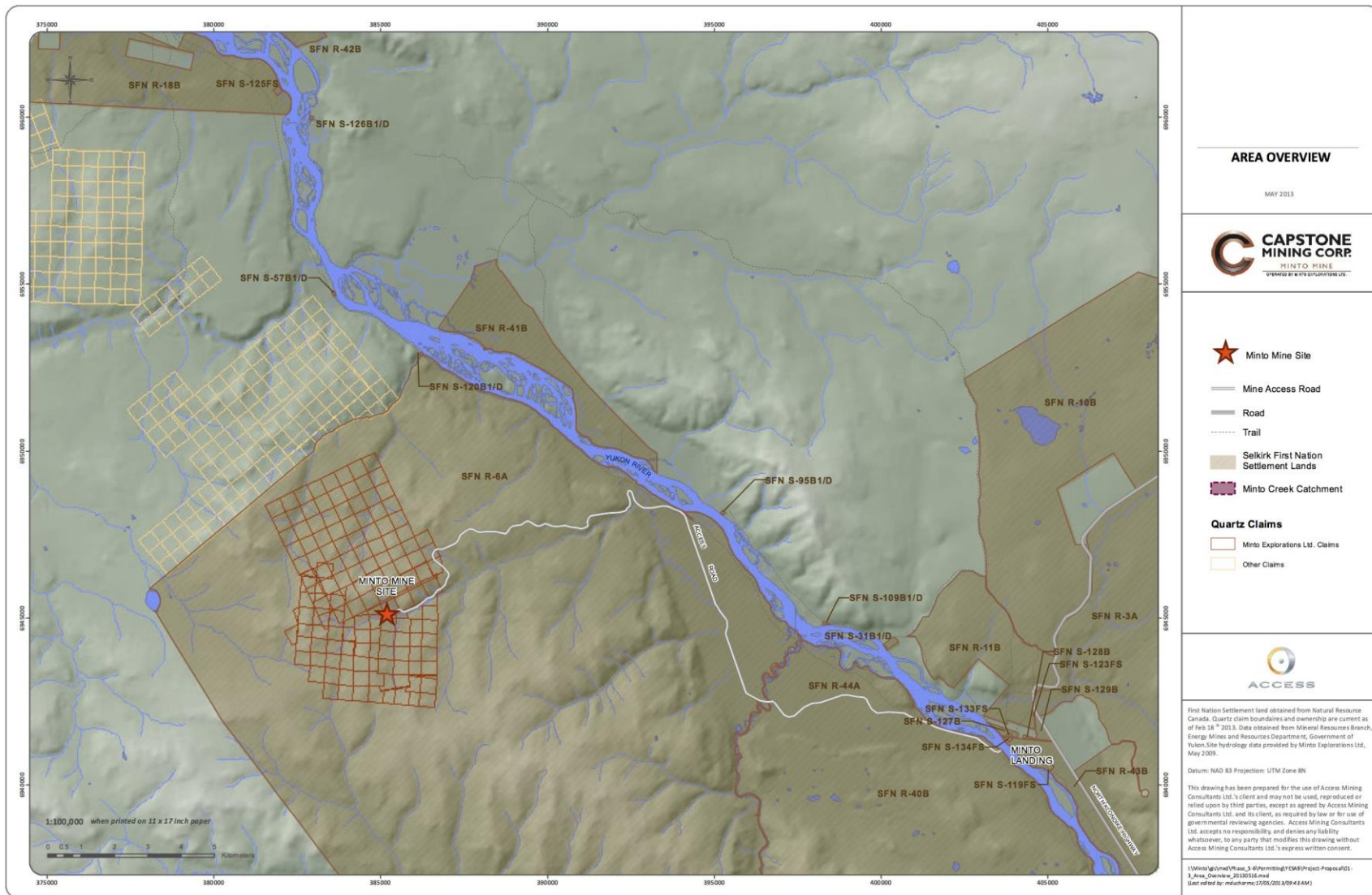


Figure 1-1: Minto Mine Area Overview

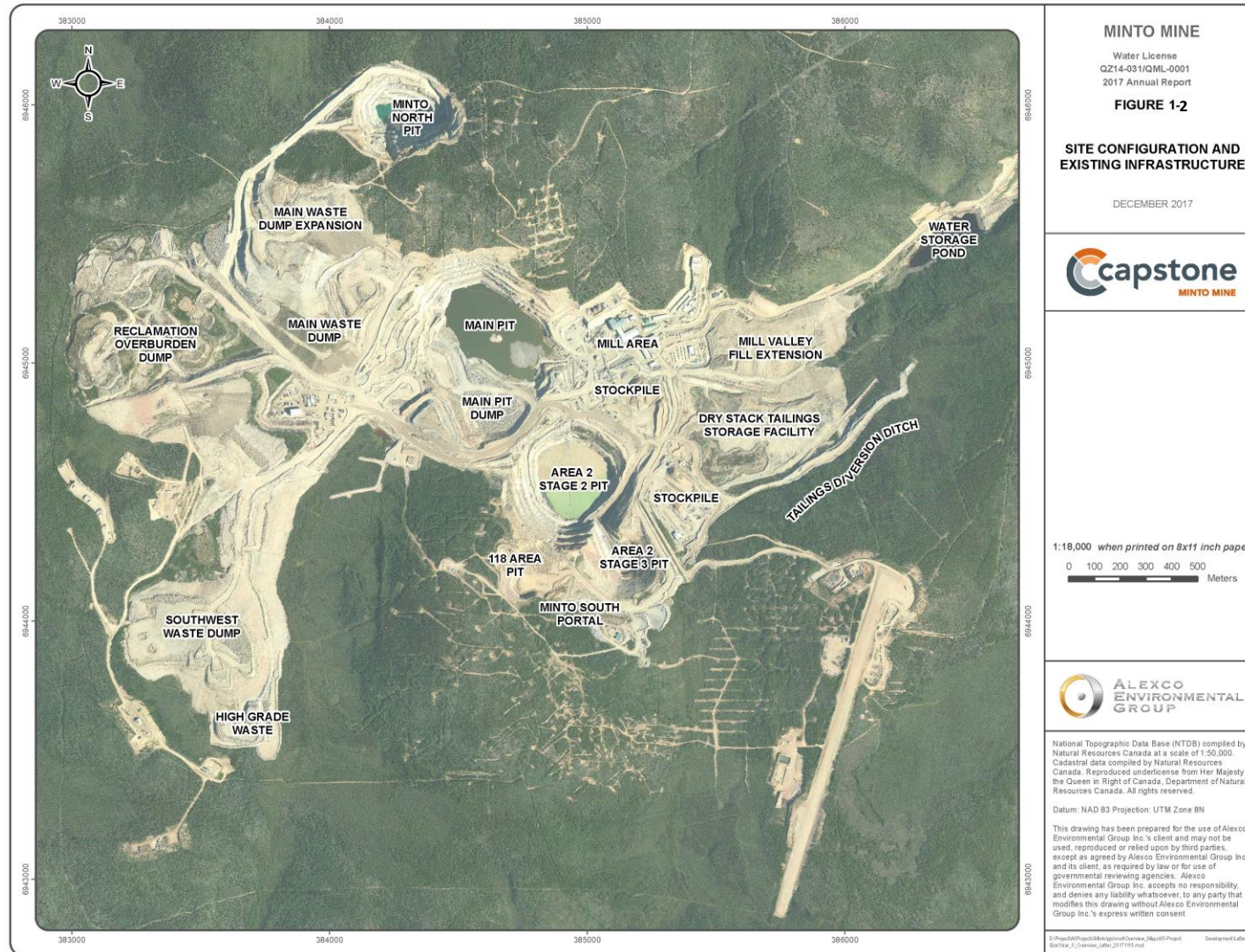


Figure 1-2: Minto Mine Area Overview – Existing Infrastructure

2 Definitions

The following definitions apply to the components of the SCP outlined herein.

Dangerous Good - A product, substance or organism included by its nature or by the regulations in any of the classes listed in the schedule to the act (*Yukon Transportation of Dangerous Goods Act*).

Deposit out of the normal course of events - A deposit that can reasonably be expected to occur at the mine and that can reasonably be expected to result in damage or danger to fish habitat or fish or the use by man of fish, and the identification of the damage or danger (*Metal Mining Effluent Regulations, Part 3, SOR/2002-222*).

Discoverer - The person that discovers an incident that could possibly result in a spill or has resulted in a spill.

Spill - A release of a substance in to the natural environment that is abnormal in quantity or quality in light of all circumstances of the release; or is in excess of an amount specified in the regulations (*Yukon Environment Act, Part 11*):

Emergency Spill - A release of a hazardous product where there is potential for that product to enter a waterway or cause significant danger to life, health or environment.

Non-Emergency Spill - All spills that do not meet criteria of an *emergency spill* and that the responsible party is competent to manage safely and efficiently in terms of assessment, prevention, containment and clean-up.

Substance - A hazardous substance, pesticide, contaminant or special waste often referred to as a “deleterious substance”.

3 Purpose and Scope

Minto will ensure that all requirements related to Spill Response and reporting within these documents are implemented throughout the property for the life of mine. If statutory and regulatory responsibilities change over time updating of this Plan will result.

This SCP is prepared in support of:

- Minto’s Type “A” Water Use License QZ14-031 (WUL) and Type “B” Water Use License MS15-094, which state that:

“The Licensee shall apply the relevant procedures in the Spill Contingency Plan. The Licensee shall review the spill contingency plan annually and shall provide a summary of that review, including any revisions to the plan, as a component of the annual report.”
- *Part 3 – Unauthorized Deposits*, Section 30 of the *Metal and Diamond Mining Effluent Regulations* (MDMER), which indicates that:

“The owner or operator of a mine shall prepare an emergency response that describes the measures to be taken in respect of a deleterious substance within the meaning of subsection 34(1) of the Act to prevent any unauthorized of such a substance or to mitigate the effects of such a deposit.”

- *Part 7 – Emergency Response Assistance Plans and Security Plans of the Transportation of Dangerous Goods Act:*

“No person shall import, offer for transport, handle or transport dangerous goods in a quantity or concentration that is specified by regulation — or that is within a range of quantities or concentrations that is specified by regulation — unless the person has an emergency response assistance plan that is approved under this section.”

- Satisfying the requirements of the Quartz Mining License QML-0001 Schedule B, that requires:

“A plan that describes the measures designed to minimize the potential impact to the environment following a fuel or chemical spill.”

The SCP will apply to Minto Mine and the main access route for one year, whereby the owner or operator shall update and test the SCP to ensure it continues to meet the requirements of both the WUL, subsection 30(2) of the MDMER, and the QML.

3.1 Purpose

The purpose of the SCP is to outline a general set of procedures to be followed to assess, prevent, contain and clean-up a spill at the Minto Mine. For procedures to be effective, Minto must ensure that employees and contractors, through experience and training, possess the skills necessary to safely assess, prevent, contain and clean-up a spill or potential spill. These procedures are necessary to ensure continuity and develop the foundation for a robust and effective SCP. The SCP is also designed to establish clear reporting and clean-up procedures as they apply to emergency and non-emergency spills and incidents.

This document also addresses opportunities to improve spill preparedness, response, and mitigation for deposits out of the normal course of events that have the potential to impact the Yukon River and its tributaries within the project site.

All Minto employees and contract staff must be familiar with the general spill reporting procedures outlined in this document and will be introduced to them as part of their site orientation.

3.2 Scope

The objectives of the SCP are to:

- identify potentially hazardous materials located on site;
- identify spill prevention measures;

- establish a high order of preparedness in the event that a spill occurs;
- ensure an orderly and timely decision-making, response and reporting process; and
- describe current and planned protective measures for all areas of the Mine Site

The C&M *Minto Mine Emergency Response Plan* (Minto, 2018) contains other information that relates to Emergency spill procedures. The Emergency Response Team (ERT) and members of the Environmental Department have been trained on responding to Hazmat Spills. It is beyond the scope of this document to define the specific Spill Response Procedures and decision loops involved in an ERT response. Any details pertaining to a response from ERT to assess, prevent, contain and clean-up a spill at a spill incident is the responsibility of the Site Safety Lead. General procedures for spill response procedures to emergency spills will be detailed herein.

3.2.1 Hardcopy Locations

Copies of the SCP are kept on-site at all times in the following locations: Site Safety Office/ERT; Environmental Office; and in the Site Manager's Office; and on the Copper Queen Tug. Contact information is provided in

Table 4-2.

4 Communication and Spill Reporting

Any spill that occurs at the Minto Mine site must be reported through the internal reporting chain of command and follow the procedures for assessment, prevention, containment and clean-up and reporting. Should a spill exceed the thresholds set by the Yukon Government (Table 4-1) then it must be reported to external authorities.

A spill in excess of the thresholds outlined in Table 4-1 or any spill that is abnormal in quality or quantity is considered a "reportable spill" under the *Yukon Spill Regulations* (O.I.C. 1996/193), pursuant to the *Environment Act*.

Table 4-1: Reportable Spill Thresholds

Product	TDG ¹ Code	Threshold Quantity
Explosives	1	Any amount
Flammable gases	2.1	> 100 litres
Non-flammable gases	2.2	> 100 litres
Poisonous gases	2.3	Any amount
Corrosive gases	2.4	Any amount
Flammable liquids	3	> 200 litres
Flammable solids	4	> 25 kg
Spontaneously combustibles	4	> 25 kg
Dangerous when wet	4	> 25 kg
Oxidizers	5.1	> 50 kg or 50 litres
Organic peroxides	5.2	> 1 kg or 1 litre
Poisonous substances	6.1	> 5 kg or 5 litres
Corrosive materials	8	> 5 kg or 5 litres
Miscellaneous Dangerous Goods	9.1	> 50 kg or 50 litres
Special wastes	9.3	> 5 kg or 5 litres

1. TDG = *Transportation of Dangerous Goods Regulations* (Government of Canada, 1985)

4.1 Internal Reporting (All Spills)

All spills (whether reportable externally or not) must be reported by the discoverer to their immediate supervisor and then to the Environmental Department by radio or telephone following assessment of the scene. The supervisor of the responsible department will issue an Environmental Incident Notification, with assistance from the Environment department, to notify the site and its directors including senior management. This typically occurs concurrently with spill response (prevention, containment and clean-up) activities.

Following the spill response, responsible department supervisors are required to document the spill on an Environmental Incident Report, available through the Environmental Department, and provided in Appendix A. The report requires inclusion of photos, a description of clean-up activities, subsequent actions, identifies root cause and determines any required corrective actions.

4.2 External Reporting (Reportable Spills Only)

Under federal and territorial regulations, the environmental lead will call the 24-hour Yukon Spill Report line should a spill of a reportable quantity occur (Table 4-1). Although several government agencies at the federal, territorial and municipal levels may ultimately be informed, only the Yukon 24-Hour Spill Report line is required for reporting purposes. The environmental lead will ensure that the appropriate information is collected before reporting to the Spill Report line and the report will be filed within 24 hours.

Any spill of an amount greater than those listed in Table 4-1 or a spill of any amount that enters the Yukon River or a tributary of the river is a “reportable spill”.

The following information should be provided to the 24-Hour Spill Report line:

- Name
- Phone number
- Product spilled
- Quantity spilled
- Quality of product (thin, viscous etc.)
- Location of spill
- Distance to water
- Distance to drinking water wells
- What happened
- Responsible party
- Actions to contain the spill

When reporting the spill to the Spill Report line, the environment lead will obtain the Environment Yukon Spill Reporting Number and first/last name of the person whom the report has been made to (in the event of a reporting discrepancy).

Minto will also contact: the Selkirk First Nation Lands Director; and Energy Mines and Resources Client Services and Inspections via email or phone after discovery of a reportable spill. Should the spill enter a waterway or be categorized as a major spill, Minto will also contact Environment Canada. A detailed written report will be submitted to the regulatory authorities within 10 days after the event. The contact information for the various Minto employees, emergency response and external reporting personnel is provided in

Table 4-2.

Table 4-2: Contact Information for Minto Personnel and External Agencies

Resource	Email	Contact Number
Minto Internal Communications Contact Info		
Health and Safety Lead	safety@mintomine.com	604-759-4644
Environmental Department	minto_environment@mintomine.com	604-759-4660
Doug Harris, Site Manager	dough@mintomine.com	604-759-4639

Resource	Email	Contact Number
David Crottey, Alt. Site Manager	davidc@mintomine.com	604-759-4639
Deborah Flemming, Environment and Permitting Manager	deborahf@mintomine.com	604-759-4634
Emergency Phone Contacts		
Yukon 24- Hour Spill Line		867 667-7244
CANUTEC-Dangerous Goods Help (Transport Canada)		1-888-CANUTEC or 613 996-6666
Fire Department – Pelly Crossing (Emergency)		867 537-3000
Police – Pelly Crossing		867 537-5555
Health Centre - Carmacks		867 863-4444
Hospital – Whitehorse		867 667-8700
Fire Department – Whitehorse		867 668-8699 or 867 668-2462
Police – Whitehorse		867 667-5555
YG Department of Environment, Water Resources Branch		867 667-3227
YG Environmental Protection Branch		867 667-3436
Selkirk First Nation, Betty Baptiste, Lands Manager		867 537-3331
YG EMR, Client Services and Inspections		867 667-3199
External Reporting and Contacts for Submission of Spill Reports		
YG EMR, Matthew Jenner, Natural Resources Officer - Mining	Matthew.Jenner@gov.yk.ca	867-863-5271
Selkirk First Nation, Betty Baptiste, SFN Lands Manager	landsmgr@selkirkfn.com	867 537-3331 ext. 603

Resource	Email	Contact Number
YG Environmental Health Services, Craig Van Lankveld, Environmental Health Officer	craig.vanlankveld@gov.yk.ca	867 667-8316
Environment Canada, Travis Teel, Enforcement Officer	Travis.Teel@ec.gc.ca	867-393-6705

5 Spill Action Plan

Implementation of the spill action plan requires knowledge of spill response supplies and locations, spill response procedures (Sections 5.1 and 5.2) and clean-up protocols (Section 5.3). In addition to the internal and external reporting requirements, spills must further be categorized as “emergency” or “non-emergency” incidents as the action plans and reporting requirements will differ according to the type of spill.

5.1 Spill Response Procedures: Non-Emergency

The majority of spills that are likely to occur on the Minto Mine Site will include a simple stepwise process initiated by the discoverer. If the safety at the scene is in doubt, then it is imperative that the Site Safety Lead is notified immediately. A “non-emergency” spill is defined as a spill of any product that the discoverer, or other personnel within close proximity of the incident can competently, safely, and efficiently manage in terms of assessment, prevention, containment and clean-up. This typically includes fuels, blasting agents, oils, lubricants or coolants and many of the reagents involved in mill operations. Once the scene is assessed for safety by the discoverer or supervisor and deemed non-emergency, they will prevent, contain and clean-up and contact the environmental team as soon as practical. If assistance is required to deal with the incident, the environmental team is to be notified by radio/telephone immediately.

A complete inventory of Dangerous Goods stored and used at the Minto Mine, including details on material handling and clean-up, reporting thresholds, special precautions, PPE requirements, and disposal methods is provided for reference during spill response activities (Appendix B).

5.2 Spill Response Procedures: Emergency

An “emergency spill” is a release of a hazardous product where there is potential for that product to enter a waterway or cause significant danger to life, health or environment. When a spill is discovered, the first step is to assess the scene for safety and **if safe to do so** immediately control and contain the spill by any means necessary. If the discoverer or other personnel within close proximity of the incident do not have

the required training, resources or equipment to deal with the incident then the individual must report a “Code 1” callout. This protocol will initiate response of the Safety Lead, Environmental Lead and the Emergency Response Team. The Emergency Spill Response Command Structure and General Spill Procedure are detailed in Figure 5-1 and Figure 5-2, respectively. If the scene is safe and the discoverer and the immediate supervisor have the means necessary to control, contain and recover the spill then they should proceed as such.

Once called via a “Code 1” the Safety Lead will respond to the scene and conduct an initial assessment and assume command of the scene. If the Safety Lead/Medic is required to treat patients, command is transferred to the Emergency Response Team Captain. Unified Command Structure will be initiated once the Site Manager or Environmental Lead is on scene. The Unified Command Structure is a cooperative effort command between the Site Manager, Health and Safety Lead, and the Environmental Lead. Transfer of command includes a detailed verbal report of the incident and activities conducted and underway.

A “Code 1” Protocol initiated by an emergency spill will trigger the specific spill response procedure based on the product type, quantity and environmental and safety conditions.

Initial spill response will be conducted in accordance to *Transport Canada’s 2016 Emergency Response Guidebook* (Transport Canada, 2016). This Guidebook will assist Incident Command with information to identify the material, use the guide to reference potential hazards, public safety and emergency response information. The *Table of Initial Isolation and Protective Action Distances* will be used to dictate isolation and protection for large and small spills. However, this is not a comprehensive spill mitigation and response document and will only assist responders in making initial decisions upon arriving at the scene of a dangerous goods incident. It should not be considered as a substitute for emergency response training, knowledge or sound judgment. The *Emergency Response Guidebook* does not address all possible circumstances that may be associated with a dangerous goods incident. The *Minto Mine Emergency Response Plan* (Appendix C) has additional specific procedures for responding to the most commonly transported and hazardous materials including Nitric Acid, Gasoline, Diesel, Ammonium Nitrate, Sodium Sulfide and Propane.

In addition to on-site response, Minto, through its carriers of dangerous goods, has contracts in place with spill responders. These are full service response agencies that have commitments to mobilize fully trained emergency response teams and equipment 24 hours a day, 7 days a week.

5.2.1 CANUTEC Transport Canada

In the event that a spill requires additional technical resources Minto is registered with CANUTEC, a division of Transport Canada, for 24-hour Spill Response support and information to deal with emergency situations. If a spill occurs beyond the boundaries of the Minto property, the owner of the transportation firm and the owner or consignor of the dangerous goods will communicate with the regulators. For incidents that occur on the Minto property, the Environmental Department will ensure reporting to regulators is performed accordingly.

5.2.2 Surrounding and Downstream Communities

Notification of downstream water users of a spill, if required, is the responsibility of the Yukon Government, Environmental Protection Branch. Minto will additionally notify the authorities including police and fire departments and the Selkirk First Nation community of Pelly Crossing.

5.2.3 Public Relations

The Site Manager is the designated spokesman for Minto. The Site Manager may delegate his responsibility for public relations if required to do so by the scale of the incident.

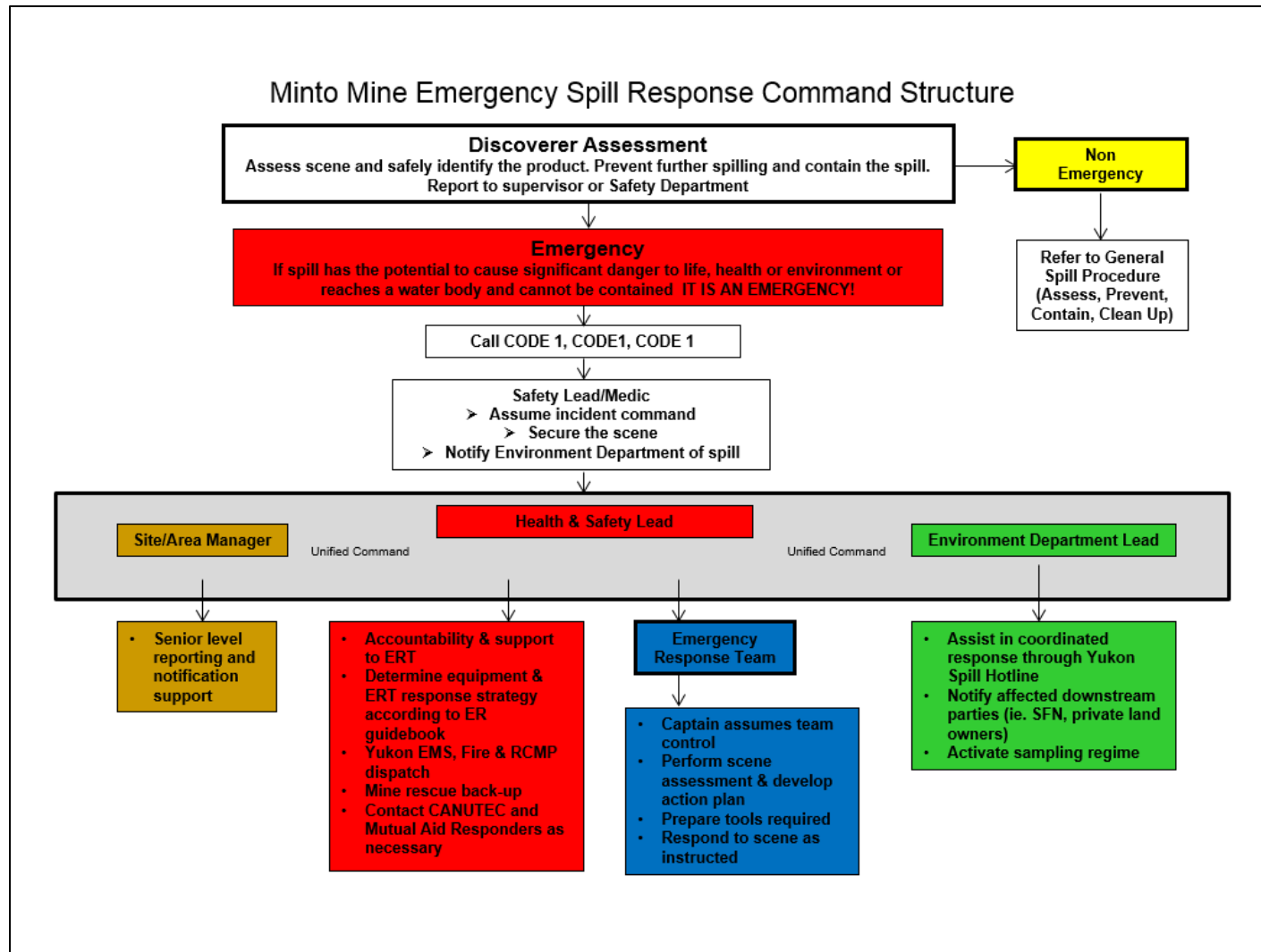


Figure 5-1: Minto Mine Emergency Spill Response Command Structure

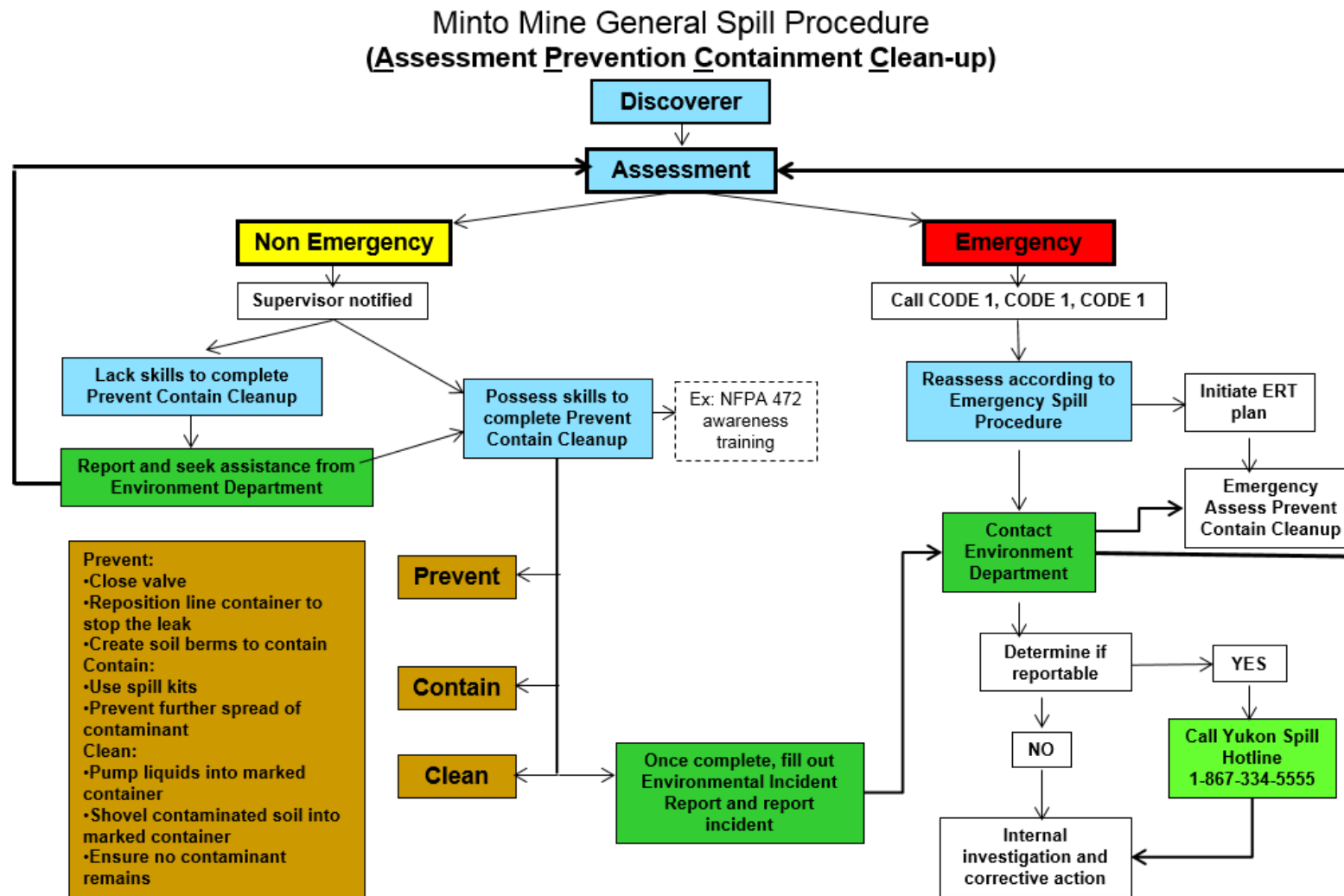


Figure 5-2: Minto Mine General Spill Procedure

5.3 Disposal and clean-up

Disposal and treatment methods of contaminated material are outlined below, and are further detailed in the *Minto Mine Spill Response Procedure: Non-emergency spills on soil* and the *Minto Mine Land Treatment Facility Standard Operating Procedure* documents. The Minto Mine Site has a Land Treatment Facility to accept incoming contaminated material from petroleum hydrocarbon and ethylene glycol spills. Depending on the state and substrate of the surface material, the clean-up and disposal location will differ. Brief practical descriptions of the clean-up procedures are summarized in Table 5-1.

Table 5-1: Disposal and Movement of Contaminated Material from Spill Sites

WASTE TYPE	DESCRIPTION	MOVEMENT OF MATERIAL FROM SPILLS
Oil or Glycol Contaminated Soil	Soil, Organics, and granular material (avoid coarse rock) contaminated as a result of a hydrocarbon or glycol spill	Contaminated soil will be transferred to the Land Treatment Facility. Contaminated soil will first be placed in the staging cell and labelled to be later categorized and treated. Contact Environment dept. before dropping off material in the Land Treatment Facility. Small spills will be stored in a composite pile in the staging area. Larger spills will be stored separately in staging while waiting for lab results.
Oil or Glycol Contaminated Rock	Blasted rock and coarse material and/or bedrock, contaminated as result of a hydrocarbon spill or glycol spill	If blasted rock contains ore and has been cleared by Mill operations ore will be processed through the mill. Non-ore containing rock will be placed in the main pit and in-situ bioremediation will be applied to the pile.
Oil or Glycol Contaminated Snow/Ice/Water	Snow, Ice, and/or Water that has been contaminated as a result of a hydrocarbon spill or glycol spill	Contaminated snow/water will be transferred to the Land Treatment Facility. The contaminated product will be placed in a separate pile in the cell.

**** Any amount of material that has more than 30,000 ppm oil or glycol is considered special waste and must be disposed of off-site to a Special Waste Facility**

6 Spill Response Supplies

Spill kits (yellow and blue drums) are located throughout the Minto Mine Property at locations indicated in Figure 6-1. Additionally, there are blue drums located at the km 12 gravel pit, Big Creek and at the east and west terminals of Minto Landing. The contents of the yellow and blue barrels are summarized in Table 6-1. Spill kits are also supplied for each heavy and light truck at the Minto Mine. Contractor supervisor trucks have spill kits permanently affixed to the truck body. All contract trucking agencies coming to the mine are required to carry spill kits within or affixed to the truck. Spill kits are loaned to short term visitors if required.

Table 6-1: Spill Kit Contents

Spill Kit Item	Yellow Barrel	Blue Barrel	Yellow Truck Bag	Loaner Spill Kit (20 L Pail)
Tyvek splash suits	2	2		
Chemical master gloves	2	2	1	2
Garbage bags with ties	5	5	3	1
Oil only booms (5" x 10')	2	4	1	
Oil only mats (16" x 20")	50	50		10
Universal sorbent mat	20	20	10	5
Sorbent socks	10	10		1
Tarp	1	1		
Duct tape	1	1		
Utility knife	1	1		
Field notebook and pencil	1	1		
Instruction sheet (laminated)	1	1	1	1

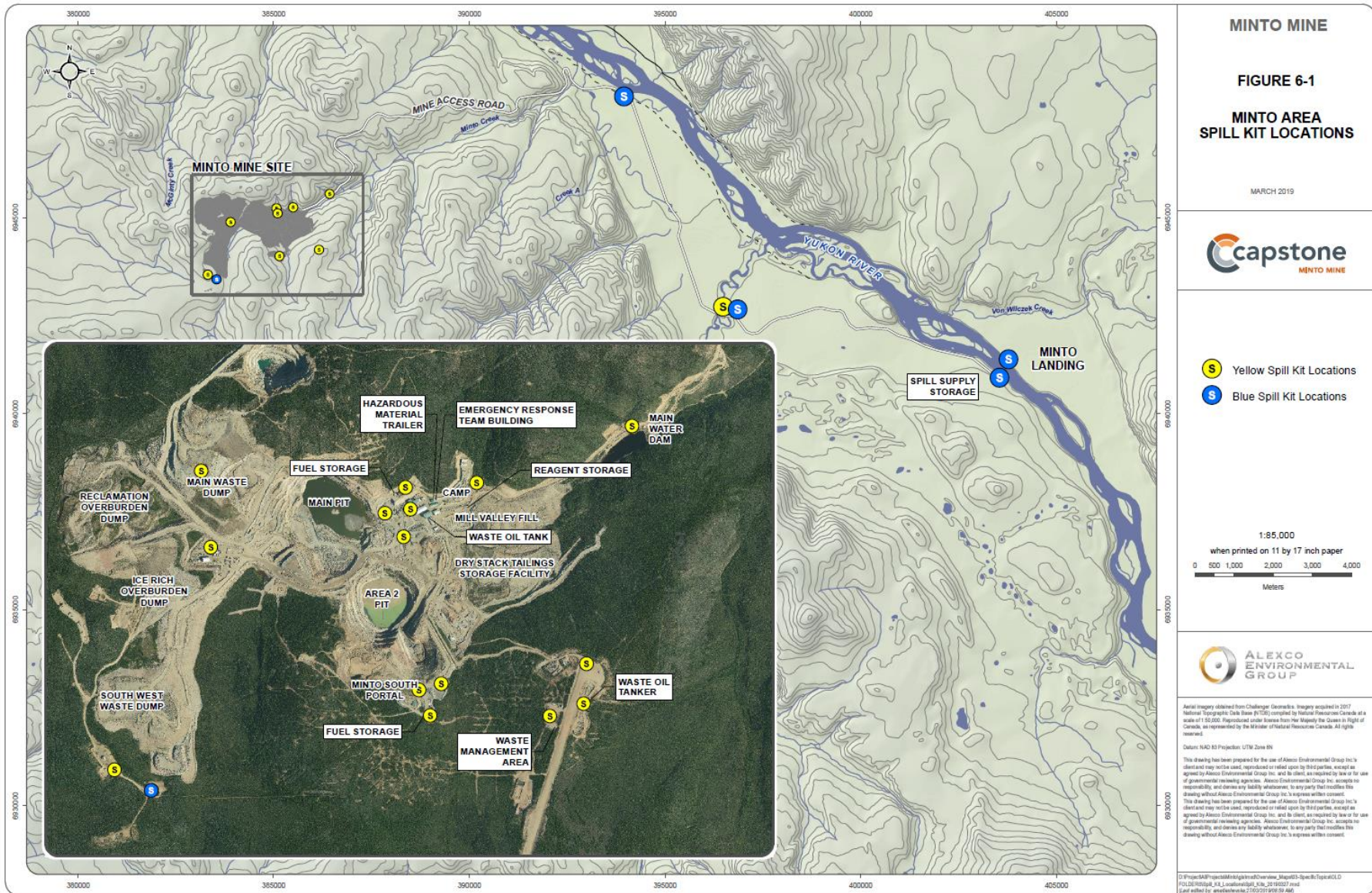


Figure 6-1: Minto Mine Area Overview – Hazmat Storage and Spill Supplies

Heavy machinery at the mine site is available for use in spill response and clean-up, as required under contract. Additionally, Minto has a 1991 Chevrolet Top Kick Fire truck with a 3200 litre/minute pump with 3800 litre supply tank and 3000 litre drop tank. This truck can support all spill response activities with SCBA, Class A and B foam capabilities, decontamination needs, as well as fire suppression/protection tools and equipment common to a truck of this nature. All ERT members are competent with the operation of this fire truck and related equipment in accordance with NFPA standards.

In 2013, Minto, on advice from Emergency Response Action Plan providers, procured a 20 foot Hazmat trailer and a helicopter-portable In-Viro-Drum vacuum unit (Figure 6-2) capable of being transported to locations not reachable with a vacuum truck. It has a liquid cooled three cylinder Kubota diesel engine and 250 CFM non-sparking blower, which makes it safe to vacuum flammable liquids and solids from water or dry land. It comes with a Double Port Vac Drum that allows for transfer of product from the drum to one of our 9500 litre bladders, while the drum continues to be filled. This system allows for quick, efficient and effective clean-up of hazardous products from hard to reach locations.

In 2016, Minto purchased a S.S. Alpha Adjustable Folding Weir Skimmer. Weir skimmers float on the surface of water and are designed to remove pollutants from the surface of calm or sheltered waters and shore line areas. Connected to a shore-based portable pump (e.g. Honda), contaminants can be removed from the water surface and transferred to a drum or other container for proper disposal.

Figure 6-2: In-Viro Drum and vacuum unit, 24' Packman vessel, and Alpha Skimmer for spill response operations.



Minto Mine also acquired a 24-foot Packman man boat, which is described, further in the “Barge Emergency Contingency Plan” (Appendix D).

Spill contingency equipment and earth moving equipment located at Minto Mine are listed in Table 6-2. Contractor Reclamation and Revegetation equipment is available for use in spills and clean-up operations.

Table 6-2: Spill contingency equipment located at Minto Mine

Quantity of Units	Equipment		Quantity of Units	Equipment
1	430 Backhoe		1	Assorted Wooden Plugs
1	3800 Litre Vacuum Truck		1	Large Haul Truck
Various	Dozers, Excavator, Loaders		1	Hazmat trailer 20'
1	In-Viro Drum Portable Vacuum unit		1	Top Kick fire truck
2	9500 Litre bladders		500'	Sorbent Boom (various sizes)
1	24' Packman Response Vessel		1	Storage Sea Can at Landing
1	Roll Over Kit		3	Trash pumps
1	Pipe Plug kit		1	S.S. Alpha Adjustable Folding Weir Skimmer Pump

7 Spill Prevention and Response Training

Education and training are critical to the success of any site-wide initiative, and the most important tool to ensuring the success of the SCP. Minto has a comprehensive training program in place that ensures all workers and supervisors are aware of their responsibilities and the practices that personnel and contractors must adhere to. Records are kept of the names of all employees or contractors that receive training, tracked through either the Simply Safety software program or in the Environmental Department tracking sheets. Annual re-training is scheduled for all Minto employees.

7.1 Existing Spill Prevention and Response Training

Employees are trained to understand the potentially hazardous situations that spills can create with respect to the health and safety of workers and the environment. They are trained to understand responsibilities as employees to Assess, Prevent, Contain, and Clean-up as well as to report any spills. The SCP is made available to all employees and employees will be advised of revisions or changes to the SCP.

7.1.1 Orientation

Employees and visitors are required to sign off on the environmental policy as part of the employee, contractor and visitor orientations that include a summary of the response required when a spill has occurred. The orientation has a strong focus on ensuring proper reporting of spills, so that the appropriate response and clean-up can occur.

7.1.2 “Big 7” Training

As part of the orientation, all Minto employees and major contractors receive training that is a computer based PowerPoint presentation, followed by a written test. The “Big 7” package focuses on some of the most common safety training required for site, which includes WHMIS (Workplace Hazardous Material Information System), fall protection, confined spaces, lock out, hot work, Explosives awareness training and Environmental Awareness. The Environmental Awareness portion of the training is comprised of four modules, with one module dedicated to Spill Response covering reporting and basic steps for assessing, preventing, containing and cleaning-up spills.

7.1.3 Targeted Practical Training

Training sessions are put on by the Environmental Department, and efforts are made to tailor the training to the attending group (i.e. underground miners, surface contractors, site services, etc.). Smaller groups are identified and targeted for specialised spill prevention training that is more job-specific. These include, but are not be limited to; maintenance personnel (mechanics), waste and water truck operators, fuelling personnel, and warehouse workers. Training in smaller groups focusses on spill prevention techniques.

7.1.4 Training for Fuel Handling Employees

Currently there are Safe Work Practices (SWP) designed for bulk fueling at the fuel farm and for fueling of equipment in the field. These SWPs include descriptions of the stepwise procedure for safely performing the task and includes steps to take for emergency shut-off. Both the procedure and the equipment are audited during Workplace Inspections and Planned Job Observations by immediate supervisors and the Environmental Department.

7.1.5 ERT Training

An Emergency Response Team (ERT) has been established to, among other duties, respond to emergency spills. The Emergency Response Team periodically receives training to the National Fire Protection Association (NFPA) 472 Hazardous Material awareness level, and are required to thoroughly understand this document in order to respond to spills or incidents of a specific nature. This training is required as a foundation to develop site specific contingency planning for response tactics in areas specific to the Minto Mine associated activities that present a risk to the Yukon River and its tributaries.

7.1.6 Emergency Spill Response Drills

Table top exercises and/or field drills will help to prepare the ERT and other mine staff to respond to a major spill safely by identifying any deficiencies in the equipment or processes in place.

On November 7, 2018, a table top exercise was conducted to assess the SCP's response to a large propane leak.

The scenario was as follows:

- A cloud of vapour was seen by employee conducting daily propane checks at the underground mine-heater propane farm.

The table-top exercise identified ready-made responses in keeping with the information from the Canutec Emergency Response Guidebook. Items for discussion and follow-up included:

- While the SCP/E2 plan calls for ground monitor water fog to dissipate a vapour cloud, there is insufficient water volume on the truck to effectively do so.
- There is an LEL alarm and nitrogen switch that will shut off gas supply in the event of a large gas leak, therefore it is important to ensure this switch is maintained and tested regularly (confirmed with propane supplier).

On October 26th, 2014, a combined field and table top exercise took place with the following objectives:

- Help individuals become more knowledgeable with the ERP and SCP;
- Identify gaps in the plan;

- Improve communication between stakeholders and departments; and
- Learn new ways and better ways to execute the plan.

The announced exercise was initiated to test part of the Emergency Response Plan as it applies to Spills and the SCP. It focused on the crisis, interaction and escalation of problems within:

- Administrative;
- Operational;
- Managerial; and
- Facilities.

The scenario was as follows:

- A tanker truck with pup and trailer of diesel overturns on Oct 26th on icy roads at 3:20pm at south end of Big Creek. It is still dark and it is a Sunday and roads are icy and snowing lightly.

The exercise lasted approximately 2 hours and involved management staff onsite and offsite, the ERT, major contractors, The Yukon Spill Hotline, CANUTEC, Transnorth Helicopters, WCB, Parkland Fuel, and Quantum Murray. A post-incident debrief revealed both opportunities and successes at the field operations and management level.

7.1.7 Training KPI's

Individuals who receive training are tracked, and training numbers are used as a key performance indicator (KPI) with annual targets. In addition, tracking is used to ensure annual retraining is delivered and statistics measured against key performance indicators.

8 Routine Maintenance and Monitoring

The Fuel Farm is visually inspected weekly for any leakages. An overfill protection system is installed on the two main diesel tanks using a visual indicator and a relay to the control room that will alarm on the HMI to alert maintenance personnel. The area also receives inspections by a qualified engineer and recommendations are recorded and deficiencies corrected as per the *CCME Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products* (Canadian Council of Ministers of the Environment, 2003).

The tug and barge receive frequent inventory inspections for spill equipment and have had major overhauls in the last few years to ensure that the operation is continually improving. Maintenance activities are also carried out regularly and systems are inspected as per Transport Canada Regulations. The daily start-up procedure includes checking for leaks and ensuring all systems are performing to specifications. Annual maintenance activities have included the following: propeller repairs, controls work, system checks and repairs. Substantive refits have included: cylinder heads, exhaust manifold seals, motor mounts, transmission mounts and replacement of water pumps. A new transmission, propulsion seals and propellers have been installed and aligned. Other improvements have included welding reinforcements on the bow of the barge for landings, electrical upgrades, and the installation of an anchor with hawser.

All fuel trucks receive a daily walk-around inspection to ensure emergency shutoffs and hatches and tank valves are operating properly and are free of leaks. These are recorded daily.

The Waste Management Area (WMA) is restricted to access on an as-needed basis by an attendant familiar with the protocols for waste segregation, incineration, special waste handling and landfilling. The attendant will inspect all loads that come into the WMA to ensure that waste has been properly sorted before any material is off loaded. The Environmental Department is directly responsible for the administration, compliance and procedures associated with the management of waste. They are also responsible for providing support and manpower to prepare shipments for backhauling and to ensure the WMA is maintained in accordance with the Commercial Dump Permit (# 81-005). The Environmental Monitors are responsible for conducting weekly inspections to ensure that the WMA is in compliance.

9 References

Canadian Council of Ministers of the Environment. (2003). *Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products*. Winnipeg: CCME.

Government of Canada. (1985, January 18). Transportation of Dangerous Goods Act SOR/85/77.

Government of Yukon. (1996). Spills Regulation. *Environment Act: Spills Regulation O.I.C. 1996/193*.

Government of Yukon. (2002). Environment Act. *Revised Statutes of the Yukon: Environment Act, RSY 2002, c.76*.

Minto. (2018). Care and Maintenance *Emergency Response Plan*.

Transport Canada. (2016). 2016 Emergency Response Guidebook. *A Guidebook for First Responders During the Initial Phase of a Dangerous Goods/Hazardous Materials Transportation Incident*.

Yukon Government. (2013, August). *Plan Requirement Guidance for Quartz Mining Projects*. Retrieved from
<http://www.yukonwaterboard.ca/forms/quartz/Plan%20Requirement%20Guideline%20for%20Quartz%20Mining%20Projects%20-%20August%202013-kh.pdf>

Appendix A: Spill Report and Environmental Incident Report Forms

Spill Report Form



Spill Name:

General Report Information: (To be completed by the supervisor of responsible department or company)

EIR #:		Location of Incident:	
Date of Incident:		Time of Incident:	
Contaminant Type:		Volume of Spill (L):	
Equipment (Type):		Equipment (#):	
Company or Department:		Supervisor	
Hours since last PM:		Proximity to nearest waterbody:	
Previous indication of leak (i.e. Prior Drip) (Yes/No):		Estimated cost of spill:	

Failure of Mechanism: (Check one box below)

Blown Hose		Failed Hose Connection		Human Error	
Unforeseen		Blown or Leaking Seal		Unknown	
Other					

Brief Description of Cause: (conditions at time of spill, what was happening at the time, specific direct cause of spill, etc.)

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Clean Up Actions Undertaken:

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Land Treatment Facility Information: (To be filled out by Environment Department)

Material Moved to LTF (Yes/No):		Material Sampled (Yes/No):		Quantity (m ³):	
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Notes:

Corrective Actions: (Must fill out for all reportable and preventable spills)

Action Item #	Responsible Department	Corrective Action	Due Date

Reporting Sequence:					
First Observer:					
		Name	Company	Date/Time	
Reported To:					
		Name	Company	Date/Time	
Reported To Environmental:					
		Name	Company	Date/Time	
Reported To General Manager:					
		Name	Company	Date/Time	
Regulatory Tracking: (To be completed by Environment Department)					
24 Hour Spill Hotline (867) 667-7244:					
Reported By:		Reported To:		Date/Time:	
Selkirk First Nation Lands Director (867)-537-3331					
Reported By:		Reported To:		Date/Time:	
EMR - Client services and Inspections (867) 456-3882: (or site inspectors)					
Reported By:		Reported To:		Date/Time:	
Environment Canada in the event of a discharge to a waterway (867)-667-3400					
Reported By:		Reported To:		Date/Time:	
Detailed written report and MSDS to YWB, EMR, EC and SFN (Required within 10 days of spill):					
Submitted By:		Date of Submission:			
Photos:					

Appendix B: Reporting Threshold, Special Precautions, PPE Requirements, and Cleanup and Disposal Methods

Minto Mine - Inventory of Dangerous Goods

Reporting Threshold, Special Precautions, PPE Requirements, and Cleanup and Disposal Methods

Common Name (Synonyms)	Chemical Name	Manufacture / Supplier	Phase	TDG Class	WHMIS Class	NFPA Rating	Reporting Threshold	Use	Special Precautions	PPE Required	Special Cleanup and Disposal Info
Acetone	2-Propanone	Anachemia	Liquid	3	B-2, D-2B	1, 3, 0	200 L	Solvent	Extremely Flammable	Goggles, gloves. SCBA if in confined space	Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use dry chemical, CO ₂ , Alcohol-resistant foam. Do not allow into waterway or drains. Contain spread of spill and soak up with absorb all, absorbant pads. Clear up using non-sparking tools. Place liquid and absorbents into tightly sealed container, label clearly and dispose of as hazardous waste offsite.
Acetylene	C ₂ H ₂	AIRGAS INC	Pressurized gas dissolved	2.1	A, B-1, F	1, 4, 3	any if container larger than 100 L	Welding/cutting gas	Extremely flammable, pressurized gas dissolved in an extremely flammable liquid (Acetone)	Goggles, gloves. Respirator or SCBA if in confined space	Eliminate all sources of ignition, if possible without risk, shut off bottles. If bottle is ruptured after the gas has been expelled, the bottle will release the Acetone. At that point treat as an Acetone spill.
AERO 6493 Promoter	Alkyl hydroxamate	Cytec Canada	Liquid above 15C	9		2, 1, 2	5 L	Metal flotation in mill			Soak up with absorbent (do NOT use sawdust. Use PLASTIC tools). In case of fire, use dry chemical, CO ₂ , Alcohol-resistant Foam or water spray. Place recovered spilt liquid in labelled drums for disposal as Special waste. Incinerate used absorbent pads.
AERO MX-5149	Modified Thionocarbamate 15-40% Xanthate ester 40-70%	Cytec Canada	Liquid	3	B3, D-1B, D-2B	3,2,0	200 L	Metal flotation in mill	Flammable	Closed system, safety glasses, gloves	Remove sources of ignition. Cover spills with some inert absorbent material; sweep up and place in a waste disposal container. Flush spill area with water.
Aerodri 100 Dewatering Agent		Cytec Canada	Liquid	3	B3, B-2, D-2A	2, 3, 0	200 L		Avoid contact with strong oxidizers or acids.	Safety Glasses, Gloves	Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use dry chemical, CO ₂ , Alcohol-resistant Foam or water spray. Incinerate waste. Soak up with absorbent materials and dispose of offsite in clearly labeled containers
Alconox		Anachemia	solid	not regulated	D-2B	1, 0, 0	50 kg			Safety Glasses, Gloves	Clean up uncontaminated material for reuse. Incinerate waste.
ALIQUAT 336	Methytriocetyl-ammonium Chloride	Sigma-Aldrich Canada	Liquid	6	D-2B	2, 1, 1	5 kg		Toxic if swallowed. Very corrosive. Will burn skin and eyes. Avoid contact with strong oxidizers. Hygroscopic; avoid contact with moist air.	Safety Glasses, Gloves	Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use dry chemical, CO ₂ , Alcohol-resistant Foam or water spray. Incinerate waste.
AlphaSolve II	>50% Sodium Hydroxide <50% Silicate	Alpha Resources	Solid						Avoid contact with strong oxidizers.	Safety Glasses, Impervious Gloves.	Highly caustic. Will produce heat and steam on contact with water. May boil and spatter. May generate hydrogen gas on contact with metals. Sweep or vaccum and, if not re-useable, send offsite as hazardous waste, in tightly closed, well labeled containers.
Aluminex 5	Aluminum Chloride Hydroxide Sulphate 15%	NALCO	Liquid	8	E		5 L	Coagulant		Safety Glasses, Gloves	Soak up with absorbent materials. These can be incinerated. Any remaining spilt liquid should be stored in closed container, labelled and disposed of off-site as Special Waste.
Aluminum Standard - AA		Anachemia	Liquid	8	E	4, 0, 0	5 L		Dilute Nitric Acid <5%	Safety Glasses, Gloves	Neutralize with soda ash or lime. Contain spill, do not allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system.
AM28 Flotation Reagent	Mixture of Potassium Hydroxide Alkyl hydroxamate	Axis House (Pty) Ltd.	Liquid	not regulated	D-2B	2,1,0		Floatation Reagent	corrosive solid.	Safety Glasses, Gloves	Soak up with absorbent (do NOT use sawdust. Use PLASTIC tools). In case of fire, use dry chemical, CO ₂ , Alcohol-resistant Foam or water spray. Place recovered spilt liquid in labelled drums for disposal as Special waste. Incinerate used absorbent pads.
Amco Clear Turbidity Standard		GFS Chemicals	Liquid	not regulated	not regulated					Safety Glasses, Gloves	Contain spill. Incinerate waste or place in landfill
Ammonia, Refrigerant	Ammonia, Anhydrous	GT&S, INC	Liquefied Gas	2.3, 8	does not appear classified??	3, 0, 0	any amount		Liquefied gas, will produce extreme cold when released. Death has occurred at 5000ppm exposure for 5 minutes. Evacuate release area upwind and avoid low areas.	Goggles, gloves. SCBA.	Toxic gas and will react with a large number of substances, many in a violent manner, Gas will dissipate quickly in air. Small spills can be dissolved in water at ratio of 1:10 Not very flammable. Do not attempt to neutralise.

Minto Mine - Inventory of Dangerous Goods

Reporting Threshold, Special Precautions, PPE Requirements, and Cleanup and Disposal Methods

Common Name (Synonyms)	Chemical Name	Manufacture / Supplier	Phase	TDG Class	WHMIS Class	NFPA Rating	Reporting Threshold	Use	Special Precautions	PPE Required	Special Cleanup and Disposal Info
Ammonium Nitrate prill	Ammonium Nitrate	Agrium	solid	5.1	C, D-2B	1.0.3	50 kg		Oxidizing material, does not burn but may contribute to combustion of materials that can burn	Safety Glasses, Gloves	In case of fire, cool containing vessels with water jet in order to prevent pressure build-up/explosion. Use flooding quantities of water. Evacuate surrounding area. If fumes or gases present, fire fighters should wear self-contained breathing apparatus. In event of spill, prevent from entering waterways. Will dissolve and disperse in water.
Ammonium Nitrate Emulsion	Ammonium Nitrate Emulsion	on-site	Liquid	5.1		2,0,3	50 kg	Explosive	Oxidizing material, does not burn but may contribute to combustion of materials that can burn	Safety Glasses, Gloves, chemical suits, SCBA may be required	In case of fire, cool containing vessels with water jet in order to prevent pressure build-up/explosion. Use flooding quantities of water. Evacuate surrounding area. If fumes or gases present, fire fighters should wear self-contained breathing apparatus. In event of spill, prevent from entering waterways. Use non-combustible material to soak up.
Arsenic Standard - AA		Anachemia	Liquid	8	D-2A, E	4, 0, 0	5 L		Dilute Nitric Acid <5%	Safety Glasses, Gloves	Neutralize with soda ash or lime. Contain spill, do not allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system.
Ascorbic Acid	L-Ascorbic Acid (Vitamin C)	Anachemia	solid	not regulated	not regulated	1, 1, 1	5 kg		also known as Vitamin C	Safety Glasses, Gloves	Contain spill. Incinerate waste or place in landfill
Brake & Electrical Parts Kleen	CO ₂ aerosol of Heptane and Isopropyl alcohol	Kleen-Flo Tumbler Industries	aerosol	Limited quantity	Consumer commodity; A, B5, D2-B	1, 3, 0			Highly flammable	Safety Glasses, Gloves	Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use dry chemical, CO ₂ , Alcohol-resistant Foam or water spray. Incinerate waste.
Buffer Solution pH 10		Anachemia	Liquid	not regulated	D-2A	1, 0, 0		Analytical Lab use	Dilute Sodium Hydroxide	Safety Glasses, Gloves	Contain spill. Absorb with sand, vermiculite or sorbal. Incinerate waste.
Buffer Solution pH 4		Anachemia	Liquid	not regulated	not regulated	1, 0, 0		Analytical Lab use		Safety Glasses, Gloves	Contain spill. Absorb with sand, vermiculite or sorbal. Incinerate waste.
Buffer Solution pH 7		Anachemia	Liquid	not regulated	not regulated	1, 0, 0		Analytical Lab use		Safety Glasses, Gloves	Contain spill. Absorb with sand, vermiculite or sorbal. Incinerate waste.
Cadmium Standard - AA		Anachemia	Liquid	8	D-2A, E	4, 0, 0	5 L		Dilute Nitric Acid <5%	Safety Glasses, Gloves	Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use flooding quantities of water. Contributes to combustion of other materials. Neutralize with soda ash or lime. Contain spill, keep from entering ground water. Neutralized spill can be pumped to the pit or tailings system.
Calcium Chloride		J.T. Baker	solid	not regulated	D-2B	1, 0, 2, 3	any amount		Road Salt, will corrode metals	Safety Glasses, Gloves	Sweep up spilled material and it may be deposited in dilute form to the pit or tailings system. In case of fire use appropriate measures for surrounding fire.
Carbon Dioxide in Argon		Mittler Supply Inc.	Pressurized gas	2.2	A, D-2B	1, 0, 0	any if container larger than 100 L		Non-Flammable but will replace the O ₂ in confined space	Goggles, gloves. SCBA if in confined space	close valve if possible without risk, or allow the vent. In case of fire use any media suitable for surrounding fire. Use water spray to cool fire exposed containers.
Caustic Soda (solid)	Sodium Hydroxide	Fisher Scientific	solid	8	E	3, 0, 1	5 kg		very corrosive solid	Safety Glasses, Gloves	Sweep up spilled material for reuse. In case of fire use appropriate measures for the surrounding fire. Minimise direct water spray on material. This material melts and 318°C and when molten reacts violently with water. Neutralize the residue with a dilute solution of acetic acid. Neutralized solution can be disposed of in the pit or tailings system.
Caustic Soda (solution)		DOW	Liquid	8	E	3, 0, 1	5 L		very corrosive liquid	Safety Glasses, Gloves	Contain spill and pump to plastic barrel for re-use. In case of fire use appropriate measures for the surrounding fire. Neutralize the residue with a dilute solution of acetic acid. Neutralized solution can be disposed of in the pit or tailings system.
Caustic Potash	Potassium Hydroxide	Brenntag Canada	Solid	8	D-1B, E	3,0,1	5 kg		water reactive, contact with metals may evolve flammable hydrogen gas.	Safety Glasses, Gloves, fume hood	Sweep up or vacuum spillage, collect in suitable container for disposal. Avoid dust formation.
Chevron 2-Cycle Oil		Chevron Lubricants Canada	Liquid	not regulated	B-3	1, 2, 0	100 L		flammable oil for 2-stroke fuel	Safety Glasses, Gloves	contain spill and use absorbent and incinerate waste
Chevron ATF+3 Automatic Transmission Fluid		Chevron Lubricants Canada	Liquid	not regulated	not regulated	1, 1, 0	100 L			Safety Glasses, Gloves	contain spill. Small amounts can use absorbent and incinerate waste. Larger material pumped into plastic drums and used in a waste oil heating system.
Chevron Automatic Transmission Fluid MD-3		Chevron Lubricants Canada	Liquid	not regulated	not regulated	1, 1, 0	100 L			Safety Glasses, Gloves	contain spill. Small amounts can use absorbent and incinerate waste. Larger material pumped into plastic drums and used in a waste oil heating system.
Chevron Clarity Synthetic Machine Oil		Chevron Lubricants Canada	Liquid	not regulated	not regulated	1, 1, 0	100 L			Safety Glasses, Gloves	contain spill. Small amounts can use absorbent and incinerate waste. Larger material pumped into plastic drums and used in a waste oil heating system.

Minto Mine - Inventory of Dangerous Goods

Reporting Threshold, Special Precautions, PPE Requirements, and Cleanup and Disposal Methods

Common Name (Synonyms)	Chemical Name	Manufacture / Supplier	Phase	TDG Class	WHMIS Class	NFPA Rating	Reporting Threshold	Use	Special Precautions	PPE Required	Special Cleanup and Disposal Info
Chevron Compressor Oil 260		Chevron Lubricants Canada	Liquid	not regulated	not regulated	1, 1, 0	100 L			Safety Glasses, Gloves	contain spill. Small amounts can use absorbent and incinerate waste. Larger material pumped into plastic drums and used in a waste oil heating system.
Chevron Coupling Grease	Grease	Chevron Lubricants Canada	Semi-Solid	not regulated	not regulated	1, 1, 0	100 L or 100 kg			Safety Glasses, Gloves	contain spill. Small amounts can use absorbent and incinerate waste. Larger absorbent material in plastic drums and shipped off site for disposal.
Chevron Delo 300 Motor Oil		Chevron Lubricants Canada	Liquid	not regulated	not regulated	1, 1, 0	100 L			Safety Glasses, Gloves	contain spill. Small amounts can use absorbent and incinerate waste. Larger material pumped into plastic drums and used in a waste oil heating system.
Chevron Delo Grease EP	Grease	Chevron Lubricants Canada	Semi-Solid	not regulated	not regulated	1, 1, 0	100 L or 100 kg			Safety Glasses, Gloves	contain spill. Small amounts can use absorbent and incinerate waste. Larger absorbent material in plastic drums and shipped off site for disposal.
Chevron Diesel Engine Oil Delo 6170 CFO		Chevron Lubricants Canada	Liquid	not regulated	not regulated	1, 1, 0	100 L			Safety Glasses, Gloves	contain spill. Small amounts can use absorbent and incinerate waste. Larger material pumped into plastic drums and used in a waste oil heating system.
Chevron Drive Train Fluid HD		Chevron Lubricants Canada	Liquid	not regulated	not regulated	1, 1, 0	100 L			Safety Glasses, Gloves	contain spill. Small amounts can use absorbent and incinerate waste. Larger material pumped into plastic drums and used in a waste oil heating system.
Chevron ECO Hydraulic Oil AW		Chevron Lubricants Canada	Liquid	not regulated	not regulated	0, 1, 0	100 L			Safety Glasses, Gloves	contain spill. Small amounts can use absorbent and incinerate waste. Larger material pumped into plastic drums and used in a waste oil heating system.
Chevron Gas Engine Oil 930 and 940		Chevron Lubricants Canada	Liquid	not regulated	not regulated	0, 1, 0	100 L			Safety Glasses, Gloves	contain spill. Small amounts can use absorbent and incinerate waste. Larger material pumped into plastic drums and used in a waste oil heating system.
Chevron Mid-grade unleaded gasoline		Chevron Products	Liquid	3	B-2, D-2A, D-2B	2, 3, 0	200 L		Extremely Flammable, Vapours are harmful and they may be explosive. Non-sparking tools required. Vapours will collect in low areas and travel along the ground to an ignition source.	Goggles, gloves. Respirator or SCBA if in confined space	Eliminate all sources of ignition. Ventilate area if required. Dike the spill and pump to containers for recycling. Use absorbent. In case of fire, use dry chemical, CO ₂ , Alcohol-resistant Foam or water spray. Allow waste absorbent to evaporate and then Incinerate waste.
Chevron NWS Manual Transmission Fluid 6044GR		Chevron Lubricants Canada	Liquid	not regulated	not regulated	1, 1, 0	100 L			Safety Glasses, Gloves	contain spill. Small amounts can use absorbent and incinerate waste. Larger material pumped into plastic drums and used in a waste oil heating system.
Chevron RPM Universal Gear Lubricant		Chevron Lubricants Canada	Liquid	not regulated	not regulated	1, 1, 0	100 L			Safety Glasses, Gloves	contain spill. Small amounts can use absorbent and incinerate waste. Larger material pumped into plastic drums and used in a waste oil heating system.
Chevron Supreme Antifreeze/Coolant	Ethylene Glycol	Chevron Lubricants Canada	Liquid	not regulated under 5000 lb.	D-2A	1, 1, 0	25 L		may be fatal by ingestion	Safety Glasses, Gloves	contain spill. Can be pumped, filtered and reused. Small amounts can use absorbent and incinerate waste. Larger absorbent material in plastic drums and shipped off site for disposal.
Chevron Ulti-Plex® Grease EP		Chevron Lubricants Canada	Semi-Solid	not regulated	not regulated	1, 1, 0	100 L			Safety Glasses, Gloves	contain spill. Small amounts can use absorbent and incinerate waste. Larger absorbent material in plastic drums and shipped off site for disposal.
Chloramine T	Chloramine-T trihydrate	Fisher	solid	8	D-2A, E	3, 1, 1	5 kg		Container may explode under fire conditions. Will release toxic fumes with fire or when mixed with strong oxidizers or acids	Goggles, gloves. SCBA if in confined space	Eliminate all sources of ignition. Ventilate area if required. In case of fire. Material by itself is non-flammable, may decompose violently >100°C, use dry chemical, CO ₂ foam or water spray. DISPOSAL mix with flammable solvent and incinerate.
Chromium Standard - AA		Anachemia	Liquid	8	D-2A, E	3, 0, 0	5 L		Dilute Nitric Acid <5%	Safety Glasses, Gloves	Neutralize with soda ash or lime. Contain spill, do not allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system.
Citric Acid	Citric Acid, Monohydrate	Anachemia	solid	not regulated	E	2, 1, 0	5 L		Will cause severe eye damage. Avoid oxidizers, acids, bases and bleach.	Safety Glasses, Gloves	Eliminate all sources of ignition. Ventilate area if required. In case of fire, use flooding quantities of water. Will decompose at high temperatures and emit acrid smoke and fumes.
Copper Standard - AA		Anachemia	Liquid	8	E	4, 0, 0	5 L		Dilute Nitric Acid <5%	Safety Glasses, Gloves	Neutralize with soda ash or lime. Contain spill, do not allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system.
Crystal 78	Sodium Silicate	Quadra Chemicals	Liquid	not regulated	D-2B		25 L		Caustic solution. Avoid mixing with strong acids. Contact with metals such as aluminum, tin, lead and zinc generates hydrogen gas.	Goggles, gloves. Respirator	solution can be pumped into plastic drum and possibly recycled in mill circuit, or shipped off site. In case of fire use appropriate measures for surrounding fire.
Cyquest DP-6	Sodium polyacrylate in water	Cyttec Canada	Liquid	not regulated	not regulated	1,1,0		Mill reagent	Slippery	Goggles, Impervious gloves	Soak up with absorbent materials. These can be incinerated. Any remaining spilt liquid should be stored in closed container, labelled and disposed of off-site as Special Waste.

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Reporting Threshold, Special Precautions, PPE Requirements, and Cleanup and Disposal Methods

Common Name (Synonyms)	Chemical Name	Manufacture / Supplier	Phase	TDG Class	WHMIS Class	NFPA Rating	Reporting Threshold	Use	Special Precautions	PPE Required	Special Cleanup and Disposal Info
Delo Diesel Fuel System Cleaner		Chevron Lubricants Canada	Liquid	3	B-3, D-2A, D-2B		200 L			Safety Glasses, Gloves	Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use dry chemical, CO ₂ , Alcohol-resistant Foam or water spray. Incinerate waste.
Diesel Fuel No. 2		Chevron Products Company	Liquid	3	B-3, D-2A, D-2B	0, 2, 0	200 L			Safety Glasses, Gloves	contain spill. Small amounts can use absorbent and incinerate waste. Larger material pumped into plastic drums and used in a waste oil heating system.
DIISOBUTYL KETONE	2,6-Dimethyl-4-heptanone	J.T. Baker	Liquid	3	B-2, D-2A	2, 2, 0	200 L		Avoid contact with strong oxidizers or acids.	Safety Glasses, Gloves	Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use dry chemical, CO ₂ , Alcohol-resistant Foam or water spray. Incinerate waste.
Drierite, indicating		Anachemia	solid	not regulated	D-2A	1, 0, 1				Safety Glasses, Gloves	Eliminate all sources of ignition. In case of fire use measures dictated by surrounding fire. Will decompose at 1450°C liberating Cl ₂ and SO ₂ . This product can be dried and reused, recycled.
Envirobind KFZ		Power Chemicals Ltd.	Liquid	not regulated	not regulated	1, 0, 0		Dust Suppression	Avoid contact with oxidizing agents or strong acids.	Goggles, Gloves	Do not use absorbents. Contain spill using noncombustible materials such as vermiculite, earth or sand.
Envirobind KTF		Power Chemicals Ltd.	Liquid	not regulated	not regulated	1, 0, 0		Dust Suppression	Avoid contact with oxidizing agents or strong acids.	Goggles/Glasses, Gloves	Do not use absorbents. Contain spill using noncombustible materials such as vermiculite, earth or sand.
Envirobind PCW		Power Chemicals Ltd.	Liquid	not regulated	not regulated	1, 0, 0		Dust Suppression	Avoid contact with strong oxidizing materials.	Goggles/Glasses, Gloves	Dike or contain. Absorb irrecoverable material onto inert oil absorbent medium, package, and label for legal disposal. Wash hard surfaces with water. Contaminated absorbent material may be disposed of in an approved landfill
FLEET CHARGE 50/50 Antifreeze	Ethylene Glycol	OLD WORLD INDUSTRIES	Liquid	9	D-2A	1, 1, 0	25 L		may be fatal by ingestion	Safety Glasses, Gloves	contain spill. Can be pumped, filtered and reused. Small amounts can use absorbent and incinerate waste. Larger absorbent material in plastic drums and shipped off site for disposal.
Fleet Charge PG Antifreeze/Coolant	Propylene Glycol	OLD WORLD INDUSTRIES	Liquid	not regulated	not regulated	0, 1, 0	25 L			Safety Glasses, Gloves	contain spill. Can be pumped, filtered and reused. Small amounts can use absorbent and incinerate waste. Larger absorbent material in plastic drums and shipped off site for disposal.
Flomin C 3505 Collector	Potassium amyl xanthate (PAX)	Flomin Inc.	solid	4	not regulated	2, 2, 1	25 kg		Product is spontaneously combustible. Avoid contact with heat, moist air, and water.	Safety Glasses, Gloves	Sweep up spilled material and place in closed container for reuse. Solutions of product my be deposed of on the pit or tailings system. In case of fire use appropriate measures for surrounding fire.
Flomin F 500 Frother	4-METHYL-2-PENTANOL (Methyl isobutyl carbinol - MIBC)	Flomin Inc.	Liquid	3	B-2, D-2B	2, 2, 0	200 L		Acids, acid chlorides, alkalis, oxidizing agents. Will attack some forms of plastics, rubber and coatings	Goggles, gloves. Respirator or SCBA if in confined space	Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use dry chemical, CO ₂ , Alcohol-resistant Foam or water spray. Incinerate waste.
Floran Catalyst	Proprietary Inorganic Peroxide Blend	Floran Technologies	Liquid	5	C, D-2B	2, 0, 1, OX	50 L		Non-Flammable but will aid combustion of other materials	Safety Glasses, Gloves	Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use flooding quantities of water. Contributes to combustion of other materials. Contain spill, keep from entering ground water. Absorbed pill can be disposed in the pit or tailings system.
Frost Killer (Tannergas)	Methyl alcohol	TANNER SYSTEMS, INC.	Liquid	3, 6.1	B-2, D-1B, D-2A,D-2B	1, 3, 0	200 L		Extremely Flammable, Vapours are harmful and solution is poisonous	Goggles, gloves. Respirator or SCBA if in confined space	Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use dry chemical, CO ₂ , Alcohol-resistant Foam or water spray. Incinerate waste.
FUEL INJECTOR CLEANER		Radiator Specialty Co	Liquid	3	B-3, D-2A, D-2B		200 L			Safety Glasses, Gloves	Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use dry chemical, CO ₂ , Alcohol-resistant Foam or water spray. Incinerate waste.
Gasoline, Unleaded		Petro-Canada	Liquid	3	B-2, D-2A, D-2B	2, 3, 0	200 L		Extremely Flammable, Vapours are harmful and they may be explosive. Non-sparking tools required. Vapours will collect in low areas and travel along the ground to an ignition source.	Goggles, gloves. Respirator or SCBA if in confined space	Eliminate all sources of ignition. Ventilate area if required. Dike the spill and pump to containers for recycling. Use absorbent. In case of fire, use dry chemical, CO ₂ , Alcohol-resistant Foam or water spray. Allow waste absorbent to evaporate and then Incinerate waste.
Glycerin	IPAC	Power Chemicals Ltd.	Liquid	Not regulated	Not regulated				Avoid contact with reducing agents and oxidizing agents.	Goggles, gloves.	Dike spilled product to prevent runoff
Havoline DEX-COOL Extended Life 50/50 Anti-Freeze/Coolant	Ethylene Glycol	Chevron Lubricants Canada	Liquid	not regulated	D-1b, D-2A	2, 0, 0	25 L		may be fatal by ingestion	Safety Glasses, Gloves	contain spill. Can be pumped, filtered and reused. Small amounts can use absorbent and incinerate waste. Larger absorbent material in plastic drums and shipped off site for disposal.

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Reporting Threshold, Special Precautions, PPE Requirements, and Cleanup and Disposal Methods

Common Name (Synonyms)	Chemical Name	Manufacture / Supplier	Phase	TDG Class	WHMIS Class	NFPA Rating	Reporting Threshold	Use	Special Precautions	PPE Required	Special Cleanup and Disposal Info
HAVOLINE DEX-COOL extended life anti-freeze/coolant-B	Ethylene Glycol	Chevron Lubricants Canada	Liquid	not regulated	D-1b, D-2A	2, 1, 0	25 L		may be fatal by ingestion	Safety Glasses, Gloves	contain spill. Can be pumped, filtered and reused. Small amounts can use absorbent and incinerate waste. Larger absorbent material in plastic drums and shipped off site for disposal.
Havoline Power Steering Fluid		Chevron Products	Liquid	not regulated	not regulated	0, 1, 0				Safety Glasses, Gloves	contain spill. Small amounts can use absorbent and incinerate waste. Larger material pumped into plastic drums and used in a waste oil heating system.
Hot 4-in-1 Heating Oil Treatment	Proprietary Blend	FPPF Chemical Company, Inc.	Liquid	3	B-3, D-1A, D-2A, D-2B	3, 2, 0	200 L		Fuel Additive, fumes will collect in low area's.	Safety Glasses, Gloves	Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use dry chemical, CO2, Alcohol-resistant Foam or water spray. Incinerate waste.
Hydrated Lime	Ca(OH) ₂	Chemical Lime Company of Canada Inc.	Solid	not regulated	D-2A, E				Will cause severe caustic burns. Avoid strong acids, and aluminum	Safety Glasses, Gloves	sweep up uncontaminated material for reuse. Neutralize with dilute acid and may be disposed of in pit or tailings system.
Hydraulic Oil SAE 10W		EXXON MOBIL	Liquid	not regulated	not regulated	0, 1, 0	200 L			Safety Glasses, Gloves	Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use dry chemical, CO2, Alcohol-resistant Foam or water spray. Incinerate waste.
Hydrex 3223		Veolia	Liquid	8	E	1, 0, 0	5kg or 5L	Coagulant in the WTP		Safety glasses with side shields or goggles, face shield, chemical resistant gloves. Suitable respiratory equipment in poorly ventilated areas.	Contain spill. Ventilate area if required. Use absorbent. Place contaminated materials in sealed container for disposal and dispose of via a licensed waste disposal contractor.
Hydrex 6186		Veolia	Solid	not regulated	not regulated	0, 1, 0		Flocculant in the WTP		Safety glasses with side shields or goggles	Sweep or vacuum spilled material. Do not get water on spilled material. Flush area with water after product recovery. Place recovered material in sealed container and dispose of via a licensed waste disposal contractor.
Hydrochloric Acid		Anachemia	Liquid	8	D-1A, E	3, 0, 1	5 L		Concentrated acid, Extremely corrosive. Ventilate or stay upwind	Goggles, gloves. Respirator or SCBA if in confined space	Neutralize with soda ash or lime. Contain spill, do not allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system.
Hydrofluoric acid, 47 - 51%		Fisher	Liquid	8, 6.1	D-1A, D-2A, E	4, 0, 1	5 L		Extremely corrosive and Toxic acid. Causes very severe acid burns with symptoms being delayed. Skin contact of <10% can be fatal from cardio-pulmonary problems. IMMEDIATE medical attention is required for all exposures.	Goggles, gloves. Respirator or SCBA if in confined space (Actually SCBA should be used anywhere unless spill is in a fumehood)	Neutralize with soda ash. Contain spill, do not allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to a plastic barrel and then disposed of in the pit or tailings system.
IPAC 6832		Quadra Chemicals	Liquid	not regulated	not regulated				water soluble	Safety Glasses, Gloves	No special clean up procedures,
Iron Standard - AA		Anachemia	Liquid	8	E	1, 0, 0	5 L		Dilute Nitric Acid <5%	Safety Glasses, Gloves	Neutralize with soda ash or lime. Contain spill, do not allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system.
Isopropylxanthic acid sodium salt (SIPX)		Quadra Chemicals Ltd.	Solid	4.2	B-6, D-1B, D-2B		25 kg	Collector in Mill	Keep away from water - contact with water liberates extremely flammable gases. Keep away from heat, sparks and flame - fine dust clouds may form explosive mixtures with air. Use only with adequate ventilation.	Goggles, Gloves, Respirator (air-purifying or air-fed)	Move containers from spill area. Avoid allowing the spilled material to get wet or using water to clean up spillages or residues, unless the quantity remaining is very small. Vacuum or sweep up material and place in a designated, labeled waste container. Use spark-proof tools and explosion-proof equipment. Dispose of via a licensed waste disposal contractor.
Javex Liquid Bleach	NaOCl	Colgate Palmolive	Liquid	not regulated	E, D-2B, C				Self heating and may catch fire.	Safety Glasses, Gloves, SCBA	Ventilate area and allow qualified personnel to stop/control spill. Small spills: flush area with plenty of water and mop up. Large spills: dike the ingredient and transfer to appropriate containers. Consult Federal, Provincial and Municipal regulations for disposal. May be neutralized with sodium bisulphite or dilute hydrogen peroxide.
KAX 51	Proprietary Blend (mix of isoamyl alcohol, potassium amyl xanthate, and potassium hydroxide)	Prospec Chemicals	Solid	4.2	B-6, D-1B, E		25 kg	Collector in Mill		Safety Glasses, Face Shield, Gloves, SCBA	If in the liquid state: Stop spill at source. Contain any spilled material to prevent discharge into the environment. Eliminate all sources of ignition. Persons not wearing protective equipment should be excluded from the area. Absorb with inert dry material. Put into an approved metal salvage drum for disposal. If in the solid state: Eliminate all sources of ignition. Restrict access to area until completion of clean-up. Ensure clean-up is conducted by trained personnel only. Do not touch spilled material. Do not use water on spilled material as heat will be generated. Put spilled material into approved salvage drums for disposal. Flush cleaned area with water, making sure no water enters xanthate containers.

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Reporting Threshold, Special Precautions, PPE Requirements, and Cleanup and Disposal Methods

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KOPR-KOTE	Graphite, Cu & MoS ₂ mixture	Jet-Lube of Canada	paste	not regulated	not regulated	1,1,1				Safety Glasses, Gloves	Wipe up spill with rags and incinerate waste.
Lead Standard - AA		Anachemia	Liquid	8	D-2A, E	4, 0, 0	5 L		Dilute Nitric Acid <5%	Safety Glasses, Gloves	Neutralize with soda ash or lime. Contain spill, do not allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system.
Lime		Chemical Lime Company of Canada Inc.	powder	not regulated	E	3, 0, 1			Will cause severe caustic burns. Avoid strong acids, and aluminum	Safety Glasses, Gloves	sweep up uncontaminated material for reuse. Neutralize with dilute acid and may be disposed of in pit or tailings system.
Liquid Nitrogen	Nitrogen	Praxair Canada Inc.	Liquefied Gas	2.2 Non-flammable gas	A	3, 0, 2	any if container larger then 100 L		Use air supplied respirator when working in confined space, Loose-fitting cryogenic gloves, Metatarsal shoes for cylinder handling. Protective clothing where needed. Cuff less trousers should be worn outside of shoes	Extremely cold liquefied gas, Will cause severe frost bite Use SCBA when working in confined space,	Evacuate all personnel from danger area. Allow spilled liquid to evaporate. Use self contained breathing apparatus where needed. Shut off flow if you can do so without risk. Ventilate area or move cylinder to a well-ventilated area. Test for sufficient oxygen, especially in confined spaces, before allowing re-entry
LIQUID WRENCH SUPER LUBRICANT (AEROSOL)	Proprietary Blend	Radiator Specialty Co	aerosol	2.1	A, B5, D-1A, D2-B		any if container larger then 100 L		containers may rupture if exposed to high temperatures.	Safety Glasses, Gloves	Allow container to completely discharge while eliminating ignitions sources. Wipe up spill with rags and incinerate waste.
Loctite Belt Dressing	Proprietary Blend	Henkel Canada, Inc.	aerosol	2.2	A, D-2A, D-2B		any if container larger then 100 L		containers may rupture if exposed to high temperatures.	Safety Glasses, Gloves	Allow container to completely discharge Wipe up spill with rags and incinerate waste.
LPS 2 Spray Lubricant	Proprietary Blend	LPS Laboratories	aerosol	2.2	A, D-2A, D-2B		any if container larger then 100 L		containers may rupture if exposed to high temperatures.	Safety Glasses, Gloves	Allow container to completely discharge Wipe up spill with rags and incinerate waste.
Magnesium Nitrate Matrix Modifier		Spex CertiPrep	Liquid	8	D-2A, E	3, 0, 0	5 L		Dilute Nitric Acid <5%	Safety Glasses, Gloves	Neutralize with soda ash or lime. Contain spill, do not allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system.
MAXGOLD™ 900 Promoter	Proprietary Blend	Cytec Canada	Liquid	3	B-3, D-2A	3, 2, 0	200 L		slightly yellow liquid that has a slight sulphur smell. In confined space use respirator with organic vapour cartridges	Goggles, gloves. Respirator or SCBA if in confined space	eliminate ignition sources, use absorbent on small spills, for large spill pump to plastic drum for shipment off site. In case of fire use dry chemical extinguisher, CO ₂ or foam. Water likely not effective.
MERCSORB Mercury Amalgamation Powder		NPS Corporation	solid	4		0, 1, 1	25 kg		Dry zinc dust will not ignite spontaneously, but once ignited, it may burn readily in air	Safety Glasses, Gloves	Sweep up spilled material and place in closed container for reuse. In case of fire use appropriate measures for surrounding fire.
Mercury Indicator Powder	Proprietary Blend	NPS Corporation	solid	not regulated		2, 1, 0			Odorless, yellowish-tan to gray powder. Dust may form a flammable or explosive mixture in air. When heated to decomposition, toxic fumes of sulfur oxides are produced	Safety Glasses, Gloves	Sweep up spilled material and place in closed container for reuse. In case of fire use appropriate measures for surrounding fire. This product in itself is considered to be non-hazardous.
Mercury Standard - AA		Anachemia	Liquid	8	D-2A, E	3, 0, 0	5 L		Dilute Nitric Acid <5%	Safety Glasses, Gloves	Neutralize with soda ash or lime. Contain spill, do not allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system.
Mercury Vapor Suppressor	Proprietary Blend	NPS Corporation	solid	not regulated		2, 1, 0			Odorless, black, irregular, dry granular solid. Wet activated carbon removes oxygen from the air causing a severe hazard to workers in confined space.	Safety Glasses, Gloves	Sweep up spilled material and place in closed container for reuse. Contaminated waste can be incinerated. In case of fire use appropriate measures for surrounding fire. This product in itself is considered to be non-hazardous.
Methanol		Anachemia	Liquid	3, 6.1	B-2, D-1B, D-2A, D-2B	1, 3, 0	200 L		Extremely Flammable, Vapours are harmful and solution is poisonous	Goggles, gloves. Respirator or SCBA if in confined space	Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use dry chemical, CO ₂ , Alcohol-resistant Foam or water spray. Incinerate waste.
MIBC	Methyl Isobutyl Carbinol	Flomin Inc.	Liquid	3		2, 2, 0	200 L	Frother in Mill	Product liquid and vapor are flammable. Keep away from heat and sources of ignition. Product vapors or mist may be irritating to eyes and respiratory system. Product liquid may cause eye and skin burns. Harmful if swallowed.	Googles or Face Shield, Gloves, Respirator (NIOSH/MSA)	Dike spill and collect for disposal or reuse. Use adsorbents on residual material. Flush spill area with water. Keep flush material out of waterways. Dispose of cleanup material in an approved manner.
MIBK	4-Methyl-2-pentanone	Fisher Scientific	Liquid	3	B-2	2, 3, 0	200 L		clear liquid that has a slightly sweet smell. In confined space use respirator with organic vapour cartridges	Safety Glasses, Gloves	Clear liquid that is immiscible with water. Use absorbent for small spills and incinerate waste. Large spills, eliminate ignitions sources and pump to plastic drum for shipment off site.
Molybdenum Standard - AA		Anachemia	Liquid	not regulated	not regulated	0, 0, 0				Safety Glasses, Gloves	Contain spill. Incinerate waste or place in landfill
Mucosal universal detergent		Sigma-Aldrich Canada	Liquid	not regulated	D-2B	2, 0, 0				Safety Glasses, Gloves	

Minto Mine - Inventory of Dangerous Goods

Reporting Threshold, Special Precautions, PPE Requirements, and Cleanup and Disposal Methods

Common Name (Synonyms)	Chemical Name	Manufacture / Supplier	Phase	TDG Class	WHMIS Class	NFPA Rating	Reporting Threshold	Use	Special Precautions	PPE Required	Special Cleanup and Disposal Info
Nickel Standard - AA		Anachemia	Liquid	8	D-2A, E	1, 0, 0	5 L		Dilute Nitric Acid <5%	Safety Glasses, Gloves	Neutralize with soda ash or lime. Contain spill, do not allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system.
Nitric Acid		Anachemia	Liquid	8	C, D-1A, E	4, 0, 0, OX	5 L		Concentrated acid, Extremely corrosive. Ventilate or stay upwind. Strong Oxidizer	Goggles, gloves. Respirator or SCBA if in confined space	Neutralize with soda ash or lime. Contain spill, do not allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system.
Nitric Acid 40%		Quadra Chemicals	Liquid	8	C, D-1A, E	4, 0, 0, OX	5 L		Concentrated acid, Extremely corrosive. Ventilate or stay upwind. Strong Oxidizer	Goggles, gloves. Respirator or SCBA if in confined space	Neutralize with soda ash or lime. Contain spill, do not allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system.
Oxygen		BOC Canada Limited (Linde)	Pressurized gas	2.2	A, C	0, 3, 0, OX	any if container larger then 100 L		Strong Oxidizer will Contribute to combustion of other materials.	Safety Glasses, Gloves	close valve if possible without risk, or allow the vent. In case of fire use any media suitable for surrounding fire. Use water spray to cool fire exposed containers.
Oxygen Refrigerant		Air Liquide Canada	Liquefied Gas	2.2	A, C	0, 3, 0, OX	any if container larger then 100 L		Strong Oxidizer will Contribute to combustion of other materials. Liquefied gas, will produce extreme cold when released.	Safety Glasses, Gloves	close valve if possible without risk, or allow the vent. In case of fire use any media suitable for surrounding fire. Use water spray to cool fire exposed containers.
Palladium Nitrate Matrix Modifier		Spex CertiPrep	Liquid	8	D-2A, E	3, 0, 0	5 L		Dilute Nitric Acid <5%	Safety Glasses, Gloves	Neutralize with soda ash or lime. Contain spill, do not allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system.
Phosphoric acid		Sigma-Aldrich Canada	Liquid	8	D-1A, D-2B, E		5 L		Concentrated acid, Extremely corrosive. Ventilate or stay upwind.	Goggles, gloves. Respirator	Neutralize with soda ash or lime. Contain spill, do not allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system.
Pine Oil (Terpene SW Blend)		Quadra Chemicals Ltd.	Liquid	not regulated	B-3, D-2B			Frother in Mill	Combustible liquid and vapor. Causes respiratory tract, eye and skin irritation. Use only with adequate ventilation. Keep container tightly closed and sealed until ready for use. Wash thoroughly after handling. Avoid oxidizing materials.	Goggles, Gloves, Respirator (air-purifying or air-fed)	Stop leak if without risk. Move containers from spill area. Dilute with water and mop up if water-soluble or absorb with an inert dry material and place in an appropriate waste disposal container. Use spark-proof tools and explosion-proof equipment. Dispose of via a licensed waste disposal contractor.
PAX	Potassium Amyl Xanthate	Quadra Chemicals Ltd.	Solid	4.2	B-6, D-2B		25 kg	Collector in Mill	Keep away from water - contact with water liberates extremely flammable gases. Keep away from heat, sparks and flame - fine dust clouds may form explosive mixtures with air. Use only with adequate ventilation.	Goggles, Gloves, Respirator (air-purifying or air-fed)	Move containers from spill area. Avoid allowing the spilled material to get wet or using water to clean up spillages or residues, unless the quantity remaining is very small. Vacuum or sweep up material and place in a designated, labeled waste container. Use spark-proof tools and explosion-proof equipment. Dispose of via a licensed waste disposal contractor.
Polyclear A2501		Quadra Chemicals Ltd.	Solid	not regulated	not regulated			Tailings thickener flocculant	Keep away from heat, sparks and flame - fine dust clouds may form explosive mixtures with air. Take precautionary measures against electrostatic discharges. Use only with adequate ventilation. Avoid oxidizing materials.	Safety Glasses, Gloves	Move containers from spill area. Vacuum or sweep up material and place in a designated, labeled waste container. Use spark-proof tools and explosion-proof equipment. In case of fire use appropriate measures for surrounding fire. Place in sealed container and dispose of via a licensed waste disposal contractor.
Polyclear 2528	Polyclear Floc	Quadra Chemicals Ltd.	solid	not regulated	not regulated				concentrated solution is extremely slippery, use caution	Safety Glasses, Gloves, respiratory equipment if risk assesment deems necessary	Sweep up spilled material and it may be deposited of in dilute form to the pit or tailings system. In case of fire use appropriate measures for surrounding fire.
Polyclear 31080C		Quadra Chemicals Ltd.	Liquid	9	D-2B			Dewatering Aid in Mill	Use only with adequate ventilation. Avoid contact with strong oxidizers or halogens	Goggles, Gloves, Respirator (air-purifying or air-fed)	Stop leak if without risk. Move containers from spill area. Dilute with water and mop up if water-soluble or absorb with an inert dry material and place in an appropriate waste disposal container. Dispose of via a licensed waste disposal contractor.
Polyfroth W31		Quadra Chemicals Ltd.	Liquid	not regulated	not regulated			Frother in Mill	Harmful or fatal if swallowed. Can enter lungs and cause damage. May cause target organ damage	Goggles, Gloves, Respirator (air-purifying or air-fed)	Stop leak if without risk. Move containers from spill area. Dilute with water and mop up if water-soluble or absorb with an inert dry material and place in an appropriate waste disposal container. Dispose of via a licensed waste disposal contractor.
Potassium hydroxide	KOH	Science lab	Solid	8	D-1B	3, 0, 1	5 kg		very corrosive solid	Safety Glasses, Gloves	Use appropriate tools to put the spilled solid in a convenient waste disposal container. If necessary: Neutralize the residue with a dilute solution of acetic acid.
Potassium Iodide		Anachemia	solid	not regulated	D-2A	1, 1, 1			light and water exposure will cause breakdown	Safety Glasses, Gloves	Eliminate all sources of ignition. In case of fire use measures dictated by surrounding fire. Will decompose at high temperatures and emit toxic I ₂ fumes. Use appropriate SCBA.
Potassium permanganate		CAIROX	Solid	5.1	C, E	1, 0, 0, OX	50 kg		corrosive solid. Oxidizing solid	Safety Glasses, Gloves	Sweep up solid spill for possible reuse. If necessary reduce material in aqueous solution with sodium thiosulfate (hypo). In case of fire use flooding quantities of water, material will contribute to combustion.
Propane		Superior Propane	Liquefied Gas	2.1	A, B-1		any if container larger then 100 L		Extremely flammable. Liquefied gas, will produce extreme cold when released.	Goggles, gloves. SCBA if in confined space	close valve if possible without risk, or allow the vent. In case of fire use any media suitable for surrounding fire. Use water spray to cool fire exposed containers.
Selenium Standard - AA		Anachemia	Liquid	8	E	1, 0, 0	5 L		Dilute Nitric Acid <5%	Safety Glasses, Gloves	Neutralize with soda ash or lime. Contain spill, do not allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system.

Minto Mine - Inventory of Dangerous Goods

Reporting Threshold, Special Precautions, PPE Requirements, and Cleanup and Disposal Methods

Common Name (Synonyms)	Chemical Name	Manufacture / Supplier	Phase	TDG Class	WHMIS Class	NFPA Rating	Reporting Threshold	Use	Special Precautions	PPE Required	Special Cleanup and Disposal Info
Sodium Borohydride		Anachemia	solid	4.3	B-6, B-4, D-1B, E	3, 1, 2	25 kg		Flammable solid. Reacts violently with water and acids to produce flammable H ₂ gas. Strong reducing agent.	Safety Glasses, Gloves	Eliminate ignition sources, sweep up dry material. In case of fire use only dry chemical extinguisher, DO NOT USE WATER OR CO ₂
Sodium Hydroxide Solutions (various strengths)	NaOH (The Anachemia MSDS is current, treat all solutions in the same manner regardless of strength.)	Various Suppliers	Liquid	8	E	3, 0, 1	5 L		Caustic solution. Avoid mixing with strong acids. Contact with metals such as aluminum, tin, lead and zinc generates hydrogen gas.	Safety Glasses, Gloves	Neutralize the residue with a dilute solution of acetic acid. Neutralized solution can be disposed of in the pit or tailings system.
Sodium Nitrite		Anachemia	solid	5.1, 6.1	C, D-1B, D-2A	3, 0, 2, OX	50 kg		Strong Oxidizer will contribute to combustion of other materials.	Safety Glasses, Gloves	Eliminate all sources of ignition. In case of fire, use flooding quantities of water. Will decompose at high temperatures and emit acrid smoke. Strong oxidizer, may form compound that are sensitive to shock, friction. Sweep up solid spill for disposal. Dispose of contaminated solution in the pit or tailings system.
sodium sulphide Flakes	Sodium sulphide Hydrated	Quadra Chemicals	solid	8	D-1B, E		5 kg		caustic, very corrosive solid	Goggles, gloves. And a respirator, avoid creating dust and avoid any acids. Contact with acids liberate toxic H ₂ S	Sweep up spilled material in place in plastic sealed container for shipment off site.
TMT 15%	trisodium salt	Quadra Chemicals	Liquid	not regulated (treated as Cl. 9 Miscellaneous)	D-2B		25 L		water soluble	Safety Glasses, Gloves	No special clean up procedures, treated as Class 9 Miscellaneous as product does not meet Class 6 Toxicity standards but is an environmental hazard.
Urea	Carbamide	Anachemia	solid	not regulated	not regulated	1, 0, 0			Avoid contact with strong oxidizers. In fire conditions it can produce oxides of nitrogen. Also ammonia, and HCN	Safety Glasses, Gloves	Sweep up spilled material and it may be deposited in dilute form to the pit or tailings system. In case of fire use appropriate measures for surrounding fire.
Vitec 7000		Avista Technologies	Liquid	not regulated	2A	1, 0, 0		Antiscalant in WTP	Avoid mixing with strong bases, strong oxidizers, very strong acids, water reactive materials	SCBA or SABA in confined space, Safety goggles/glasses, Chemical impervious gloves	Soak up or wet vacuum spilled liquid. Neutralize residue with sodium bicarbonate or other neutralizing agent for very dilute acids. Decontaminate the area thoroughly. Place all spill residues in suitable container and dispose of via a licensed waste disposal contractor.
VARSOL 3139 SOLVENT	Petroleum Hydrocarbons	Imperial Oil Chemicals	Liquid	3	B-3, D-2B	1, 2, 0	200 L		Flammable solvent	Safety Glasses, Gloves	Clean up uncontaminated material for reuse. Incinerate waste.
VoltEsso 35		Imperial Oil Chemicals	Liquid	not regulated	not regulated	1, 1, 0			electrical insulating oil	Safety Glasses, Gloves	Clean up uncontaminated material for reuse. Incinerate waste.
Zinc Standard - AA		Anachemia	Liquid	8	E	1, 0, 0	5 L		Dilute Nitric Acid <5%	Safety Glasses, Gloves	Neutralize with soda ash or lime. Contain spill, do not allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system.

Appendix C: ERT Response to HazMat Spills

ERT Response to Hazmat Spill

Spill Contact: Yukon Territory Spill Line 1-867-667-7244

Canutec: 1-613-996-6666 Cell: *666

1. Site Management and control

Initial responders will :

- Approach the scene from uphill and upwind.
- Establish command uphill and upwind of spill at an appropriate distance.
- Establish 2 isolation perimeters: one that separates the hot zone from the warm zone and another that separates the warm zone from the cold zone. Emergency Response Guide or Canutec shall be referenced for perimeter size.
- Evacuate affected area or 'protect in place', as req'd. Emergency Response Guide or Canutec shall be referenced for evacuation zone.
- Identify contaminated persons and ensure they remain isolated until they can be decontaminated.
- Establish a staging area.
- Designate an information officer.
- Possible unification of command.

2. Identification of the problem

I/C will identify the:

- Spilled product, as per witness testimony, placards, labels, bill of lading, type of container, etc. If product cannot be identified from command position, then a recon team will be tasked with identification.
- Size of container.
- Size and nature of release.
- Conditions and # of victims at accident site.
- Topography of area, and exposures threatened.

3. Hazard & Risk Evaluation

A risk evaluation will be conducted, taking into consideration:

- Product hazards
- Access & Egress

- Size of Spill
- Condition of container
- Proximity of exposures
- Personnel available to perform operations, and their level of training/experience
- Information from MSDS, ERG, Canutec, etc., minimum 3 sources

4. Personal Protective Equipment

PPE will be selected for Ops, RIT, and Decon teams, considering:

- Flammability/explosiveness of product
- Toxicity of product
- Route of entry of product
- Permeation rate of PPE
- Breakthrough time of PPE
- Availability of PPE
- Visibility and workability while wearing PPE

5. Information management and resource coordination

The information officer will begin to gather information about the product once it has been identified. The information officer can use the MSDS, ERG, Canutec, or many other resources to gather information, such as:

- Properties of the product
- Hazards of the product
- Expected travel of product released
- Populations/ environment in jeopardy
- PPE req'd by responders
- Decontamination requirements

Command will prioritize the information and ensure that the correct people receive the correct information.

6. Implementing Response Objectives

Command will develop an overall strategy, which may be offensive (entry of hot zone to gain quick control), defensive (contain from the cold zone to prevent spread), or passive (isolate only, and wait for incident to run its course), considering:

- Life safety
- Incident stabilization
- Environmental protection
- Property salvage

Command will delegate tactics to operations teams, such as:

- Reconnaissance for unknown product
- Evacuation for toxic gas leak, fire, or explosive hazard
- Fire control for flammable gas, flammable liquid, or oxidizer
- Search and rescue
- Leak control
- Neutralization of corrosives
- Deployment of boom, drain covers, etc.
- Building of dams, dykes, etc.

To follow: specific tactic options will be discussed in more detail, pertaining to hazardous materials that are commonly found in large quantities at the Minto Mine.

Entry teams will enter with a clear objective, but must assess for the next team's objective. For example, the 1st entry team may be tasked with rescuing the driver of a fuel truck that rolled down a bank and is spilling fuel. Although their objective is to rescue, while they are on scene they should observe where the leak is, consider what could be used to stop it, where the fuel is going, and what is needed to contain it. They should bring a camera, so that pictures can be brought back to command. This will give command crucial information and better prepare the next team for their task.

7. Decontamination

Considerations for decontamination should begin at the outset of the incident. A decontamination construct will exist in the warm zone prior to any team entering the hot zone. It will typically consist of a large berm fashioned out of a large chemical resistant tarp, wrapped over a charged 2 ½" hose-line. There will be a charged 1 ½" hose-line nearby for emergency decontamination. Within the berm, there will be a series of smaller berms, in which, personnel will stand while being decontaminated. Personnel conducting the decontamination will be wearing the appropriate PPE (typically 1 class below ops) and will use detergent and water to gently scrub and rinse ops personnel and rescuees as they exit the hot zone. Tools and anything else exiting the hot zone will be decontaminated as well.

Once decontamination is complete, all product collected by the berms, will be handled as per the MSDS.

8. Termination

Once emergency operations are complete, the scene will be handed over to clean-up & recovery operations. Command will ensure that the hand-off includes all pertinent information about the spilled product:

- Properties
- Hazards
- Location
- Safe-handling
- Exposure signs and symptoms
- Req'd PPE
- Disposal procedures

Command will conduct an on-site debrief. As well, a more formal debrief will be conducted, with all parties involved, at a later time. The incident will be documented, including exposure records for all personnel that entered the warm and/or hot zones.

Nitric Acid 40%

Note: when it comes to corrosives such as Nitric Acid, the solution to pollution is NOT dilution. For a spill of 1 45 gal drum, it would take over 450,000 gal of pure water to make the solution habitable for fish. It would take over 45,000,000 gal of pure water to neutralize it.

Site management and control

- Set up perimeter with at least 50m radius.
- Command, staging, & decon shall be positioned uphill.
- Unify command with Safety Superintendent, Mine Manager, Environmental Dept., product Carrier (if spill occurs during delivery to mine).

Identification



- UN# 2031
- Liquid state
- Colourless to yellow
- Transported in 45 gallon drums
- # of 45 gal drums possibly damaged will help estimate size of spill.
- What is downhill from spill? Could acid reach a stream?

Hazard & risk evaluation

- Strong acid, very corrosive.
- Severely hazardous to eyes and skin
- Ingestion could cause death
- Inhalation hazard, although low vapour pressure 1.3kPa (wants to be a liquid).
- Could be devastating to stream life.
- Strong oxidizer, could have explosive reaction with organic or combustible materials

PPE

- If there is a fire situation, PPE will consist of full turn-out gear and SCBA.
Otherwise
- Know and heed permeability rate and breakthrough times of all PPE.
- Acid resistant, class B suit with hood.
- Full-face respirator with appropriate chemical cartridges.
- Chemical resistant gloves & boots
- Chemical resistant tape used to seal between boots/suit, gloves/suit, and mask/hood.

Information management and resource coordination

- See MSDS for product information.
- Know the product's route of travel.
- Was anyone exposed?
- Will non-human life be exposed?
- Standard decon set-up will be constructed.
- Have tools cribbed for entry teams.
- Ensure there is enough PPE at the site to complete the task.
- Ensure there is enough neutralizing agent at the site to complete the task. *See below for chart*
- Ensure there is drinking water for responders.
- Have hazmat trailer, ambulance & fire truck in staging area, as req'd
- Have Site Services staged for digging, damming, product extraction, as req'd.

Implementing Response Objectives

- Rescue injured/exposed personnel.
- Prevent from entering streams
- Prevent from contacting combustibles and organics.
- If possible, stop the leak.
- If possible, contain by covering drains/culverts, damming, diverting to a berm, etc.
- Use over-pack to contain leaking drums that still contain product.
- Neutralize spilled product with weak caustic – primary neutralizing agent is Ansul Spill X-A, alternatively hydrated lime or baking soda (if available). Be cautious of chemical reaction.
- Use Litmus paper to test for pH when neutralizing with lime or baking soda.
- Site Services Vac-truck is an option for cleaning up product before or after neutralized, as necessary.

Decontamination

Standard decon set-up will be utilized in warm zone:

- Large berm fashioned out of large chemical resistant tarp, wrapped over charged 2 ½" hose-line, 2 small berms, will be in series, within the large berm.
- Decon personnel shall don class C suits without need for respiratory or splash protection, other than safety glasses.
- Ensure all personnel that entered hot zone are properly decontaminated.
- Ensure that all tools that entered the hot zone are properly decontaminated.

Termination

- Once operation complete, vac-truck can be utilized to clean up solution contained with the decon berms.
- Safe and proper disposal of all spent PPE.

- Transition of command.
- Debrief

Quick Access Chart for Estimating Amount of Caustic Req'd to Neutralize 40% Nitric Acid

For **Spill X-A**, use 1:1 ratio by volume, or 10lbs Spill X-A per 1 gal Nitric Acid.

Amount of Nitric Acid Spilled (in Gal.)	Amount of Baking Soda Req'd (in Lbs.)
1	5.6
2	11
5	28
10	56
20	110
45	252
90	504
135	756
180	1,008

Amount of Nitric Acid Spilled (in Gal.)	Amount of Lime Req'd (in Lbs.)
1	2.4
2	4.8
5	12
10	24
20	48
45	108
90	216
135	324
180	432

Charts derived from formulas below

Specific Gravity Nitric Acid: 1.2455

Concentration: 40%

$$1 \text{ gal HNO}_3 \times 1.24 \times 8.34 \text{ lbs/gal} \times 0.40 = 4.14 \text{ lbs HNO}_3$$

$\text{HNO}_3 + \text{NaHCO}_3 \rightarrow \text{NaNO}_3 + \text{H}_2\text{O} + \text{CO}_2$ Therefore 1 mol Nitric Acid per 1 mol Sodium Bicarb (Baking Soda)

$2\text{HNO}_3 + \text{Ca(OH)}_2 \rightarrow \text{Ca(NO}_3)_2 + 2\text{H}_2\text{O}$ Therefore 2 mol Nitric Acid per 1 mol Calcium Hydroxide (Lime)

$\text{HNO}_3 = 63 \text{ amu}$

$\text{NaHCO}_3 = 85 \text{ amu}$

$\text{Ca}(\text{NO}_3)_2 = 164 \text{ amu}$

$(4.14 \text{ lbs HNO}_3 / 63 \text{ amu-HNO}_3) \times 85 \text{ amu-NaHCO}_3 = 5.6 \text{ lbs NaHCO}_3$

Therefore 1 gallon of Nitric Acid req's 5.6 lbs of baking soda

$(4.14 \text{ lbs HNO}_3 / 63 \text{ amu-HNO}_3) \times 164 \text{ amu-Ca}(\text{OH})_2 = 10.7 \text{ lbs Ca}(\text{NO}_3)_2$

Neutralization Formulas and Quick Access Charts Formulas

The key to effective and efficient neutralization, is knowing how to use the following formulas.

1. The first formula indicates how much acid is spilled in weight.

Step #1- Determine the quantity of acid spilled, usually in gallons.

Step #2- Determine the specific gravity of the acid usually provided in MSDS.

Step #3- Determine the concentration of the acid spilled usually in %.

Step #4- The weight of water is 8.34 pounds per gallon.

After the above figures are known plug them into the following formula.

Quantity of spill X specific gravity X weight of water X concentration = weight of the spill

Example

One gallon of sulfuric X 1.84 X 8.34 X 98% = 15.04 pounds of sulfuric

2. The second formula will determine the quantity of the neutralizer needed. The type of neutralizer needs to be selected based on costs and availability. Plug numbers into the following formula.
- 3.

Weight of the acid spilled X number in the chart for the selected neutralizer.

Example

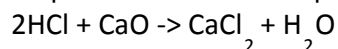
15.04 pounds of sulfuric X 1.06 for Soda Ash = 15.94 pounds of Soda Ash

Determination through Chemistry

To calculate the amount of neutralization agent needed the balanced chemical reaction must be written and the equivalent weights of acid and base determined.

Example: 1,000 gallons of 38% hydrochloric acid will be neutralized with lime.

Step #1 – Write the complete balanced neutralization reaction:



This equation shows that 2 moles of HCl are required in the reaction with one mole of calcium oxide (lime).

Step #2 – Calculate the molecular weight of each compound:

HCl – H = 1, Cl = 35.5, Total = 36.5 amu

CaO – Ca = 40, O = 16, Total = 56

Step #3 – Calculate the weight of the HCl spill:

1,000 gallons X 1.20 X 8.34 X 0.38 = 3,803.04 pounds of HCl

Step #4 – Calculate the amount of neutralizer needed:

From Step #1 it was found that 2 moles of HCl are needed to react with 1 mole of CaO. From Step #2 it was found that 1 mole of HCl weighs 36.5 amu's so 2 moles weigh 73.0 amu's. The formula is;
weight of acid/formula weight of acid X formula weight of base = pounds of the neutralizer needed.

3,803.04/73 X 56 = 2,917.4 pounds of lime

Finer Points

The final amount is an approximation and in actual practice more neutralizing agent should be obtained. The neutralization process needs to be checked at several spots to assure pH levels are acceptable and uniform.

Neutralization Precautions

Remember, the neutralization process is exothermic and it may involve splashing of product. Safety is paramount and proper protective equipment is very important. Also, the neutralizer is hazardous in its own right and needs to be handled with care. Consider expense and availability in selecting neutralizer. Other weak bases that may be used and their molecular weights are; sodium bicarbonate (NaHCO_3)- 85, and magnesium hydroxide (Mg(OH)_2)-58.

Neutralization Chart Information

Acids

Hydrochloric Acid, HCl, MW = 36.5, density/specific gravity is 1.19, weight of a gallon is 3.77 pounds at 38% concentration. Synonyms are chlorohydric acid and muriatic acid.

Nitric Acid, HNO_3 , MW = 63, density/specific gravity is 1.41, weight of a gallon is 8.23 pounds at 70% concentration. Synonyms are Aqua Fortis and Azotic Acid. (Aqua Regia is a mixture of nitric and hydrochloric acids).

Phosphoric Acid, H_3PO_4 , MW = 98, density/specific gravity is 1.69, weight of a gallon is 11.98 pounds at 85% concentration. Synonyms are orthophosphoric acid.

Sulfuric Acid, H_2SO_4 , MW = 98, density/specific gravity is 1.84, weight of a gallon is 15.04 pounds at 98% concentration. Synonyms are Oil of vitriol and “oleum” is fuming sulfuric acid.

Bases

Ammonium hydroxide, NH_4OH , MW = 35, clear solution, synonyms are ammonia solution and aqua ammonia.

Strong ammonia odor evolves from liquid. High vapor pressure.

Calcium carbonate, CaCO_3 , MW = 100, white powder, synonyms are crushed limestone and dolomite. Low heat of reaction that gives off carbon dioxide gas.

Calcium hydroxide, Ca(OH)_2 , MW = 74, white powder, synonyms are slaked lime, hydrated lime, and calcium hydrate.

Calcium oxide, CaO , MW = 56, white powder, synonyms are quicklime, lime, and unslaked lime. Most economical, lowest cost, neutralizer. **Best choice!** Maximum pH is 12.45 at 25C.

Magnesium carbonate, MgCO_3 , MW = 84, synonyms are magnesia alba and carbonate magnesium.

Magnesium hydroxide, Mg(OH)_2 , MW = 58, white powder, synonyms are milk of magnesia and magnesia hydrate. Good neutralization agent. Maximum pH is 10.6 at 25C.

Potassium hydroxide, KOH , MW = 56, white flakes, synonyms are caustic potash. High heat of reaction with toxic fumes. Maximum pH is 14 at 25C.

Sodium bicarbonate, NaHCO_3 , MW = 85, white powder, synonyms are baking soda and sodium acid carbonate. Low heat of reaction with carbon dioxide gas evolution.

Sodium Carbonate, Na_2CO_3 , MW = 106, white powder, synonyms are soda ash. **Second most economical neutralization agent next to lime.** Maximum pH is approximately 11 at 25C.

Sodium hydroxide, NaOH , MW = 40, white powder, synonyms are caustic soda, soda lye, caustic, and lye. High heat of reaction with toxic fumes. Maximum pH is 14 at 25C.

Quick Access Charts

Sulfuric Acid neutralization using Baking Soda (Sodium Bicarbonate)

Amount of Sulfuric Acid spilled	Amount of Baking Soda needed in pounds
1 gallon	25.6
2 gallons	51.2
3 gallons	76.8
4 gallons	102.4
5 gallons	128.0
10 gallons	256.0
50 gallons	1280.0
55 gallons	1408.0
100 gallons	2560.0

Hydrochloric Acid neutralization using Baking Soda

Amount of Hydrochloric Acid spilled	Amount of Baking Soda needed in pounds
1 gallon	5.5
2 gallons	11.0
3 gallons	16.5
4 gallons	22.0
5 gallons	27.5
10 gallons	55.0

50 gallons	275.0
55 gallons	302.5
100 gallons	550.0

Nitric Acid neutralization using Baking Soda

Amount of Nitric Acid spilled	Amount of Baking Soda needed in pounds
1 gallon	7.4
2 gallons	14.8
3 gallons	22.2
4 gallons	29.6
5 gallons	37.0
10 gallons	74.0
50 gallons	370.0
55 gallons	407.0
100 gallons	740.0

Sodium Sulfide

Site management and control

- Set up perimeter with at least 50m radius if water introduced, or 25m if solid.
- Command, staging, & decon shall be position upwind and uphill.
- Unify command with Safety Superintendent, Mine Manager, Environmental Dept., product carrier (if spill occurs during delivery to mine).

Identification



- UN# 1849
- Solid state
- Yellow
- Smell sulfurous or like rotten eggs with introduction of moisture.
- Transported in 1000 Kg 'Super-Sacks'.
- # of super-sacks possibly damaged, will help estimate size of spill.
- Is water being introduced to the spill? If so, what is downhill from the spill? Could run-off reach a stream?
- Are corrosives being introduced to spill? If so, what is downwind?

Hazard & risk evaluation

- Strong caustic.

- Severely corrosive to digestive tract, respiratory system, eyes, and skin.
- Dust is powerful systemic poison. Inhalation could cause headache, dizziness, unconsciousness, pulmonary edema, asphyxiation, death.
- Contact with acid releases toxic and flammable Hydrogen Sulfide.
- Routes of entry include absorption, inhalation, and ingestion.
- Keep spilled product dry
- If water introduced, avoid run-off, contact with soil, waterways.

PPE

- If there is a fire situation, PPE will consist of full turn-out gear and SCBA.
Otherwise
- Know and heed permeability rate and breakthrough times of all PPE.
- SCBA if significant H₂S release, otherwise, full-face respirator & OV cartridges with pre-filter.
- Corrosive resistant, class B suit with hood.
- Chemical resistant gloves & boots
- Chemical resistant tape used to seal between boots/suit, gloves/suit, and mask/suit.

Information management and resource coordination

- See MSDS for product information.
- Was anyone exposed?
- Will non-human life be exposed?
- Standard decon set-up will be constructed.
- Have tools cribbed for entry team.
- Ensure there is enough PPE at the site to complete the task.
- Ensure there is drinking water for responders.
- Have hazmat trailer, ambulance & fire truck in staging area, as req'd
- Have Site Services staged for digging, damming, product extraction, as req'd.

Implementing Response Objectives

- Rescue injured/exposed personnel.
- Keep product dry.
- Monitor atmosphere for H₂S and SO₂.
- If water introduced, contain run-off by covering drains/culverts, damming, diverting to a berm, etc. Solution collected can be mixed with oxidizing agent, such as hydrogen peroxide or sodium hypochlorite to prevent evolution of H₂S.
- If product has entered a stream, consider using over-flow dams to contain product, for extraction.
- Vacuum or sweep up dry product
- Disposal as per Environmental Dept. recommendations

Decontamination

Standard decon set-up will be utilized in warm zone:

- Large berm fashioned out of large chemical resistant tarp, wrapped over charged 2 ½" hose-line, 2 small berms, will be in series, within the large berm.
- Decon personnel shall don class C suits without need for respiratory or splash protection, other than safety glasses.
- Ensure all personnel that entered hot zone are properly decontaminated.
- Ensure that all tools that entered the hot zone are properly decontaminated.

Termination

- Once operation complete, solution in decon berms to be disposed of, as per Environmental recommendations.
- Safe and proper disposal of all spent PPE.
- Transition of command.
- Debrief

LPG (Propane)

Note: Minto gas detectors are calibrated to methane, and must be corrected to propane prior to use, during propane leak mitigation.

Site management and control

- Set up initial perimeter of at least 100m. For large tank where there is fire, set up perimeter of at least 1600m.
- Command, staging, & decon shall be positioned uphill and upwind.
- Eliminate sources of ignition.
- Unify command with Safety Superintendent, Mine Manager, Environmental Dept., product carrier (if spill occurs during delivery to mine).

Identification



- UN# 1075
- Colourless liquid and vapour while stored under pressure.
- Colourless and odourless gas in natural state at any concentration.
- Commercial propane has an odorant added which is commonly ethyl.
- Transported by tanker truck.
- Stored in 12,000L tank at ramp to camp and twin 18,000L tanks at Km 0 of the access road.

- What is downhill from spill?
- Is there threat to life?
- Is there threat to a stream?

Hazard & risk evaluation

- Extremely flammable gas.
- Vapour could be ignited by any source of ignition.
- Vapour is heavier than air and may travel considerable distance to an ignition source, and flash back.
- Stored under pressure, as a liquid.
- Product extraction methods could create static if not bonded/grounded, and serve as an ignition source.
- Massive explosion hazard where flame impingement on tank.

PPE

- Full turn-out gear with SCBA.

Information management and resource coordination

- See MSDS for product information.
- Consider contacting Canutec.
- Know the product's route of travel.
- Ensure tools are cribbed for entry teams.
-
- Have fire truck at scene and ambulance in staging area, as req'd

Implementing Response Objectives Leak in an enclosed space

- Evacuate structure.
- Close supply valve remotely if possible.
- Eliminate any source of ignition.
- Use positive pressure to ventilate space, ensure that it is exhausting to safe location.

If no remote isolation valve:

- Entry team (2 ERT members) & RIT team (2 ERT members) will don full turn-out gear & SCBA.
- Any electronic equipment being carried, such as radio or gas detector, must be intrinsically safe.
- Entry team will enter with charged 1 ½" hose-line and gas detector equipped with LEL sensor, while RIT stages in the cold zone .

- Once entry team is at 'reach of stream' distance from the leak, the nozzleman (Entry member 1) will set-up, with nozzle fixed on Entry member 2. Entry member 2 will continue toward valve, with gas detector.

If LEL sensor rises above 20%, entry team will retreat until ventilation can be made adequate.

- Once Entry member 2 reaches the valve, he will close the valve, then back away until he reaches entry member 1.
- Entry team will exit the structure, until it has been adequately ventilated.
- Once adequately ventilated, ERT members, wearing appropriate PPE, will sweep the structure with gas detector(s), to ensure there are no pockets of gas, before deeming the structure 'safe to enter'.

LPG line on fire, with no impingement

Note: a propane leak that is burning is safer than one that is not burning, as long as there is no impingement on a tank or structure. Therefore, in this scenario, gas will be allowed to burn until the valve can be shut off.

- Evacuate immediate area.
- If possible, close isolation valve from remote location.

If no remote isolation valve:

- Eliminate any further source of ignition.
- 2 or more ERT members in full turn-out gear & SCBA will be on 1 ½" hose-line.
- Nozzle will be turned to full fog, which will create a water-curtain between the fire and the fire fighters.
- The fire team will approach the isolation valve, keeping the water-curtain between themselves and the fire at all times, being careful not to put the fire out with the stream
- When the valve is reached by the team, the 2nd member on the line will let go of the hose and approach the valve, while the nozzleman maintains the water-curtain between the fire and the valve/fire team.
- The 2nd member will close the valve then back away from the fire until he regains his position on the hose.
- The team will maintain the water-curtain while they back away from the damaged gas-line.
- Once the team is at a safe distance, a 45 degree pattern can be fixed on the broken gas-line to cool it, and disperse any residual gases.

LPG leak, not enclosed, not on fire

Note: LPG has a very high vapour pressure (1013 kPa) so it wants to be a gas, a high vapour density (1.52) so it's heavier than air, and a low flash point (-103.4 C). This combination means that it can form an explosive gas cloud that will stay close to the ground, may linger in incident area, or migrate downwind and/or downhill, possibly settling in low lying areas.

- Evacuate immediate area as well as areas downwind/downhill as per ERG recommendations.
- If possible, close isolation valve from remote location.
- From 'reach of stream', set up ground monitor and fix a 45 degree fog pattern on area of concern. This will push gas cloud away from area and disperse it. Be sure to push it to a safe location.

If no remote isolation valve:

- Entry team (2 ERT members) & RIT team (2 ERT members) will don full turn-out gear & SCBA.
- Any electronic equipment being carried, such as radio or gas detector, must be intrinsically safe.
- Entry team will enter with charged 1 ½" hose-line and gas detector equipped with LEL sensor, while RIT stages in the cold zone.
- While ground monitor continues to 'make it rain' in the hot zone, nozzleman (entry member 1) will fix nozzle on entry member 2, as entry member 2 approaches the isolation valve, with gas detector.

If LEL sensor rises above 20%, entry team will retreat until water stream can be made more effective

- Once Entry member 2 reaches the valve, he will close the valve, then back away until he reaches entry member 1.
- Entry team will retreat to the cold zone until gases are adequately dispersed
- Once the gas is adequately dispersed, ERT members, wearing appropriate PPE, will sweep the area with gas detector(s), including low-lying areas where gas may have migrated to, before deeming the area 'safe to enter'.

Fire where there is flame impingement on LPG tank

- Evacuate all non-ERT members for at least 1,800 m where there is flame impingement on either the 12,000 L tank or the tandem 18,000 L tanks.
- Command will know and understand the signs of imminent BLEVE.
- If Command witnesses signs of imminent BLEVE from an upright tank, there shall be no attempt made to cool tanks, rather, all focus shall be on a rapid evacuation of all personnel, at least 1,800m.
- If tank has been knocked over, there may be little or no warning signs of BLEVE, therefore no attempt shall be made to cool, rather, all focus shall be on a rapid evacuation of all personnel, at least 1,800m.
- If a BLEVE is not imminent, an attempt will be made to connect a ground monitor to the stand-pipe at the Tailings bldg.
- A narrow fog stream will be fixed on the tank at the area of flame impingement.
- The monitor will be left unmanned and the remaining ERT will evacuate at least 1,800m.

Where a tanker truck carrying propane has over-turned on the access road, causing damage to the tank trailer and subsequent rapid release of propane, the strategy for the hazmat portion of the incident response, will be passive and conducted from an upwind/uphill location, at a safe distance, as per the ERG. Transfer of residual product for the scenario, will be conducted by outside resource.

Decontamination

- 1 ½" charged hose-line, as emergency decon

Termination

- Debrief

BW GasAlert Micro 5 is intrinsically safe, as per: http://directories.csa-international.org/xml_transform.asp?xml=certxml%5C080259_0_000-4828-82.xml&xsl=xsl/certrec.xsl

- GasAlert Micro 5 Portable Gas Detector, Model M5-xwt1t2-r-p-d-a-b-cc & M5PID-xwt1t2-r-p-d-a-b-cc; utilizing electrochemical, catalytic bead and photo-ionization sensors; Intrinsically Safe when powered by one of the following AA Size Batteries /

Battery Pack

- Duracell MN1500; T-Code T4; Ambient -20 to +40°C; T-Code 139.8°C (T3C); Ambient -20 to +50°C
- Energizer E91; T-Code 153°C(T3C); Ambient -20 to +40°C; T-Code 163°C (T3B); Ambient -20 to +50°C
- NiMH Rechargeable Battery Pack "M5-BAT01"; T-code T4; Ambient -20 to +50°C
- Lithium Polymer Rechargeable Battery pack "M5-BAT07B"; T-Code T4; Ambient -20 to +50°C

Diesel, Kerosene, CFE 150

Note: LEL sensor will not detect presence of long-chain hydrocarbon vapour. Photo-ionization detector (PID) should be used, if available.

Site management and control

- Set up perimeter with at least 50m radius.
- Command, staging, & decon shall be positioned uphill and upwind.
- Eliminate sources of ignition.
- Unify command with Safety Superintendent, Mine Manager, Environmental Dept, Dyno Nobel (if spilled product is CFE 150), product carrier (if spill occurs during delivery to mine).

Identification



- UN# 1202.
- Liquid state.
- Colour varies.
- Petroleum odour.
- Transported by B-train, tidy-tanks.
- Stored in tanks at fuel farm.
- What is downhill from spill??
- Is there threat to life?
- Is there threat to a stream?

Hazard & risk evaluation

- Combustible liquid.
- Vapour could be ignited by any source of ignition.
- Extraction methods could create static if not bonded/grounded, and serve as an ignition source.
- Ambient temperature relevant.

- Irritant to eyes and skin
- Ingestion and inhalation hazard
- Toxic to aquatic life.

PPE

- If there is a fire situation, PPE will consist of full turn-out gear with SCBA.
Otherwise
- For offensive strategies, such as rescue or plugging, full turn-out gear with SCBA
- For defensive strategies, such as diverting, damming, booming, diking, class B suit.
- Respirator with OV cartridges.
- Oil resistant gloves & boots

Information management and resource coordination

- See MSDS for product information.
- Know the product's route of travel.
- Standard decon set-up will be constructed.
- Ensure tools are cribbed for entry teams.
- Ensure there is enough PPE at the site to complete the task.
- Ensure there is drinking water for responders.
- Have hazmat trailer, ambulance & fire truck in staging area, as req'd.
- Have Site Services staged for digging, damming, product extraction, as req'd.

Implementing Response Objectives

- Rescue injured personnel.
- Consider using fog stream to protect rescuers.
- Fire-fighting: Use dry chemical, CO2, Class B foam, or water with fog pattern.
- If using fog, considering increased run-off hazard
- Prevent from entering streams.
- If possible, stop the leak: close valves, use plugs, plug n' dyke, gaskets, straps, jacks, cribbing, etc.
- Containment berm at source, 'Surrey Condom'.
- If possible, contain by covering drains/culverts, diking, diverting to a berm, absorbing, etc.
- If product has entered a stream, use booms, hydrocarbon-only absorbent socks and pads, under-flow dams, diversion-booms, skimmers to contain and extract, as per instructions found later in this document.
- If transfer of product req'd, ensure entire system is bonded/grounded.
- Use non-sparking tools, such as pneumatics.
- Site Services Vac-truck is an option for cleaning up product.

Decontamination

Standard decon set-up will be utilized in warm zone:

- Large berm fashioned out of large chemical resistant tarp, wrapped over charged 2 ½" hose-line, 2 small berms, will be in series, within the large berm.
- Decon personnel shall don class C suits without need for respiratory or splash protection, other than safety glasses.
- Ensure all personnel that entered hot zone are properly decontaminated.
- Ensure that all tools that entered the hot zone are properly decontaminated.

Termination

- Once operation complete, vac-truck can be utilized to clean up solution contained with the decon berms.
- Safe and proper disposal of all spent PPE.
- Transition of command.
- Debrief

Gasoline

Note: Minto gas detectors are calibrated to methane and must be corrected to gasoline, or alternatively pentane, prior to use during gasoline spill mitigation

Site management and control

- Set up perimeter. Consider radius up to 800m depending on amount of product and level of explosion hazard.
- Command, staging, & decon shall be positioned uphill and upwind.
- Eliminate sources of ignition.
- Unify command with Safety Superintendent, Mine Manager, Environmental Dept., product carrier (if spill occurs during delivery to mine).

Identification



- UN# 1203.
- Liquid state.
- Colourless to slightly yellow.
- Recognizable odour.

- Transported by B-train, tidy-tanks.
- Stored in tank at fuel farm.
- What is downhill from spill??
- Is there threat to life?
- Is there threat to a stream?

Hazard & risk evaluation

- Flammable liquid. Extremely flammable in presence of ignition source, at nearly any temperature.
- Vapour could be ignited by any source of ignition.
- Vapour is heavier than air and may travel considerable distance to an ignition source, and flash back.
- Product extraction methods could create static if not bonded/grounded, and serve as an ignition source.
- Explosion hazard where flame impingement on tank.
- Irritant to eyes.
- Ingestion and inhalation hazard
- Toxic to aquatic life.

PPE

- If there is a fire situation, PPE will consist of full turn-out gear with SCBA.
- Otherwise*
- For offensive strategies, such as rescue or plugging, full turn-out gear with SCBA
 - For defensive strategies, such as diverting, damming, booming, diking, fire resistant class B suit.
 - Respirator with OV cartridges, only if LEL's are being monitored, otherwise, do not dampen sense of smell. Rather, move upwind of product vapour.

Information management and resource coordination

- See MSDS for product information.
- Know the product's route of travel.
- Standard decon set-up will be constructed.
- Ensure tools are cribbed for entry teams.
- Ensure there is enough PPE at the site to complete the task.
- Ensure there is drinking water for responders.
- Have hazmat trailer, ambulance & fire truck in staging area, as req'd
- Have Site Services staged for digging, damming, product extraction, as req'd.

Implementing Response Objectives

- Offensive tactics for rescue of injured personnel only.
- Consider blanketing affected area with class B foam, prior to rescuers entering hot zone.

- Use fog stream to suppress vapours and protect rescuers.
- Rescuers will carry intrinsically-safe radios and gas-detector.
- Prevent from entering streams
- If possible, stop the leak.
- If possible, contain by covering drains/culverts, diking, diverting to a berm, absorbing, etc.
- If product can or has entered a stream, use booms, hydrocarbon-only absorbent socks and pads, under-flow dams, diversion-booms, as per instructions found later in this document.
- Safe handling and disposal of all waste product.

Decontamination

Standard decon set-up will be utilized in warm zone:

- Large berm fashioned out of large chemical resistant tarp, wrapped over charged 2 ½" hose-line, 2 small berms, will be in series, within the large berm.
- Decon personnel shall don class C suits without need for respiratory or splash protection, other than safety glasses.
- Ensure all personnel that entered hot zone are properly decontaminated.
- Ensure that all tools that entered the hot zone are properly decontaminated.

Termination

- Once operation complete, safe disposal of decon berm contents
- Safe and proper disposal of all spent PPE
- Hand-over command of operation to Environmental Dept.
- Debrief

Ammonium Nitrate

Site management and control

- Set up perimeter with at least 25m radius.
- Command, staging, & decon shall be positioned upwind.

- Eliminate sources of ignition.
- Unify command with Safety Superintendent, Mine Manager, Environmental Dept, Dyno Nobel, product carrier (if spill occurs during delivery to mine).

Identification



- UN# 1942.
- Solid state. Prills or granules.
- White.
- Odorless.
- Is there threat to a stream?

Hazard & risk evaluation

- Oxidizer .
- Exposure to high heat may evolve toxic, flammable gases.
- Explosive when confined and exposed to high heat.
- Ingestion and inhalation hazard.
- Toxic to aquatic life.

PPE

- If there is a fire situation, PPE will consist of full turn-out gear with SCBA.
Otherwise
- Class C suit with long sleeves.
- Dust mask.
- Oil resistant gloves & boots

Information management and resource coordination

- See MSDS for product information.
- Work closely with Dyno.
- Standard decon set-up will be constructed.
- Have tools cribbed for entry teams.
- Ensure there is enough PPE at the site to complete the task.
- Ensure there is drinking water for responders.
- Have hazmat trailer, ambulance & fire truck in staging area, as req'd
- Have Site Services staged for digging, damming, product extraction, as req'd.

Implementing Response Objectives

- Rescue injured personnel.
- Fire-fighting: If flame impingement on tank, use unmanned ground monitor to supply flooding quantities of water via straight-stream, to cool tank. Then, evacuate area 800m in all directions. If signs of imminent explosion are present prior to setting up ground monitor, do not attempt to set it up, just evacuate for 800m in all directions.
- Prevent from entering streams.
- Once in stream, may be unrecoverable. Underflow dams should be constructed, and surface can be skimmed.
- If possible, stop anymore product from being spilled.
- Follow Dyno's recommendations for recovery and clean-up of product.

Decontamination

Standard decon set-up will be utilized in warm zone:

- Large berm fashioned out of large chemical resistant tarp, wrapped over charged 2 ½" hose-line, 2 small berms, will be in series, within the large berm.
- Decon personnel shall don class C suits without need for respiratory or splash protection, other than safety glasses.
- Ensure all personnel that entered hot zone are properly decontaminated.
- Ensure that all tools that entered the hot zone are properly decontaminated.

Termination

- Once operation complete, vac-truck can be utilized to clean up solution contained with the decon berms.
- Safe and proper disposal of all spent PPE.
- Transition of command.
- Debrief.

Emulsion

Site management and control

- Consider initial perimeter of 800m.

- Command, staging, & decon shall be positioned upwind.
- Eliminate sources of ignition.
- Unify command with Safety Superintendent, Mine Manager, Environmental Dept, Dyno Nobel, product carrier (if spill occurs during delivery to mine).

Identification



- UN# 0332.
- Viscous liquid.
- Pink, opaque.
- Slight fuel oil odour.
- Shipped in bulk by tanker truck.

Hazard & risk evaluation

- Emulsion explosives.
- Stable under normal conditions.
- May explode under fire conditions.
- Eye & skin irritant.
- Slight ingestion & inhalation hazard.
- Avoid contact with corrosives.
- Is there threat to a stream?

PPE

- Class C suit with long sleeves.
- Standard PPE

Information management and resource coordination

- See MSDS for product information.
- Work closely with Dyno.
- Standard decon set-up will be constructed.
- Have tools cribbed for entry teams.
- Ensure there is enough PPE at the site to complete the task.
- Ensure there is drinking water for responders.
- Have hazmat trailer, ambulance & fire truck in staging area, as req'd
- Have Site Services staged for digging, damming, product extraction, as req'd.

Implementing Response Objectives

- Rescue injured personnel.
- Fire-fighting: If fire reaches cargo, DO NOT ATTEMPT TO FIGHT FIRE. Cargo may explode. Evacuate in all directions for 1600m.
- Prevent from entering streams.
- If possible, stop anymore product from being spilled.
- Follow Dyno's recommendations for recovery and clean-up of product.

Decontamination

Standard decon set-up will be utilized in warm zone:

- Large berm fashioned out of large chemical resistant tarp, wrapped over charged 2 ½" hose-line, 2 small berms, will be in series, within the large berm.
- Decon personnel shall don class C suits without need for respiratory or splash protection, other than safety glasses.
- Ensure all personnel that entered hot zone are properly decontaminated.
- Ensure that all tools that entered the hot zone are properly decontaminated.

Termination

- Once operation complete, clean out berms under direction of Dyno.
- Safe and proper disposal of all spent PPE.
- Transition of command.
- Debrief.

Appendix D: Tug and Barge Emergency Contingency Plan



Minto Mine
Tug and Barge Emergency Contingency Plan
2017-01

Prepared by:
Minto Explorations Ltd.
Minto Mine
February 2017

First Issue: January 15, 2013

Revision History

Revision Number	Issue Date	Description and Revisions Made
2013-01	January 2013	First Issue
2017-01	February 2017	Review, revision of document and update of information: • Revised format of document (added revision history and table of contents); • Section 2.0 and 3.1 - Removed references to JDS and mutual aid agreement (not in place); • Section 4.0 - updated level of NFPA training for ERT (472 HazMat awareness level); • Section 4.0 - updated reference to 2014 field and table top exercise.

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List of Appendices

Appendix A: Man Boat Specifications

Appendix B: Safe Job Procedure for Loading and Unloading the Barge.

1 Introduction

Minto Mine (Minto) a subsidiary of Capstone Mining Corporation is pleased to submit the following contingency plan (plan) as per requirements of the Selkirk First Nation Access and Land Use Permit “Minto Landing Ice Bridge and Marshalling Area and West Side Barge Landing and Marshalling Area” (the permit). It is Minto’s intention that this plan will fulfill the requirement as stated in Schedule 2, Section 9.0 Contingency Plan of the permit. It is not Minto’s objective for this plan to mitigate all possible accidents or malfunction in regards to the in stream operation of the Copper Queen tug and barge.

The plan as prepared is adaptive and will be amended as is practicable. This plan is intended to deliver the best possible means of mitigating an accident or malfunction of the loading/unloading or in-stream operation of the tug and barge with the resources available at Minto. Preventing such an occurrence requires a combination of: procedural and engineering controls, based on an awareness of at risk conditions. These documents exist in the form of the Spill Contingency Plan, Emergency Response Plan, and any procedures or plans on the tug or barge from Site Services. This document serves as a contingency plan in the event that an accident or malfunction occurs when loading, unloading, and in-stream operations of the Copper Queen tug and barge (CQTB).

2 General Procedures

Any Response to an Emergency condition will be based on a priority sequence of Life, Environment and Property. Therefore every event will be regarded with these priorities in mind. Initial on scene assessment of the accident or malfunction will be called out on channel one as a “Code 1”. The Emergency Response Team will be dispatched, communication established and the barge operator and deckhand will respond to control the scene.

Deckhands will mitigate all emergencies on the barge to the best of their ability given the resources available. General procedure in the event of an emergency would have the barge move to the west landing if possible or practical unless otherwise communicated to the barge captain. To mitigate an emergency in offloading or loading vehicles onto the barge the deckhand will utilize the anchor points on both landings. Slack will be left in the rope to ensure the barge captain is able to maneuver when docked at the landing. Tying off to the anchor points will mitigate complete catastrophe if the barge loses power during loading and offloading and will be discussed further under the specific procedures section of this plan.

To mitigate the risk of losing control of the barge downstream Minto will be installing an anchor on the barge. In the event of an emergency the deckhand would be able to deploy the anchor allowing the barge a safety contingency if control was lost.

3 Specific Procedures

Below is a list of the current on site procedures for dealing with various emergencies in regards to the CQTB at Minto Mine.

1. Emergency Response to Sinking
2. Emergency Response to Loss of Power or Control
3. Emergency Response to Fire Onboard
4. Emergency Response to Man Overboard
5. Emergency Response to Freight or Vehicle Overboard
6. Emergency Response to Medical Emergency on Board of the Barge
7. Emergency Response to Spill Response

3.1 Emergency Response to Sinking of CQTB

1. Activation of Emergency Protocol onboard CQTB calling code 1 to initiate ERT response.
2. Captain and deckhand will deploy Canadian Coast Guard approved life rafts.
3. As per Emergency Response Plan, Incident command (IC) will communicate with Deckhand by radio to determine any further details of events, number of injured or trapped people, risks to property and environment.
4. IC will respond to scene in one emergency vehicle ahead of remaining ERT. IC will upon arrival to scene provide initial scene assessment and gather any additional information available. Minimum ERT response will include full ERT member compliment, Environmental Lead, Hazardous materials response trailer, fire truck, ambulance and all associated equipment. ERT operations to be under the control of the ERT Captain. Additional response needs based on initial assessment and

evaluation by IC will be communicated to the Emergency Communications Center (ECC) as per Emergency Response Plan.

5. Incident Accountability will be established and adhered to throughout the operation.
6. IC will determine the need for rescue of people downstream. Option to deploy rescue ropes via launcher considered for KM 12.
7. Alternate access to river to be determined by nature of incident, KM 20 provides a second potential access. All other access would require trail cutting which is possible but would take more time.
8. IC, ERT Captain, and Environmental Lead (Unified Incident Command Support) will assess ongoing situation and need for additional or fewer resources.
9. Alternate man boat (see Appendix A for details on man boat) will be deployed from landing as needed to support rescue and/or to gain more information regarding location of sunken vessel and determine possible plan for retrieval/securing. Man boat operator will work under the direction of IC.
10. Once rescued, all patients will be treated as per OFA3/EMR protocols transported as per Yukon EMS dispatch confirmation aligned with Minto Emergency Response Plan.

3.2 Emergency Response to Loss of Power or Control of CQTB

The tug operates on two engines so total loss of power is not likely; however, is still possible and below is the emergency procedure that would be activated in the event that total loss or control of the CQTB was to occur.

11. Activation of Emergency Protocol onboard CQTB calling code 1 to initiate ERT response. Captain will also communicate freight details and passenger numbers on board.
12. Passengers and crew will follow instructions from Captain and remaining on board if deemed safe. The Captain and deckhand will follow MED protocol in decision making in regards to passenger safety.
13. Captain and deckhand will deploy Canadian Coast Guard approved life rafts if deemed unsafe to stay on board by Captain.

14. IC will respond to scene or as close to it, in one emergency vehicle ahead of remaining ERT. IC will upon arrival to scene provide initial scene assessment and gather any additional information available. Minimum ERT response will include full ERT member compliment, Environmental Lead, Hazardous materials response trailer, fire truck, ambulance and all associated equipment. ERT operations to be under the control of the ERT Captain. Additional response needs and downstream communication and reporting requirements based on initial assessment and evaluation by IC will be communicated to the Emergency Communications Center (ECC) as per Emergency Response Plan.
15. Incident Accountability will be established and adhered to throughout the operation.
16. Captain will navigate to the best of his ability to the safest downstream location possible. Under the direction of the Captain the deckhand may deploy the anchor to assist in stopping the barge and tug.
17. Captain will communicate to IC location and details of condition of vessel and people and assist in determining plans for action.
18. Once vessel is secured to shore or where landed in river, Man boat will be deployed to assist with additional securing and remove non-essential people to location where they can be transferred back to site or alternate safe location.
19. If available and a benefit, Minto would exercise the use of the mutual aid agreement with JDS.
20. Plan for retrieval will be based appropriate to the conditions and location of vessel. Plan to be developed cooperatively through Barge Captain, Minto ECC and Mutual Aid resources. Equipment and additional resources will be sourced through ECC as per Minto Emergency Response Plan.

3.3 Emergency Response to Fire on the CQTB

21. Activation of Emergency Protocol onboard CQTB calling code 1 to initiate ERT response.
22. If safe to do so, deckhand will attempt to suppress fire using equipment on board following Marine Emergency Duty (MED) protocol.

23. Captain and deckhand will deploy Canadian Coast Guard approved life rafts if vessel in immediate danger. If possible and practical the Captain will position barge so that wind is blowing port to starboard, to keep smoke/flames away from life raft.
24. If able to do so Barge will cross to West Bank of crossing and continue to use barge supplied fire suppression equipment. All passengers will disembark under direction of deckhand.
25. IC will respond to scene in one emergency vehicle ahead of remaining ERT. IC will upon arrival to scene provide initial scene assessment and gather any additional information available. Minimum ERT response will include full ERT member compliment, Environmental Lead, Hazardous materials response trailer, fire truck, ambulance and all associated equipment. ERT operations to be under the control of the ERT Captain. Additional response needs based on initial assessment and evaluation by IC will be communicated to the Emergency Communications Center (ECC) as per Emergency Response Plan.
26. Incident Accountability will be established and adhered to throughout the operation.
27. Once IC on scene and vessel safely secured, fire suppression will be conducted under the direction of the IC following NFPA 1081 standards. Industrial Fire Brigade.
28. Consideration of environmental sensitivity need to be considered by IC in cooperation with the Environmental Lead (unified incident command support).
29. Defensive spill containment methods to be utilized to control run off and releases from firefighting operations. This may include tactics such as extinguishing agent selection, damming and berming on barge, boom placement around vessel, removal of burning equipment once fire controlled, etc.

3.4 Emergency Response to Man Overboard

30. Activation of Emergency Protocol onboard CQTB calling code 1 to initiate ERT response.
31. Captain and deckhand will throw out provided Canadian Coast Guard approved life-rings to all personnel overboard. The response from the barge crew will conducted as per their MED training.
32. If able to successfully rescue person overboard, deckhand will treat person based on marine first aid protocols awaiting response by ERT and site Medic.

33. If unable to successfully achieve rescue, vessel will continue to West landing and man boat deployed for downstream rescue. Communication to IC on Radio Channel 1 must be available at all times. Man boat operation will be conducted under the direction of IC once in place.
34. Captain will communicate to IC of possible downstream rescue requirement.
35. IC will instruct ERT to stage at KM 12 with option to deploy rescue ropes via launcher considered for KM 12.
36. Incident Accountability will be established and adhered to throughout the operation.
37. IC to stage ambulance for patient pick up.
38. IC will communicate the need for mutual aid to ECC who will follow the Minto ERP by contacting local agencies for assistance on East side of river.
39. Once rescued, all patients will be treated as per OFA3/EMR protocols transported as per Yukon EMS dispatch confirmation aligned with Minto Emergency Response Plan.

3.5 Emergency Response to Freight or Vehicle Overboard of the CQTB

40. Activation of Emergency Protocol onboard CQTB calling code 1 to initiate ERT response. Captain will also communicate freight details and passenger numbers on board.
41. Passengers and crew will follow instructions from Captain (Captain will respond as per MED training) remaining on board if deemed safe.
42. Captain and deckhand will deploy Canadian Coast Guard approved life rafts if deemed unsafe to stay on board by Captain. If at landing passengers will be offloaded to safe location on shore.
43. IC will respond to scene or as close to it, in one emergency vehicle ahead of remaining ERT. IC will upon arrival to scene provide initial scene assessment and gather any additional information available. Minimum ERT response will include full ERT member compliment, Environmental Lead, Hazardous materials response trailer, fire truck, ambulance and all associated equipment. ERT operations to be under the control of the ERT Captain. Additional response needs and downstream communication and reporting requirements based on initial assessment and evaluation by IC will be communicated to the Emergency Communications Center (ECC) as per Emergency Response Plan.

44. Incident Accountability will be established and adhered to throughout the operation.
45. Captain will navigate to the best of his ability to the landing, preferably west landing.
46. Once vessel is secured to shore, man boat will be deployed by deckhand or ERT members to assist with additional securing of vessel and freight, and deployment of containment booms located at landing and on vessel. Man boat operation under the direction of IC once in place.
47. Plan for retrieval of freight will be determined appropriate to the condition and location of freight. Plan developed cooperatively through Barge Captain, Minto ECC and Mutual Aid resources.
48. Equipment and additional resources will be sourced through ECC as per Minto Emergency Response Plan including manpower, expertise, heavy equipment, etc.
49. Special considerations for support in the event of incident occurring on East side of river to include Yukon Emergency Measures Organization, local first responders and alternate equipment operations contractor.

3.6 Emergency Response to Medical Emergency on board CQTB

50. Activation of Emergency Protocol onboard CQTB calling code 1 to initiate ERT response.
51. For serious injury as defined in the ERP, Yukon EMS will be notified immediately.
52. Deckhand will treat patient per Marine Emergency First Aid protocols.
53. Captain will navigate barge to west bank of Yukon River and all vehicles will offload on west bank, giving clear passage for Ambulance.
54. ERT response will include medic, ambulance, fire truck and compliment of team members to assist with patient transfer and packaging.
55. Incident Accountability will be established and adhered to throughout the operation.
56. Yukon EMS dispatch will be updated of situation once history and assessment confirmed.
57. Upon arrival, Minto Medic will take control of scene and advise ERT Captain of resources needed on scene.

58. Upon history and assessment, patient will be treated, packaged and transferred as per OFA3/ERM protocols transported as per Yukon EMS dispatch confirmation aligned with Minto Emergency Response Plan.

3.7 Emergency Response to a Spill

59. Activation of Emergency Protocol onboard CQTB calling code 1 to initiate ERT response.
60. Deckhand will attempt to contain spill using on board spill kit, to prevent spill into Yukon River.
61. IC will respond to scene in one emergency vehicle ahead of remaining ERT. IC will upon arrival to scene provide initial scene assessment and gather any additional information available. Minimum ERT response will include full ERT member compliment, Environmental Lead, Hazardous materials response trailer, fire truck, ambulance and all associated equipment. ERT operations to be under the control of the ERT Captain. Additional response needs, downstream communication, communication with CANUTEC and reporting requirements based on initial assessment and evaluation by IC will be communicated to the ECC as per Emergency Response Plan and Spill Contingency Plan.
62. Incident Accountability will be established and adhered to throughout the operation.
63. If practical the barge captain will navigate the barge to west landing.
64. All passengers will disembark vessel.
65. All vehicles and machinery that is not in the spill zone will disembark.
66. Deckhand and ERT members under the direction of IC will use the man boat to deploy containment booms around the barge.
67. IC with advice from the Environment Lead will develop and implement the SCP for stopping the spill if possible.
68. If the spill cannot be stopped a plan to mitigate the quantity of contaminant spilt to environment will be developed and implemented.
69. If safe and practical to do so Environment Lead will deploy environment staff to sample downstream of spill to measure contamination concentration.

70. IC with advice from the Environment Lead will oversee cleanup of the spill.

71. Special considerations for support in the event of incident occurring on East side of river to access the barge with ERT by man boat.

4 Minto Mine Training

The barge crew were trained and certified in Marine Emergency Duties (MED) A1 and A2 in 2012. The MED course meets the standards of training, certification and watch-keeping, and is run by Transport Canada. The A1 MED course covers basic safety with a focus on hazards and emergencies awareness, firefighting, emergency response, lifesaving appliances and abandonment, survival and rescue. The A2 MED course covers small passenger-carrying vessel safety with the same focus as A1 with the addition of maintenance and inspection of emergency equipment and passenger control. As well the barge crew is trained in Marine First Aid.

The ERT team has been trained to National Fire Protection Association (NFPA) 472 Hazardous Materials awareness level for responders. In 2014, Minto conducted a table top and field exercise in regards to Yukon River response. The table top and field exercise was held in conjunction with ERT, barge crew, environment department, management, major contractors, the Yukon Spill Hotline, CANUTEC, Transnorth Helicopters, WCB, Parkland Fuel, and Quantum Murray. A post-incident debrief revealed both opportunities and successes at the field operations and management level.

Appendix A: Man Boat Specifications



- Brand/Model: Munson Packman Landing Craft
- Hull Length: 24 feet (7.3 meters)
- Beam: 8 feet 6 inches (2.6 meters)
- Hull Type: Packman mono hull
- Power: Twin Yamaha 150hp
- Propulsion: Outboard (25" shaft)
- Outfitting: 52" bow door

Appendix B: Safe Work Procedure for Loading and Unloading the Barge.



Capstone Minto Safe Work Practice

Barge Loading and Offloading

Purpose: To ensure the safe practice of loading and offloading the barge at the Yukon River. To educate workers on the hazards of loading and offloading the barge, and working on landings.

Scope: This Safe Work Practice pertains to the Captain and the crew of the Minto Mine property who are exposed to operating the barge for transport across river.

Definitions:

Certified Flotation Device – Personal Flotation Devices marked "Approved by Department of Transport Canada" or "Approved by Canadian Coast Guard, Department of Fisheries and Oceans"

Hypothermia - A potentially fatal condition that occurs when the body core temperature falls below 95°F (35°C). This can occur quickly when immersed in cold water.

Responsibilities

Employer / Supervisor Responsibilities

- Make sure appropriate training and assistance are provided to crew.
- Make sure appropriate rescue devices such as a life hook and flotation devices are available to workers

Safety Department Responsibilities

- Ensure this SWP is in alignment with the Yukon Health and Safety Act and Regulations

Worker Responsibilities

- Read, understand, and follow this safe work practice
- If unsure then stop work and ask for assistance
- Wear appropriate PPE defined to their work area.
- Provide training for proper use of PFD to passengers

Reference to Legislative and Site Requirements

- Yukon Occupational Health and Safety Regulations – Part 1 – section 1.34 – Each worker shall be provided with and be required to use an appropriate personal flotation device with the required buoyancy where a worker is employed in a situation where there is a risk of drowning

Safe Work Practice:

The captain and crew will give direction in regards to the following.

1. Landings.

- 1.1. Assess landing and vehicles to be loaded and unloaded. The use of wooden ramps may be needed. (For more information reference safe work practice for wooden ramps.)
- 1.2. Use gauge on apron ram to determine the need for landing to be rebuilt. This gauge is located on the ram closest to deckhand shed and has a max angle marked on the gauge. If the apron should go past the marked max angle stop and fix landing. (For more information reference safe work practice for landing maintenance and apron angle.)

2. Transportation.

- 2.1. Due to landing and vehicle loads ask driver to back on or drive on. This may be determined by many factors, such as:
 - Angle and length of landing
 - Apron angle and how it contacts the landing
 - Underwater debris
 - Drivers skill
 - Extra low trailers
 - Frozen or icy landings
 - Load weights
- 2.2. Deckhand must communicate with captain any concerns about previously mention conditions. It is ultimately the captains' decision on how the barge is loaded.

3. Priority Boarding

- 3.1. Emergency vehicles on medical runs are given the top priority. Compassionate reasons or special circumstances are considered when loading vehicle traffic. The bus will also be given high priority

along with con trucks. Loading priority will be determined by the Captain or the Supervisor.

- 3.2.** Priority may change from day to day and we ask that drivers cooperate and be patient. Ultimately the captain will make the decision based on information available at the time.

4. Communication.

- 4.1.** Drivers are given a handout of standard hand signals as endorsed by WCB and a signature logbook is maintained to who has received the handout and when.
- 4.2.** The deckhand is in charge of directing and communicating with all traffic. Radios, hand signals, face to face communication are all used. An air horn is used as warning to stop the drivers quickly.

5. Hazards.

- 5.1.** Working at or near water has its inherent risks. A JHA should be conducted for any new or unusual work being conducted on or near the water. Some hazards to be aware of are:

- Exposure to the environmental elements of the season
- Slips, trips and falls on uneven ground
- Slipping on slippery rocks and surfaces
- Eroding shore line sloughing or slipping on ice along shoreline
- Falling into cold water
- Ice flows and ice jams
- Swift current
- Drowning
- Hypothermia
- Wildlife
- Slippery deck

6. Emergency Equipment.

- 6.1.** Life ring with rope and pole must be available on the barge. An emergency response container complete with first aid kit, oxygen therapy unit, spare dry coveralls and several blankets is located on the tug. This container is used to reduce the effects of hypothermia until emergency response arrives.

- 6.2.** As the river is 27kms from the mine site emergency response will take at least 40 minutes to arrive at the scene. Deckhands should have marine first aid training and clear knowledge of where all safety equipment is and its condition.
- 6.3.** Honda pump & fire hose along with fire extinguishers are also in place. Deckhands should be well train in this area and will instruct people as needed on what to do in case of an emergency.

7. Training.

- 7.1.** All workers must be trained and competent to operate or run any equipment that pertains to their job.
- 7.2.** At least one worker must have a valid marine first aid ticket in the event of an emergency due to the location of this worksite and the anticipated delay on response time by ERT.

SWP Development and Approval

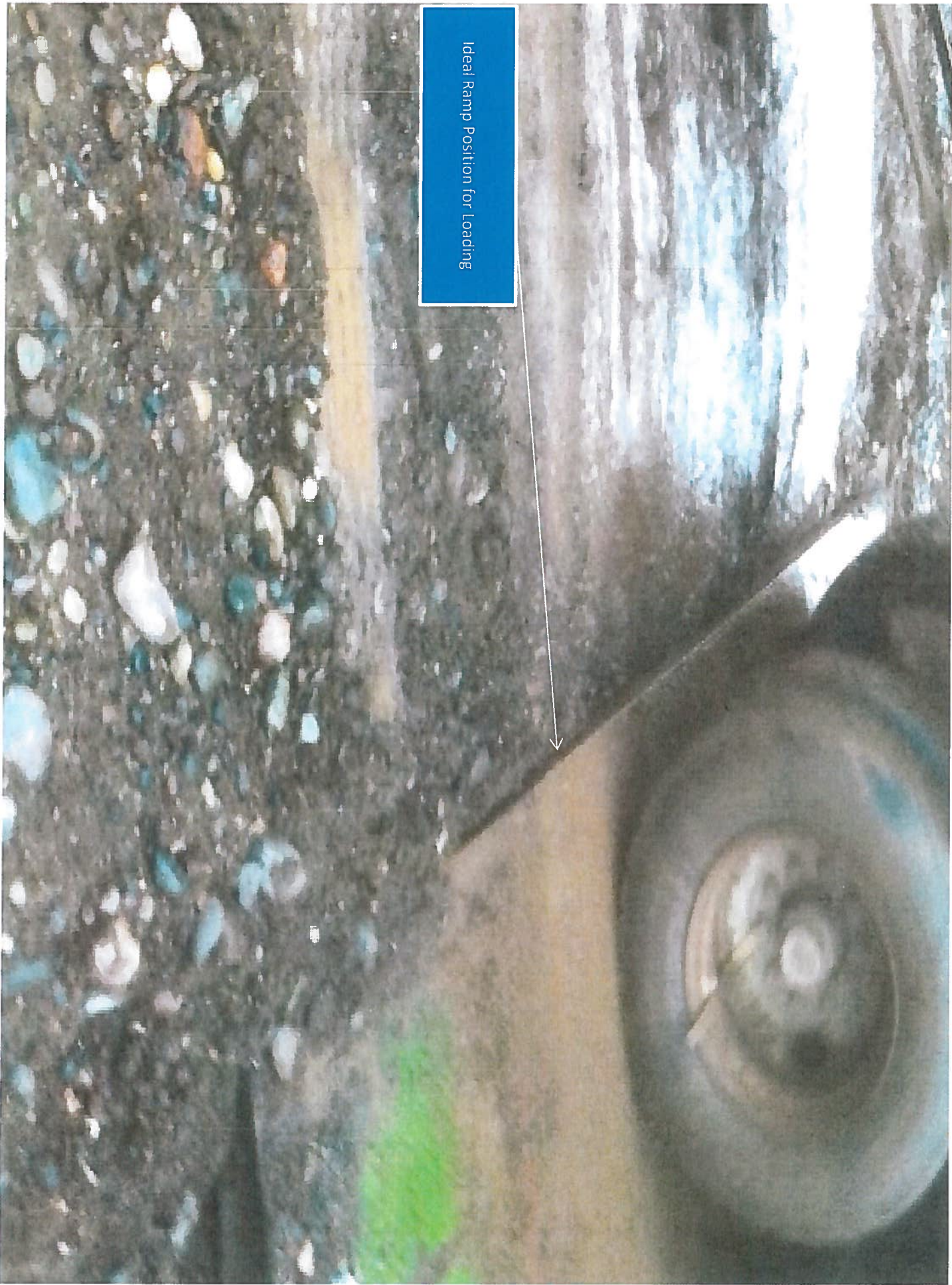
	Print: <u>Developed/ Revised by:</u>	DD/MM/YYYY
Worker:		Date:
Worker:		Date:
JOHSC Representative:	Siana mills	Date: 24/08/2012
Supervisor:	Stephen Maunder	Date: 26/08/2012
Supervisor:	Captain Dave Johnstone	Date: 26/08/2012
Supervisor:	Jeff Billings	Date: 26/08/2012
Supervisor:		Date:
JOHSC Representative:		Date:
Senior Supervisor:		Date:
Senior Supervisor:		Date:
Departmental Manager:		Date:
	Print & Sign: <u>Reviewed By:</u>	
Safety Department:	MARK GOEBEL 	
Safety Department:		Date: Sept 19/12
	Print & Sign: <u>Approved By:</u> Determined by Safety Dept. Enter NA if not applicable.	Date:
Departmental Manager:	stephen maunder	Date: 19/09/12
General Manager:	 R. L. Litz	Date: 9.20.2012

Clarification of this safe work practice can be directed to the Safety Department.

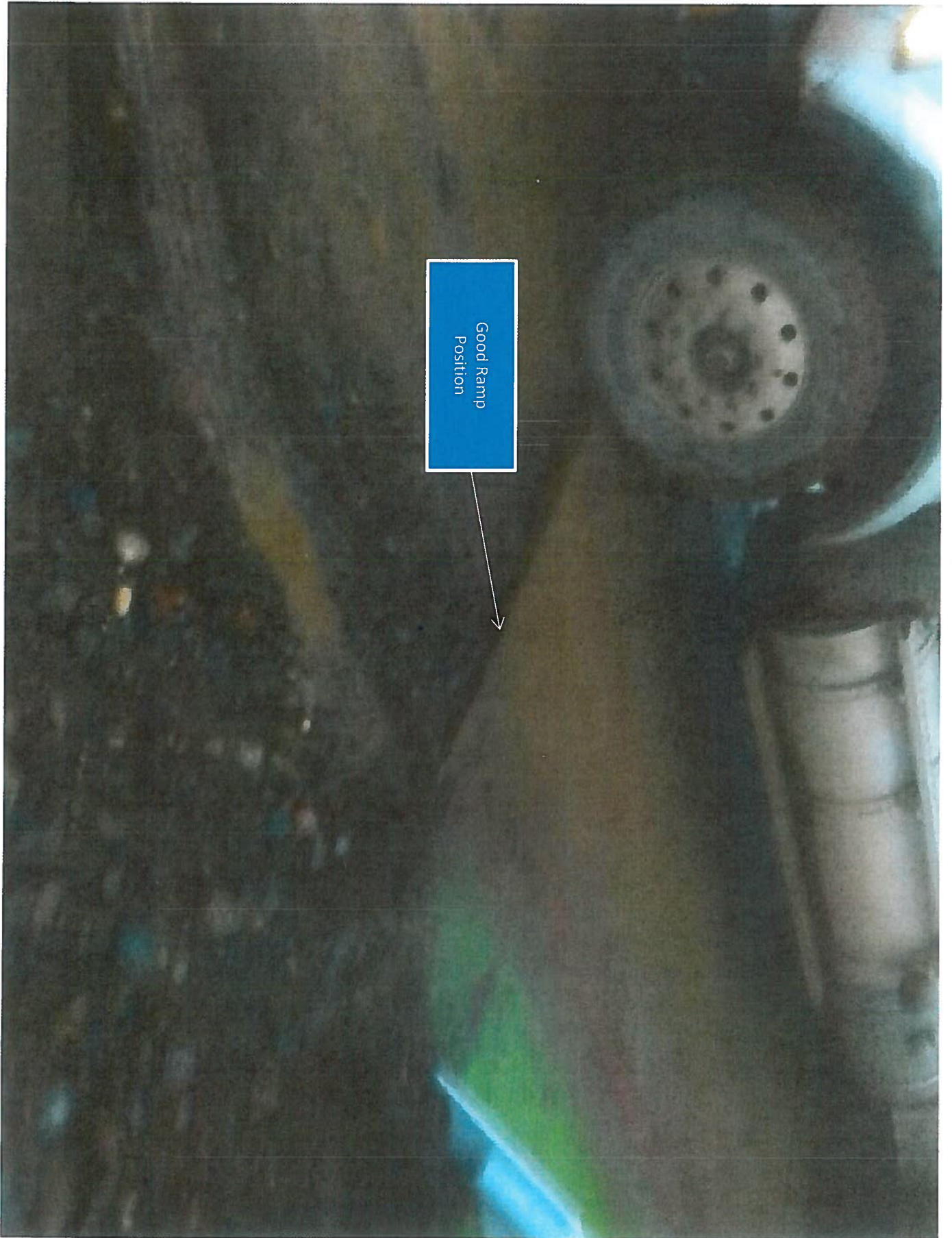
Name of SWP:

Location: X:\Health & Safety\Safety Public\Procedures and Safe Work Procedures

Last revision date: April 21 2012



Ideal Ramp Position for Loading

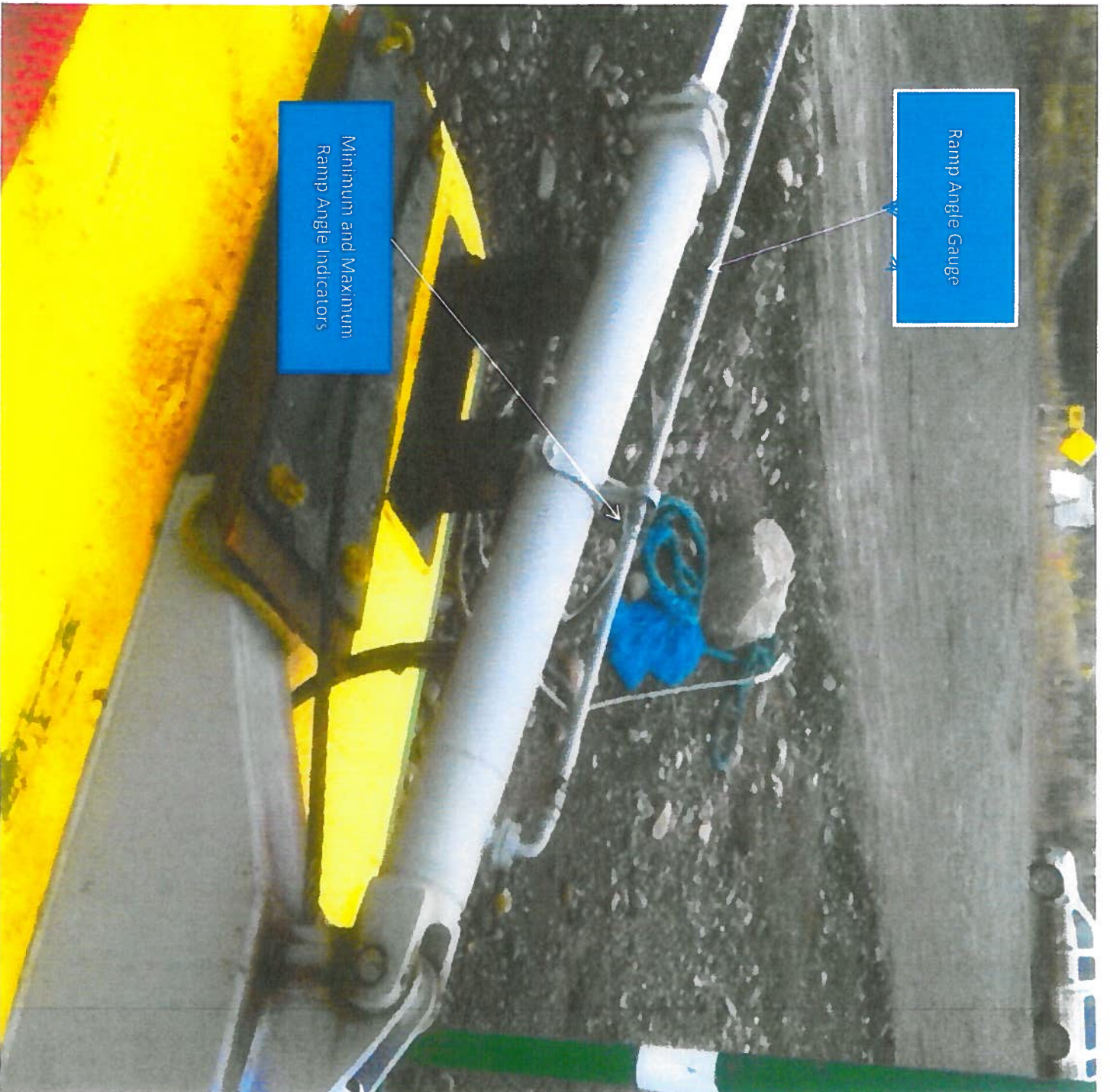


Good Ramp
Position



Unacceptable ramp position
Too much drop
Repair the landing

03/07120



Ramp Angle Gauge

Minimum and Maximum
Ramp Angle Indicators



Ramp Angle
Gauge

Minimum and Maximum
Ramp Angle Indicators

Appendix C – Groundwater Quality Monitoring Program Laboratory Results



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 17-JAN-18
Report Date: 29-JAN-18 13:20 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2046333
Project P.O. #: 229097
Job Reference:
C of C Numbers: 2018-01-17 B
Legal Site Desc:

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2046333-1 Water 13-JAN-18 14:00 MW12-07-01	L2046333-2 Water 13-JAN-18 14:20 MW12-07-02	L2046333-3 Water 13-JAN-18 15:30 MW09-03-01	L2046333-4 Water 13-JAN-18 16:10 MW09-03-02	L2046333-5 Water 13-JAN-18 DUP 1
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	1310	1060	312	345	303
	Hardness (as CaCO3) (mg/L)	632	507	149	177	148
	pH (pH)	8.12	8.11	8.26	8.29	8.29
	Total Suspended Solids (mg/L)	9.0	4.6	7.6	5.0	3.4
	TDS (Calculated) (mg/L)	935	784	174	204	173
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	288	148	149	175	149
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	288	148	149	175	149
	Ammonia, Total (as N) (mg/L)	0.974	0.0202	0.0341	<0.0050	0.0333
	Bromide (Br) (mg/L)	<0.25 ^{DLDS}	<0.25 ^{DLDS}	<0.050	<0.050	<0.050
	Chloride (Cl) (mg/L)	<2.5 ^{DLDS}	<2.5 ^{DLDS}	<0.50	0.58	<0.50
	Nitrate (as N) (mg/L)	0.243	0.132	0.0094	3.39	<0.0050
	Nitrite (as N) (mg/L)	0.555	0.305	0.237	0.226	0.234
	Sulfate (SO4) (mg/L)	427	454	19.5	7.58	19.2
	Anion Sum (meq/L)	14.7	12.4	3.39	3.93	3.39
	Cation Sum (meq/L)	16.7	12.5	3.45	3.88	3.43
	Cation - Anion Balance (%)	6.3	0.3	0.8	-0.6	0.6
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Dissolved Metals	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0026	0.0037	0.0021	<0.0010	0.0021
	Antimony (Sb)-Dissolved (mg/L)	0.00034	0.00035	0.00011	0.00027	0.00011
	Arsenic (As)-Dissolved (mg/L)	0.00082	0.00077	0.00069	0.00011	0.00067
	Barium (Ba)-Dissolved (mg/L)	0.0932	0.0176	0.0603	0.0249	0.0615
	Beryllium (Be)-Dissolved (mg/L)	0.000045	<0.000040 ^{DLA}	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.00010 ^{DLA}	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.957	0.529	0.231	0.415	0.238
	Cadmium (Cd)-Dissolved (mg/L)	<0.000050 ^{DLB}	<0.000020 ^{DLA}	<0.0000050	<0.000060 ^{DLB}	<0.000020 ^{DLB}
	Calcium (Ca)-Dissolved (mg/L)	215	153	41.2	59.2	41.3
	Chromium (Cr)-Dissolved (mg/L)	0.00032	<0.00020 ^{DLA}	<0.00010	0.00018	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00022	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00033	<0.00040 ^{DLA}	<0.00020	0.00143	0.00025
	Iron (Fe)-Dissolved (mg/L)	0.033	0.034	0.136	<0.010	0.130
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.00010 ^{DLA}	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0272	0.0193	0.0034	<0.0010	0.0033
	Magnesium (Mg)-Dissolved (mg/L)	23.0	30.4	11.1	7.02	10.9
	Manganese (Mn)-Dissolved (mg/L)	0.110	0.688	0.0844	0.00301	0.0826

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2046333-1 Water 13-JAN-18 14:00 MW12-07-01	L2046333-2 Water 13-JAN-18 14:20 MW12-07-02	L2046333-3 Water 13-JAN-18 15:30 MW09-03-01	L2046333-4 Water 13-JAN-18 16:10 MW09-03-02	L2046333-5 Water 13-JAN-18 DUP 1
Grouping	Analyte					
WATER						
Dissolved Metals	Molybdenum (Mo)-Dissolved (mg/L)	0.00169	0.0293	0.00462	0.00484	0.00466
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.0010 ^{DLA}	0.00079	<0.00050	0.00076
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.10 ^{DLA}	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	3.34	2.85	2.02	2.23	2.01
	Selenium (Se)-Dissolved (mg/L)	0.00288	0.00145	0.000308	0.000566	0.000306
	Silicon (Si)-Dissolved (mg/L)	7.97	6.11	5.25	5.23	5.33
	Silver (Ag)-Dissolved (mg/L)	0.000011	0.000217	0.000013	0.000012	<0.000010
	Sodium (Na)-Dissolved (mg/L)	89.7	52.6	9.47	6.70	9.29
	Strontium (Sr)-Dissolved (mg/L)	8.76	5.52	0.945	0.362	0.934
	Sulfur (S)-Dissolved (mg/L)	184	161	6.40	2.56	6.27
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000020 ^{DLA}	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	0.00015	<0.00020 ^{DLA}	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00060 ^{DLA}	<0.00030	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.000081	0.00261 ^{DLA}	0.000812	0.00282	0.000820
	Vanadium (V)-Dissolved (mg/L)	0.00100	<0.0010	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0033	0.0426	0.0033	0.0789	0.0062
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Cadmium (Cd)-Dissolved	MB-LOR	L2046333-1, -2, -3, -4, -5
Duplicate	Selenium (Se)-Dissolved	MES	L2046333-1, -2, -3, -4, -5
Duplicate	Silver (Ag)-Dissolved	MES	L2046333-1, -2, -3, -4, -5
Laboratory Control Sample	Titanium (Ti)-Dissolved	MES	L2046333-1, -2, -3, -4, -5
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2046333-1, -2, -3, -4, -5
Matrix Spike	Boron (B)-Dissolved	MS-B	L2046333-1, -2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2046333-1, -2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2046333-1, -2, -3, -4, -5
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2046333-1, -2, -3, -4, -5
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2046333-1, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2046333-1, -2, -3, -4, -5
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2046333-1, -2, -3, -4, -5

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLB	Detection Limit Raised. Analyte detected at comparable level in Method Blank.
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BR-L-IC-N-VA	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Reference Information

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
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VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
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Chain of Custody Numbers:

2018-01-17 B

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Page 1 of 1

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REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FROM



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 28-FEB-18
Report Date: 13-MAR-18 15:49 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2062125
Project P.O. #: 229097
Job Reference:
C of C Numbers: 2018-02-28 B
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2062125-1 Water 24-FEB-18 09:40 MW12-07-01	L2062125-2 Water 24-FEB-18 10:05 MW12-07-02	L2062125-3 Water 24-FEB-18 11:20 MW09-03-01	L2062125-4 Water 24-FEB-18 12:10 MW09-03-02	L2062125-5 Water 27-FEB-18 11:05 MW17-11-01
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	1380	1010	313	288	319
	Hardness (as CaCO3) (mg/L)	627	480	147	136	121
	pH (pH)	7.92	8.02	8.26	8.11	8.25
	Total Suspended Solids (mg/L)	5.4	<3.0	<3.0	3.4	10.0
	TDS (Calculated) (mg/L)	956	721	177	161	185
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	241	151	150	136	128
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	241	151	150	136	128
	Ammonia, Total (as N) (mg/L)	1.23	0.0163	0.0412	0.0073	<0.0050
	Bromide (Br) (mg/L)	<0.50 ^{DLDS}	<0.25 ^{DLDS}	<0.050	<0.050	2.09
	Chloride (Cl) (mg/L)	<5.0 ^{DLDS}	<2.5 ^{DLDS}	<0.50	<0.50	0.71
	Fluoride (F) (mg/L)	0.96	0.79	1.65	0.476	1.85
	Nitrate (as N) (mg/L)	0.225	0.081	0.0183	2.55	0.0098
	Nitrite (as N) (mg/L)	0.561	0.127	0.314	0.245	0.0274
	Sulfate (SO4) (mg/L)	473	402	20.2	8.00	38.5
	Anion Sum (meq/L)	14.8	11.5	3.53	3.10	3.47
	Cation Sum (meq/L)	16.8	11.9	3.44	3.05	3.46
	Cation - Anion Balance (%)	6.4	1.9	-1.4	-0.8	-0.2
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0039	0.0020	0.0024	0.0040	0.0062
	Antimony (Sb)-Dissolved (mg/L)	0.00024	0.00020	0.00016	0.00023	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00080	0.00057	0.00076	<0.00010	0.00095
	Barium (Ba)-Dissolved (mg/L)	0.0908	0.0192	0.0644	0.0222	0.0429
	Beryllium (Be)-Dissolved (mg/L)	0.000052	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	1.01	0.378	0.208	0.278	0.025
	Cadmium (Cd)-Dissolved (mg/L)	0.0000060	<0.000020 ^{DLM}	0.0000104	0.0000253	0.0000076
	Calcium (Ca)-Dissolved (mg/L)	210	141	39.5	44.2	32.7
	Chromium (Cr)-Dissolved (mg/L)	0.00027	<0.00010	<0.00010	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00023	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	<0.00020	0.00055	0.00024	0.00135	<0.00020
	Iron (Fe)-Dissolved (mg/L)	0.075	0.071	0.379	<0.010	0.219
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0215	0.0169	0.0025	<0.0010	0.0041
	Magnesium (Mg)-Dissolved (mg/L)	24.8	31.2	11.7	6.21	9.68

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2062125-6 Water 27-FEB-18 11:40 MW17-11-02	L2062125-7 Water 27-FEB-18 13:40 MW17-11-03	L2062125-8 Water 27-FEB-18 13:55 MW17-11-04	L2062125-9 Water 27-FEB-18 14:10 MW17-11-05	L2062125-10 Water 24-FEB-18 DUP 1
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	336	310	349		1010
	Hardness (as CaCO3) (mg/L)	149	140	178	910	460
	pH (pH)	8.17	8.22	8.24		8.07
	Total Suspended Solids (mg/L)	5.2	<3.0	14.0		<3.0
	TDS (Calculated) (mg/L)	194	173	197		729
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	143	147	170		151
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0		<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0		<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	143	147	170		151
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	0.0334	0.0120
	Bromide (Br) (mg/L)	0.060	<0.050	<0.050		<0.25 ^{DLDS}
	Chloride (Cl) (mg/L)	<0.50	<0.50	<0.50		<2.5 ^{DLDS}
	Fluoride (F) (mg/L)	1.98	1.62	1.22		0.83
	Nitrate (as N) (mg/L)	<0.0050	<0.0050	0.0369		0.230
	Nitrite (as N) (mg/L)	<0.0010	0.0019	0.0020		0.560
	Sulfate (SO4) (mg/L)	34.1	19.9	20.3		417
	Anion Sum (meq/L)	3.66	3.44	3.88		11.8
	Cation Sum (meq/L)	3.80	3.40	3.92		11.4
	Cation - Anion Balance (%)	1.8	-0.6	0.6		-1.6
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0050	0.0057	0.0047	0.0053 ^{DLA}	0.0020
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00050 ^{DLA}	0.00014
	Arsenic (As)-Dissolved (mg/L)	0.00055	0.00042	0.00014	<0.00050 ^{DLA}	0.00056
	Barium (Ba)-Dissolved (mg/L)	0.0434	0.0613	0.112	0.0582 ^{DLA}	0.0185
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.00010 ^{DLA}	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.00025 ^{DLA}	<0.000050
	Boron (B)-Dissolved (mg/L)	0.019	0.012	<0.010	<0.050 ^{DLA}	0.307 ^{DLM}
	Cadmium (Cd)-Dissolved (mg/L)	0.0000065	<0.0000050	0.0000062	0.000055	<0.000020
	Calcium (Ca)-Dissolved (mg/L)	40.6	37.1	51.3	319 ^{DLA}	136
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00050 ^{DLA}	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00050 ^{DLA}	0.00023
	Copper (Cu)-Dissolved (mg/L)	<0.00020	<0.00020	0.00081	0.0093 ^{DLA}	0.00071
	Iron (Fe)-Dissolved (mg/L)	0.055	0.051	<0.010	<0.050 ^{DLA}	0.068
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.00025 ^{DLA}	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0047	0.0040	0.0039	0.0109	0.0164
	Magnesium (Mg)-Dissolved (mg/L)	11.6	11.6	12.0	27.5	29.4

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2062125-11 Water 24-FEB-18 DUP 2	L2062125-12 Water 27-FEB-18 DUP		
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)		312	335		
	Hardness (as CaCO3) (mg/L)		140	140		
	pH (pH)		8.14	8.08		
	Total Suspended Solids (mg/L)		<3.0	5.0		
	TDS (Calculated) (mg/L)		167	193		
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)		141	145		
	Alkalinity, Carbonate (as CaCO3) (mg/L)		<1.0	<1.0		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)		<1.0	<1.0		
	Alkalinity, Total (as CaCO3) (mg/L)		141	145		
	Ammonia, Total (as N) (mg/L)		0.0482	<0.0050		
	Bromide (Br) (mg/L)		<0.050	0.054		
	Chloride (Cl) (mg/L)		<0.50	<0.50		
	Fluoride (F) (mg/L)		1.65	2.01		
	Nitrate (as N) (mg/L)		<0.0050	<0.0050		
	Nitrite (as N) (mg/L)		0.201	0.0013		
	Sulfate (SO4) (mg/L)		18.8	35.0		
	Anion Sum (meq/L)		3.32	3.73		
	Cation Sum (meq/L)		3.29	3.65		
	Cation - Anion Balance (%)		-0.4	-1.1		
Dissolved Metals	Dissolved Mercury Filtration Location		FIELD	FIELD		
	Dissolved Metals Filtration Location		FIELD	FIELD		
	Aluminum (Al)-Dissolved (mg/L)		0.0024	0.0027		
	Antimony (Sb)-Dissolved (mg/L)		<0.00010	<0.00010		
	Arsenic (As)-Dissolved (mg/L)		0.00075	0.00054		
	Barium (Ba)-Dissolved (mg/L)		0.0658	0.0432		
	Beryllium (Be)-Dissolved (mg/L)		<0.000020	<0.000020		
	Bismuth (Bi)-Dissolved (mg/L)		<0.000050	<0.000050		
	Boron (B)-Dissolved (mg/L)		0.170	0.019		
	Cadmium (Cd)-Dissolved (mg/L)		0.0000069	<0.0000050		
	Calcium (Ca)-Dissolved (mg/L)		38.0	38.1		
	Chromium (Cr)-Dissolved (mg/L)		<0.00010	<0.00010		
	Cobalt (Co)-Dissolved (mg/L)		<0.00010	<0.00010		
	Copper (Cu)-Dissolved (mg/L)		<0.00020	<0.00020		
	Iron (Fe)-Dissolved (mg/L)		0.381	0.054		
	Lead (Pb)-Dissolved (mg/L)		<0.000050	<0.000050		
	Lithium (Li)-Dissolved (mg/L)		0.0025	0.0046		
	Magnesium (Mg)-Dissolved (mg/L)		11.1	11.0		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2062125-1 Water 24-FEB-18 09:40 MW12-07-01	L2062125-2 Water 24-FEB-18 10:05 MW12-07-02	L2062125-3 Water 24-FEB-18 11:20 MW09-03-01	L2062125-4 Water 24-FEB-18 12:10 MW09-03-02	L2062125-5 Water 27-FEB-18 11:05 MW17-11-01
Grouping	Analyte					
WATER						
Dissolved Metals	Manganese (Mn)-Dissolved (mg/L)	0.132	0.822	0.0932	0.00233	0.0415
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00141	0.0299	0.00449	0.00454	0.0193
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	0.00072	<0.00050	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	2.94	2.97	2.26	2.22	2.77
	Selenium (Se)-Dissolved (mg/L)	0.00276	0.000562	0.000183	0.000417	0.000087
	Silicon (Si)-Dissolved (mg/L)	8.01	6.45	5.65	5.21	5.06
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	94.5	50.2	9.59	6.27	21.7
	Strontium (Sr)-Dissolved (mg/L)	9.60	5.25	0.989	0.317	0.867
	Sulfur (S)-Dissolved (mg/L)	227	154	6.43	2.74	13.2
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.000053	0.00279	0.000831	0.00208	0.000265
	Vanadium (V)-Dissolved (mg/L)	0.00118	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0053	0.0599	0.0138	0.0368	0.0164
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2062125-6 Water 27-FEB-18 11:40 MW17-11-02	L2062125-7 Water 27-FEB-18 13:40 MW17-11-03	L2062125-8 Water 27-FEB-18 13:55 MW17-11-04	L2062125-9 Water 27-FEB-18 14:10 MW17-11-05	L2062125-10 Water 24-FEB-18 DUP 1
Grouping	Analyte					
WATER						
Dissolved Metals	Manganese (Mn)-Dissolved (mg/L)	0.0524	0.0914	0.105	0.0281	0.826
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00586	0.00593	0.00475	0.00433	0.0289
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	0.0053 ^{DLA}	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.25 ^{DLA}	<0.050
	Potassium (K)-Dissolved (mg/L)	2.62	3.39	2.92	12.1	2.89
	Selenium (Se)-Dissolved (mg/L)	0.000055	0.000063	0.000133	0.00102	0.000358
	Silicon (Si)-Dissolved (mg/L)	5.40	5.32	5.46	25.0 ^{DLA}	6.47
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000050 ^{DLA}	<0.000010
	Sodium (Na)-Dissolved (mg/L)	17.2	11.5	6.76	22.9	48.8
	Strontium (Sr)-Dissolved (mg/L)	1.01	0.964	0.770	1.24	5.05
	Sulfur (S)-Dissolved (mg/L)	11.6	6.70	6.76	1330 ^{DLA}	157
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000050 ^{DLA}	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00076 ^{DLA}	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.0015 ^{DLA}	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.000481	0.00128	0.00183	0.0124 ^{DLA}	0.00283
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.0025 ^{DLA}	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0142	0.0094	0.0137	0.0737	0.0674
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2062125-11 Water 24-FEB-18 DUP 2	L2062125-12 Water 27-FEB-18 DUP			
Grouping	Analyte						
WATER							
Dissolved Metals	Manganese (Mn)-Dissolved (mg/L)		0.0905	0.0529			
	Mercury (Hg)-Dissolved (mg/L)		<0.0000050	<0.0000050			
	Molybdenum (Mo)-Dissolved (mg/L)		0.00463	0.00587			
	Nickel (Ni)-Dissolved (mg/L)		0.00070	<0.00050			
	Phosphorus (P)-Dissolved (mg/L)		<0.050	<0.050			
	Potassium (K)-Dissolved (mg/L)		2.20	2.56			
	Selenium (Se)-Dissolved (mg/L)		<0.000050	<0.000050			
	Silicon (Si)-Dissolved (mg/L)		5.56	5.39			
	Silver (Ag)-Dissolved (mg/L)		<0.000010	<0.000010			
	Sodium (Na)-Dissolved (mg/L)		9.12	17.7			
	Strontium (Sr)-Dissolved (mg/L)		0.977	0.977			
	Sulfur (S)-Dissolved (mg/L)		6.39	12.1			
	Thallium (Tl)-Dissolved (mg/L)		<0.000010	<0.000010			
	Tin (Sn)-Dissolved (mg/L)		<0.00010	<0.00010			
	Titanium (Ti)-Dissolved (mg/L)		<0.00030	<0.00030			
	Uranium (U)-Dissolved (mg/L)		0.000843	0.000482			
	Vanadium (V)-Dissolved (mg/L)		<0.00050	<0.00050			
	Zinc (Zn)-Dissolved (mg/L)		0.0087	0.0137			
	Zirconium (Zr)-Dissolved (mg/L)		<0.00030	<0.00030			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

Qualifiers for Individual Samples Listed:

Sample Number	Client Sample ID	Qualifier	Description
L2062125-9	MW17-11-05	WSMD	Water sample(s) for dissolved mercury analysis was not submitted in glass or PTFE container with HCl preservative. Results may be biased low.

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Alkalinity, Total (as CaCO ₃)	B	L2062125-12
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2062125-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2062125-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2062125-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2062125-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2062125-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2062125-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Nitrate (as N)	MS-B	L2062125-1, -10, -11, -2, -3, -4, -5, -6, -7, -8

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
DLA	Detection Limit adjusted for required dilution
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BR-L-IC-N-VA	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
F-IC-N-VA	Water	Fluoride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			

Reference Information

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
----------------------------	---------------------

VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
----	---

Chain of Custody Numbers:

2018-02-28 B

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lw - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.





Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 07-MAR-18
Report Date: 19-MAR-18 15:06 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2064857
Project P.O. #: 229097
Job Reference:
C of C Numbers: 2018-03-07 C
Legal Site Desc:

Comments:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2064857-1 Water 01-MAR-18 15:20 MW17-10-01	L2064857-2 Water 01-MAR-18 15:40 MW17-10-02	L2064857-3 Water 01-MAR-18 16:05 MW17-10-03	L2064857-4 Water 02-MAR-18 10:15 MW12-05-01	L2064857-5 Water 02-MAR-18 10:50 MW12-05-02
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	373	419	423	2160	2070
	Hardness (as CaCO3) (mg/L)	174	190	198	986	1040
	pH (pH)	8.07	7.94	7.97	7.72	7.89
	Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0	5.9	6.7
	TDS (Calculated) (mg/L)	217	249	260	1810	1740
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	118	113	114	129	191
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	118	113	114	129	191
	Ammonia, Total (as N) (mg/L)	0.0438	<0.0050	<0.0050	0.0246	0.0321
	Bromide (Br) (mg/L)	2.10	0.052	<0.050	<0.50 ^{DLDS}	<0.50 ^{DLDS}
	Chloride (Cl) (mg/L)	0.90	0.78	0.83	12.3	11.4
	Nitrate and Nitrite (as N) (mg/L)	4.01	18.3	20.5	<0.051 ^{DLDS}	0.058 ^{DLDS}
	Nitrate (as N) (mg/L)	4.00	18.3	20.5	<0.050 ^{DLDS}	<0.050 ^{DLDS}
	Nitrite (as N) (mg/L)	0.0108	0.0024	0.0035	0.020	0.058
	Sulfate (SO4) (mg/L)	56.6	24.4	22.3	1190	1080
	Anion Sum (meq/L)	3.88	4.11	4.25	27.8	26.8
	Cation Sum (meq/L)	3.93	4.14	4.27	26.7	27.2
	Cation - Anion Balance (%)	0.7	0.3	0.2	-2.0	0.9
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0048	0.0023	0.0021	0.0038	0.0040
	Antimony (Sb)-Dissolved (mg/L)	0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00022	0.00012	0.00013	0.00069	0.00034
	Barium (Ba)-Dissolved (mg/L)	0.0275	0.0336	0.0350	0.0390	0.0919
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.013 ^{DLM}	<0.010	<0.010	0.070	0.070
	Cadmium (Cd)-Dissolved (mg/L)	<0.000015	0.0000100	0.0000117	<0.0000050	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	42.6	50.6	53.9	326	321
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00017	0.00015
	Cobalt (Co)-Dissolved (mg/L)	0.00031	0.00044	0.00069	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00388	0.00231	0.00201	<0.00020	<0.00020
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	<0.010	0.033	0.072
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0017	0.0013	0.0015	0.0071	0.0050
	Magnesium (Mg)-Dissolved (mg/L)	16.3	15.6	15.3	41.5	58.1

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2064857-6 Water 02-MAR-18 11:10 MW12-05-03	L2064857-7 Water 02-MAR-18 11:25 MW12-05-04	L2064857-8 Water 02-MAR-18 13:35 MW12-05-05	L2064857-9 Water 02-MAR-18 14:40 MW12-05-06	L2064857-10 Water 02-MAR-18 15:00 MW12-05-07
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	1660	498	496	494	508
	Hardness (as CaCO3) (mg/L)	810	240	235	246	251
	pH (pH)	7.85	7.97	7.79	7.87	7.86
	Total Suspended Solids (mg/L)	4.1	<3.0	<3.0	<3.0	<3.0
	TDS (Calculated) (mg/L)	1280	279	275	281	284
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	252	243	212	214	228
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	252	243	212	214	228
	Ammonia, Total (as N) (mg/L)	0.0320	0.0218	0.0107	<0.0050	0.0433
	Bromide (Br) (mg/L)	<0.25 ^{DLDS}	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl) (mg/L)	8.0	4.96	4.86	4.87	4.69
	Nitrate and Nitrite (as N) (mg/L)	<0.025	<0.0051	0.159	0.188	<0.0051
	Nitrate (as N) (mg/L)	<0.025 ^{DLDS}	<0.0050	0.137	0.181	<0.0050
	Nitrite (as N) (mg/L)	0.0156	0.0023	0.0219	0.0073	<0.0010
	Sulfate (SO4) (mg/L)	742	27.0	47.5	48.5	41.4
	Anion Sum (meq/L)	20.8	5.59	5.41	5.47	5.58
	Cation Sum (meq/L)	20.7	5.78	5.47	5.67	5.81
	Cation - Anion Balance (%)	-0.2	1.6	0.6	1.9	2.0
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0029	0.0037	0.0020	0.0020	0.0023
	Antimony (Sb)-Dissolved (mg/L)	0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00028	0.00010	0.00015	0.00012	0.00038
	Barium (Ba)-Dissolved (mg/L)	0.0445	0.0745	0.0705	0.0687	0.313
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.073	0.031	0.032	0.030	0.023
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050	0.0000238	0.0000150	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	201	47.4	47.0	50.5	52.9
	Chromium (Cr)-Dissolved (mg/L)	0.00015	0.00018	<0.00010	<0.00010	0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00011	0.00012
	Copper (Cu)-Dissolved (mg/L)	<0.00020	<0.00020	0.00114	0.00128	<0.00020
	Iron (Fe)-Dissolved (mg/L)	0.582	0.117	0.012	<0.010	0.467
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0040	0.0031	0.0037	0.0038	0.0036
	Magnesium (Mg)-Dissolved (mg/L)	74.9	29.6	28.6	29.0	28.8

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2064857-11 Water 05-MAR-18 14:10 MW17-12-01	L2064857-12 Water 05-MAR-18 14:30 MW17-12-02	L2064857-13 Water 05-MAR-18 14:50 MW17-12-03	L2064857-14 Water 05-MAR-18 15:10 MW17-12-04	L2064857-15 Water 05-MAR-18 15:25 MW17-12-05
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	2550	2180	879	718	758
	Hardness (as CaCO3) (mg/L)	1060	825	351	341	386
	pH (pH)	7.68	7.87	8.09	8.21	8.17
	Total Suspended Solids (mg/L)	10.3	12.1	<3.0	<3.0	<3.0
	TDS (Calculated) (mg/L)	2120	1780	543	423	458
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	198	226	362	309	349
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	198	226	362	309	349
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Bromide (Br) (mg/L)	<1.0 ^{DLDS}	<0.50 ^{DLDS}	<0.25 ^{DLDS}	<0.050	<0.25 ^{DLDS}
	Chloride (Cl) (mg/L)	13	11.5	<2.5 ^{DLDS}	1.60	<2.5 ^{DLDS}
	Nitrate and Nitrite (as N) (mg/L)	<0.10 ^{DLDS}	<0.051 ^{DLDS}	<0.025 ^{DLDS}	0.335	0.415
	Nitrate (as N) (mg/L)	<0.10 ^{DLDS}	<0.050 ^{DLDS}	<0.025 ^{DLDS}	0.335	0.415 ^{DLDS}
	Nitrite (as N) (mg/L)	<0.020 ^{DLDS}	<0.010 ^{DLDS}	<0.0050 ^{DLDS}	<0.0010	<0.0050 ^{DLDS}
	Sulfate (SO4) (mg/L)	1340	1100	139	93.6	92.4
	Anion Sum (meq/L)	32.3	27.8	10.2	8.24	8.98
	Cation Sum (meq/L)	32.4	26.6	9.89	8.26	9.10
	Cation - Anion Balance (%)	0.1	-2.1	-1.7	0.2	0.6
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0025 ^{DLA}	0.0038	0.0023	0.0023	0.0026
	Antimony (Sb)-Dissolved (mg/L)	<0.00020 ^{DLA}	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00232	0.00199	0.00104	0.00024	<0.00010
	Barium (Ba)-Dissolved (mg/L)	0.00883	0.0116	0.0175	0.0304	0.0450
	Beryllium (Be)-Dissolved (mg/L)	0.000086 ^{DLA}	0.000043	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.00010 ^{DLA}	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.163	0.136	0.052	0.031	0.031
	Cadmium (Cd)-Dissolved (mg/L)	0.000060	0.0000171	0.0000128	0.0000150	0.0000232
	Calcium (Ca)-Dissolved (mg/L)	330 ^{DLA}	254	81.1	57.3	66.7
	Chromium (Cr)-Dissolved (mg/L)	<0.00020 ^{DLA}	<0.00010	<0.00010	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00020 ^{DLA}	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	<0.00040 ^{DLA}	<0.00020	<0.00020	0.00217	0.00098
	Iron (Fe)-Dissolved (mg/L)	3.01 ^{DLA}	2.18	0.119	<0.010	<0.010
	Lead (Pb)-Dissolved (mg/L)	<0.00010 ^{DLA}	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0156	0.0148	0.0089	0.0066	0.0073
	Magnesium (Mg)-Dissolved (mg/L)	56.8	46.2	36.1	48.0	53.3

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2064857-16 Water 05-MAR-18 15:40 MW17-12-06	L2064857-17 Water 05-MAR-18 15:55 MW17-12-07	L2064857-18 Water 05-MAR-18 16:10 MW17-12-08	L2064857-19 Water 02-MAR-18 DUP	L2064857-20 Water 05-MAR-18 DUP
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	754	568	572	500	578
	Hardness (as CaCO3) (mg/L)	377	270	279	240	272
	pH (pH)	8.18	8.12	8.20	7.99	8.17
	Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0	<3.0	<3.0
	TDS (Calculated) (mg/L)	456	327	334	284	333
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	346	252	255	222	254
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	346	252	255	222	254
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	0.0111	<0.0050
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl) (mg/L)	2.19	4.05	4.03	4.89	4.06
	Nitrate and Nitrite (as N) (mg/L)	0.0726	0.928	0.917	0.193	0.928
	Nitrate (as N) (mg/L)	0.0575	0.928	0.917	0.135	0.928
	Nitrite (as N) (mg/L)	0.0151	<0.0010	<0.0010	0.0585	<0.0010
	Sulfate (SO4) (mg/L)	91.6	60.6	61.2	48.2	61.6
	Anion Sum (meq/L)	8.92	6.51	6.59	5.62	6.59
	Cation Sum (meq/L)	9.03	6.36	6.59	5.57	6.46
	Cation - Anion Balance (%)	0.6	-1.2	0.0	-0.5	-1.0
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0024	0.0023	0.0020	0.0027	0.0029
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	<0.00010	0.00010	0.00016	0.00014	0.00014
	Barium (Ba)-Dissolved (mg/L)	0.0804	0.0245	0.0247	0.0727	0.0246
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.031	0.023	0.025	0.032	0.025
	Cadmium (Cd)-Dissolved (mg/L)	<0.000035 ^{DLM}	0.0000097	0.0000114	0.0000088	0.0000100
	Calcium (Ca)-Dissolved (mg/L)	65.6	45.8	48.7	48.8	47.7
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	0.00052	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00115	0.00085	0.00083	0.00117	0.00087
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	<0.010	0.012	<0.010
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0097	0.0056	0.0062	0.0036	0.0061
	Magnesium (Mg)-Dissolved (mg/L)	51.7	37.8	38.3	28.7	37.1

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2064857-1 Water 01-MAR-18 15:20 MW17-10-01	L2064857-2 Water 01-MAR-18 15:40 MW17-10-02	L2064857-3 Water 01-MAR-18 16:05 MW17-10-03	L2064857-4 Water 02-MAR-18 10:15 MW12-05-01	L2064857-5 Water 02-MAR-18 10:50 MW12-05-02
Grouping	Analyte					
WATER						
Dissolved Metals	Manganese (Mn)-Dissolved (mg/L)	0.0643	0.00370	0.00280	0.147	0.868
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.0290	0.00806	0.00802	0.000208	0.000247
	Nickel (Ni)-Dissolved (mg/L)	0.0122	0.00360	0.00420	<0.00050	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	1.58	1.59	1.62	3.61	4.30
	Selenium (Se)-Dissolved (mg/L)	0.000870	0.00138	0.00150	0.00239	0.00222
	Silicon (Si)-Dissolved (mg/L)	5.21	5.31	5.25	7.44	7.32
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	9.58	6.71	6.48	158	145
	Strontium (Sr)-Dissolved (mg/L)	1.12	0.875	0.825	9.09	11.8
	Sulfur (S)-Dissolved (mg/L)	19.9	8.03	7.42	451	465
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00203	0.00110	0.00108	0.000874	0.000582
	Vanadium (V)-Dissolved (mg/L)	0.00084	0.00056	0.00062	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0221	0.0201	0.0568	0.0021	0.0012
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2064857-6 Water 02-MAR-18 11:10 MW12-05-03	L2064857-7 Water 02-MAR-18 11:25 MW12-05-04	L2064857-8 Water 02-MAR-18 13:35 MW12-05-05	L2064857-9 Water 02-MAR-18 14:40 MW12-05-06	L2064857-10 Water 02-MAR-18 15:00 MW12-05-07
Grouping	Analyte					
WATER						
Dissolved Metals	Manganese (Mn)-Dissolved (mg/L)	2.20	0.475	0.118	0.0741	0.707
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.000249	0.00316	0.00389	0.00417	0.00337
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	0.00061	0.00064	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	3.99	2.23	2.04	2.03	1.92
	Selenium (Se)-Dissolved (mg/L)	0.000410	0.000820	0.000107	0.000177	0.00149
	Silicon (Si)-Dissolved (mg/L)	7.84	6.82	6.19	6.18	6.47
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	98.9	20.6	16.4	16.3	16.0
	Strontium (Sr)-Dissolved (mg/L)	7.48	0.892	0.782	0.764	0.817
	Sulfur (S)-Dissolved (mg/L)	287	12.9	16.8	16.7	20.5
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00164	0.00154	0.00299	0.00305	0.00492
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0064	0.0020	0.0096	0.0112	0.0027
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2064857-11 Water 05-MAR-18 14:10 MW17-12-01	L2064857-12 Water 05-MAR-18 14:30 MW17-12-02	L2064857-13 Water 05-MAR-18 14:50 MW17-12-03	L2064857-14 Water 05-MAR-18 15:10 MW17-12-04	L2064857-15 Water 05-MAR-18 15:25 MW17-12-05
Grouping	Analyte					
WATER						
Dissolved Metals	Manganese (Mn)-Dissolved (mg/L)	0.100	0.0598	0.114	0.00319	0.0172
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00808	0.00781	0.00563	0.00641	0.00474
	Nickel (Ni)-Dissolved (mg/L)	<0.0010 ^{DLA}	<0.00050	<0.00050	0.00086	0.00117
	Phosphorus (P)-Dissolved (mg/L)	<0.10 ^{DLA}	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	3.44	3.71	3.01	3.37	3.97
	Selenium (Se)-Dissolved (mg/L)	0.00017	0.000076	<0.000050	0.000994	0.000504
	Silicon (Si)-Dissolved (mg/L)	7.54	7.70	7.89	6.93	7.03
	Silver (Ag)-Dissolved (mg/L)	<0.000020 ^{DLA}	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	252	229	64.1	31.6	29.4
	Strontium (Sr)-Dissolved (mg/L)	10.0	9.93	3.56	1.31	1.49
	Sulfur (S)-Dissolved (mg/L)	508	385	46.7	33.0	32.2
	Thallium (Tl)-Dissolved (mg/L)	<0.000020 ^{DLA}	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00020 ^{DLA}	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00060 ^{DLA}	<0.00030	<0.00030	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.000295	0.000512	0.00448	0.00353	0.00429
	Vanadium (V)-Dissolved (mg/L)	<0.0010 ^{DLA}	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0294	0.0297	0.0146	0.0198	0.0196
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2064857-16 Water 05-MAR-18 15:40 MW17-12-06	L2064857-17 Water 05-MAR-18 15:55 MW17-12-07	L2064857-18 Water 05-MAR-18 16:10 MW17-12-08	L2064857-19 Water 02-MAR-18 DUP	L2064857-20 Water 05-MAR-18 DUP
Grouping	Analyte					
WATER						
Dissolved Metals	Manganese (Mn)-Dissolved (mg/L)	0.482	0.00259	0.00203	0.121	0.00197
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.0330	0.00676	0.00883	0.00387	0.00891
	Nickel (Ni)-Dissolved (mg/L)	0.00457	<0.00050	<0.00050	0.00056	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	5.29	2.69	2.80	2.10	2.79
	Selenium (Se)-Dissolved (mg/L)	0.000370	0.000244	0.000286	0.000059	0.000278
	Silicon (Si)-Dissolved (mg/L)	6.81	6.55	6.64	6.23	6.51
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	31.1	20.4	21.6	16.4	22.1
	Strontium (Sr)-Dissolved (mg/L)	1.69	0.959	0.984	0.809	0.999
	Sulfur (S)-Dissolved (mg/L)	31.9	20.7	21.3	16.7	20.1
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00350	0.00255	0.00260	0.00301	0.00249
	Vanadium (V)-Dissolved (mg/L)	<0.00050	0.00062	0.00072	<0.00050	0.00068
	Zinc (Zn)-Dissolved (mg/L)	0.0119	0.0108	0.0200	0.0079	0.0225
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Qualifiers for Individual Parameters Listed:			
Qualifier	Description		
DLA	Detection Limit adjusted for required dilution		
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.		
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).		

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BR-L-IC-N-VA	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
F-IC-N-VA	Water	Fluoride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)

Reference Information

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
----------------------------	---------------------

VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
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Chain of Custody Numbers:

2018-03-07 C

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



www.alsglobal.com

Report To Contact and companyname below will appear on the final report		Report Format / Distribution			Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply											
Company: Minto Explorations Ltd.		Select Report Format: ☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)			Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply											
Contact: Minto Environment - Coordinator		Quality Control (QC) Report with Report ☒ YES ☐ NO			PRIORITY (Business Days)		4 day [P4] ☐				EMERGENCY		1 Business day [E1] ☐			
Phone: 1-604-759-4659		☒ Compare Results to Criteria on Report - provide details below if box checked					3 day [P3] ☐						Same Day, Weekend or Statutory holiday [E0] ☐			
Company address below will appear on the final report		Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX			Date and Time Required for all E&P TATs:											
Street: 2100-510 West Georgia St.		Email 1 or Fax minto_environment@mintomine.com			For tests that can not be performed according to the service level selected, you will be contacted.											
City/Province: Vancouver, British Columbia		Email 2			Analysis Request											
Postal Code: V6B 0M3		Email 3			Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below											
Invoice To		Invoice Distribution														
Same as Report To ☐ YES ☒ NO		Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX														
Copy of Invoice with Report ☐ YES ☒ NO		Email 1 or Fax ap@mintomine.com														
Company: Minto Explorations Ltd.		Email 2														
Contact: Ruth Cayetano																
Project Information		Oil and Gas Required Fields (client use)														
ALS Account # / Quote #:		AFE/Cost Center:														
Job #:		Major/Minor Code:														
PO / AFE: 229097 (GW)		Requisitioner:														
LSD:		Location:														
ALS Lab Work Order # (lab use only)		ALS Contact:			Sampler:			SR/CH/CP								
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)		Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Total Metals (TM)	Dissolved Metals (DM)	Total Mercury, Hardness	Dissolved Mercury	Ammonia (Total Nutrients)	Dissolved Organic Carbon (DOC)	pH, Cond., TSS, TDS, Alkalinity, Anions	Dissolved Bromide (Br-D)	Number of Containers		
	MW17-10-01		1-Mar-18	15:20	Water		R		R	R		R	R			4
	MW17-10-02		1-Mar-18	15:40	Water		R		R	R		R	R			4
	MW17-10-03		1-Mar-18	16:05	Water		R		R	R		R	R			4
	MW12-05-01		2-Mar-18	10:15	Water		R		R	R		R	R			4
	MW12-05-02		2-Mar-18	10:50	Water		R		R	R		R	R			4
	MW12-05-03		2-Mar-18	11:10	Water		R		R	R		R	R			4
	MW12-05-04		2-Mar-18	11:25	Water		R		R	R		R	R			4
	MW12-05-05		2-Mar-18	13:35	Water		R		R	R		R	R			4
	MW12-05-06		2-Mar-18	14:40	Water		R		R	R		R	R			4
	MW12-05-07		2-Mar-18	15:00	Water		R		R	R		R	R			4
Drinking Water (DW) Samples¹ (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)			SAMPLE CONDITION AS RECEIVED (lab use only)											
Are samples taken from a Regulated DW System? ☐ YES ☒ NO					Frozen ☐ SIF Observations Yes ☐ No ☐											
Are samples for human drinking water use? ☐ YES ☒ NO					Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐											
					Cooling Initiated ☐											
					INITIAL COOLER TEMPERATURES °C: 4°C, 2°C, FINAL COOLER TEMPERATURES °C: 4, 5, 7											
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)											
Released by: Shaun Roberts		Date: 2018-03-07		Time: 10:30	Received by: 		Date: Mar 7/18		Time: 14:20	Received by: JL		Date: MAR - 8 2018		Time: 12pm		

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Report To Contact and companyname below will appear on the final report		Report Format / Distribution			Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply																																																																																																																										
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Contact: Minto Environment - Coordinator		Quality Control (QC) Report with Report ☒ YES ☐ NO			PRIORITY (Business Days) 4 day [P4] ☐ 3 day [P3] ☐ 2 day [P2] ☐		EMERGENCY 1 Business day [E1] ☐ Same Day, Weekend or Statutory holiday [E0] ☐																																																																																																																								
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City/Province: Vancouver, British Columbia		Email 2			For tests that can not be performed according to the service level selected, you will be contacted.																																																																																																																										
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Invoice To Same as Report To ☐ YES ☒ NO Copy of Invoice with Report ☐ YES ☒ NO		Invoice Distribution Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX Email 1 or Fax ap@mintomine.com Email 2			Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below																																																																																																																										
					<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td>P</td><td>F/P</td><td>P</td><td>F/P</td><td>P</td><td>F/P</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td rowspan="6" style="writing-mode: vertical-rl; transform: rotate(180deg);">Total Metals(TM)</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td rowspan="6" style="writing-mode: vertical-rl; transform: rotate(180deg);">Number of Containers</td> </tr> <tr> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> </table>												P	F/P	P	F/P	P	F/P													Total Metals(TM)																	Number of Containers																																																																											
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	MW17-12-02		5-Mar-18	14:30	Water		R		R	R		R	R				4																																																																																																														
	MW17-12-03		5-Mar-18	14:50	Water		R		R	R		R	R				4																																																																																																														
	MW17-12-04		5-Mar-18	15:10	Water		R		R	R		R	R				4																																																																																																														
	MW17-12-05		5-Mar-18	15:25	Water		R		R	R		R	R				4																																																																																																														
	MW17-12-06		5-Mar-18	15:40	Water		R		R	R		R	R				4																																																																																																														
	MW17-12-07		5-Mar-18	15:55	Water		R		R	R		R	R				4																																																																																																														
	MW17-12-08		5-Mar-18	16:10	Water		R		R	R		R	R				4																																																																																																														
	DUP		2-Mar-18		Water		R		R	R		R	R				4																																																																																																														
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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 14-MAR-18
Report Date: 26-MAR-18 16:43 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2067824
Project P.O. #: 229097 (GW)
Job Reference:
C of C Numbers: 2018-03-14 B
Legal Site Desc:

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

26-MAR-18 16:43 (MT)

Version: FINAL

Sample ID Description Sampled Date Sampled Time Client ID		L2067824-1 WATER 08-MAR-18 14:20 MW17-08-01	L2067824-2 WATER 08-MAR-18 14:45 MW17-08-02	L2067824-3 WATER 08-MAR-18 15:05 MW17-08-03	L2067824-5 WATER 12-MAR-18 13:35 MW12-06-01	L2067824-6 WATER 12-MAR-18 14:10 MW12-06-02
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	474	311	272	748	1010
	Hardness (as CaCO3) (mg/L)	252	161	143	297	491
	pH (pH)	8.32	8.26	8.25	8.17	8.03
	Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0	3.5	33.9
	TDS (Calculated) (mg/L)	269	170	149	418	653
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	223	157	142	405	365
	Alkalinity, Carbonate (as CaCO3) (mg/L)	6.8	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	230	157	142	405	365
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	0.116	0.0530
	Chloride (Cl) (mg/L)	<0.50	<0.50	<0.50	5.09	<2.5
	Nitrate (as N) (mg/L)	0.367	0.657	0.771	0.0880	0.050
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	0.316	0.196
	Sulfate (SO4) (mg/L)	38.8	11.8	5.43	0.87	215
	Anion Sum (meq/L)	5.44	3.45	3.02	8.33	11.9
	Cation Sum (meq/L)	5.41	3.47	3.06	8.51	11.7
	Cation - Anion Balance (%)	-0.3	0.4	0.7	1.1	-0.8
						DLDS
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0012	0.0021	0.0031	0.0158	0.0013
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	0.00013	0.00013	0.00025	0.00011
	Arsenic (As)-Dissolved (mg/L)	0.00022	0.00032	0.00025	0.00724	0.00370
	Barium (Ba)-Dissolved (mg/L)	0.00852	0.0887	0.0872	0.209	0.0293
	Beryllium (Be)-Dissolved (mg/L)	<0.000030 ^{DLB}	<0.000030 ^{DLB}	<0.000030 ^{DLB}	<0.000080 ^{DLB}	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.021	<0.010	<0.010	0.175	0.286
	Cadmium (Cd)-Dissolved (mg/L)	0.0000658	0.0000458	0.0000247	0.0000178	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	50.2	37.7	36.6	87.0	138
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00386	0.00012
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00061	0.00226	0.00056	0.00104	<0.00020
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	<0.010	0.282	1.12
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0018	<0.0010	<0.0010	0.0112	0.0097
	Magnesium (Mg)-Dissolved (mg/L)	30.8	16.3	12.5	19.4	35.7
	Manganese (Mn)-Dissolved (mg/L)	0.00187	0.00189	0.00100	0.0777	0.0258
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

26-MAR-18 16:43 (MT)

Version: FINAL

Sample ID Description Sampled Date Sampled Time Client ID		L2067824-7 WATER 12-MAR-18 14:30 MW12-06-03	L2067824-8 WATER 12-MAR-18 14:45 MW12-06-04	L2067824-9 WATER 12-MAR-18 15:00 MW12-06-05	L2067824-10 WATER 12-MAR-18 15:30 MW12-06-06	L2067824-11 WATER 12-MAR-18 DUP
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	1020	1010	1010	852	1000
	Hardness (as CaCO3) (mg/L)	492	483	507	414	516
	pH (pH)	8.11	8.11	8.19	8.21	8.23
	Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0	<3.0	<3.0
	TDS (Calculated) (mg/L)	646	627	635	531	641
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	383	413	410	328	408
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	383	413	410	328	408
	Ammonia, Total (as N) (mg/L)	0.0724	0.0087	0.0073	0.0133	<0.0050
	Chloride (Cl) (mg/L)	<2.5 ^{DLDS}	<2.5 ^{DLDS}	<2.5 ^{DLDS}	7.0	<2.5 ^{DLDS}
	Nitrate (as N) (mg/L)	<0.025 ^{DLDS}	<0.025 ^{DLDS}	<0.025 ^{DLDS}	1.00	<0.025 ^{DLDS}
	Nitrite (as N) (mg/L)	0.0675	0.0731	0.0328	0.0619	0.0333
	Sulfate (SO4) (mg/L)	211	183	183	155	189
	Anion Sum (meq/L)	12.1	12.1	12.1	10.1	12.1
	Cation Sum (meq/L)	11.5	11.1	11.8	9.69	11.9
	Cation - Anion Balance (%)	-2.6	-4.3	-1.3	-2.0	-1.0
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0015	0.0031	0.0022	0.0018	0.0012
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00068	0.00223	0.00072	0.00015	0.00081
	Barium (Ba)-Dissolved (mg/L)	0.0245	0.0175	0.0399	0.0145	0.0442
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.128	0.052	0.058	0.067	0.057
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	0.0000069	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	111	107	108	81.3	109
	Chromium (Cr)-Dissolved (mg/L)	0.00020	<0.00010	<0.00010	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	0.00106	<0.00010	0.00110
	Copper (Cu)-Dissolved (mg/L)	<0.00020	<0.00020	0.00026	0.00096	<0.00020
	Iron (Fe)-Dissolved (mg/L)	1.11	0.728	0.134	<0.010	0.126
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0080	0.0063	0.0067	0.0044	0.0059
	Magnesium (Mg)-Dissolved (mg/L)	52.0	52.4	57.8	51.2	59.4
	Manganese (Mn)-Dissolved (mg/L)	0.0145	0.0388	0.360	0.0348	0.358
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2067824-1 WATER 08-MAR-18 14:20 MW17-08-01	L2067824-2 WATER 08-MAR-18 14:45 MW17-08-02	L2067824-3 WATER 08-MAR-18 15:05 MW17-08-03	L2067824-5 WATER 12-MAR-18 13:35 MW12-06-01	L2067824-6 WATER 12-MAR-18 14:10 MW12-06-02
Grouping	Analyte					
WATER						
Dissolved Metals	Molybdenum (Mo)-Dissolved (mg/L)	0.00820	0.00306	0.000994	0.000938	0.00775
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	1.57	0.98	0.99	2.46	3.21
	Selenium (Se)-Dissolved (mg/L)	0.000598	0.000810	0.000605	0.000632	0.000307
	Silicon (Si)-Dissolved (mg/L)	5.09	4.73	4.21	7.68	10.1
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	7.57	5.12	4.13	56.9	39.3
	Strontium (Sr)-Dissolved (mg/L)	6.84	1.08	0.755	3.53	10.4
	Sulfur (S)-Dissolved (mg/L)	12.6	4.09	2.03	2.70	65.3
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	0.00022	0.00016	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	0.00283	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.000245	0.000160	0.000128	0.000689	0.00243
	Vanadium (V)-Dissolved (mg/L)	<0.00050	0.00081	0.00064	0.0143	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0373	0.0313	0.0381	0.0075	0.0061
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	0.00109	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2067824-7 WATER 12-MAR-18 14:30 MW12-06-03	L2067824-8 WATER 12-MAR-18 14:45 MW12-06-04	L2067824-9 WATER 12-MAR-18 15:00 MW12-06-05	L2067824-10 WATER 12-MAR-18 15:30 MW12-06-06	L2067824-11 WATER 12-MAR-18 DUP
Grouping	Analyte					
WATER						
Dissolved Metals	Molybdenum (Mo)-Dissolved (mg/L)	0.00243	0.00845	0.00876	0.00561	0.00925
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	0.00055	<0.00050	0.00056
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	3.45	3.24	3.50	3.39	3.66
	Selenium (Se)-Dissolved (mg/L)	0.000119	<0.000050	<0.000050	0.000281	<0.000050
	Silicon (Si)-Dissolved (mg/L)	8.94	8.39	8.17	6.59	8.12
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	35.3	31.3	35.2	30.7	34.0
	Strontium (Sr)-Dissolved (mg/L)	4.88	3.28	2.92	1.65	3.01
	Sulfur (S)-Dissolved (mg/L)	62.6	58.2	57.5	47.8	58.7
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00237	0.00565	0.00577	0.00411	0.00617
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0034	0.0088	0.0120	0.0335	0.0113
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Beryllium (Be)-Dissolved	MB-LOR	L2067824-1, -10, -11, -2, -3, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2067824-1, -10, -11, -2, -3, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2067824-1, -10, -11, -2, -3, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2067824-1, -10, -11, -2, -3, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2067824-1, -10, -11, -2, -3, -5, -6, -7, -8, -9
Matrix Spike	Molybdenum (Mo)-Dissolved	MS-B	L2067824-1, -10, -11, -2, -3, -5, -6, -7, -8, -9
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2067824-1, -10, -11, -2, -3, -5, -6, -7, -8, -9
Matrix Spike	Silicon (Si)-Dissolved	MS-B	L2067824-1, -10, -11, -2, -3, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2067824-1, -10, -11, -2, -3, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2067824-1, -10, -11, -2, -3, -5, -6, -7, -8, -9
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2067824-1, -10, -11, -2, -3, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLB	Detection Limit Raised. Analyte detected at comparable level in Method Blank.
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BR-L-IC-N-VA	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
F-IC-N-VA	Water	Fluoride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			

Reference Information

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
----------------------------	---------------------

VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
----	---

Chain of Custody Numbers:

2018-03-14 B

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



12067824-COFC

COC Number: 2018-03-14 B

Page 1 of 1

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Report To		Contact and company name below will appear on the final report		Report Format / Distribution				Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply													
Company:		Minto Explorations Ltd.		Select Report Format: ☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)				Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply													
Contact:		Minto Environment - Coordinator		Quality Control (QC) Report with Report ☒ YES ☐ NO				PRIORITY (Business Days) 4 day [P4] ☐ 3 day [P3] ☐ 2 day [P2] ☐ EMERGENCY 1 Business day [E1] ☐ Same Day, Weekend or Statutory holiday [E0] ☐													
Phone:		1-604-759-4659		☒ Compare Results to Criteria on Report - provide details below if box checked																	
Company address below will appear on the final report				Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX																	
Street:		2100-510 West Georgia St.		Email 1 or Fax minto_environment@mintomine.com				Date and Time Required for all E&P TATs: 08:00 AM - 05:00 PM													
City/Province:		Vancouver, British Columbia		Email 2				For tests that can not be performed according to the service level selected, you will be contacted.													
Postal Code:		V6B 0M3		Email 3				Analysis Request													
Invoice To				Invoice Distribution				Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below													
Same as Report To ☐ YES ☒ NO				Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX				P F/P P F/P P F/P													
Copy of Invoice with Report ☐ YES ☒ NO				Email 1 or Fax ap@mintomine.com				P F/P P F/P P F/P													
Company:				Email 2				P F/P P F/P P F/P													
Contact:				Ruth Cayetano				P F/P P F/P P F/P													
Project Information				Oil and Gas Required Fields (client use)				P F/P P F/P P F/P													
ALS Account # / Quote #:				AFE/Cost Center:				P F/P P F/P P F/P													
Job #:				Major/Minor Code:				P F/P P F/P P F/P													
PO / AFE: 229097 (GW)				Requisitioner:				P F/P P F/P P F/P													
LSD:				Location:				P F/P P F/P P F/P													
ALS Lab Work Order # (lab use only)				ALS Contact:				P F/P P F/P P F/P													
Sampler: CR/CH/EB								P F/P P F/P P F/P													
ALS Sample # (lab use only)		Sample Identification and/or Coordinates (This description will appear on the report)		Date (dd-mmm-yy)		Time (hh:mm)		Sample Type		P F/P P F/P P F/P											
		MW17-08-01		8-Mar-18		14:20		Water		P F/P P F/P P F/P											
		MW17-08-02		8-Mar-18		14:45		Water		P F/P P F/P P F/P											
		MW17-08-03		8-Mar-18		15:05		Water		P F/P P F/P P F/P											
		MW17-08-04		8-Mar-18		15:20		Water		P F/P P F/P P F/P											
		MW12-06-01		12-Mar-18		13:35		Water		P F/P P F/P P F/P											
		MW12-06-02		12-Mar-18		14:10		Water		P F/P P F/P P F/P											
		MW12-06-03		12-Mar-18		14:30		Water		P F/P P F/P P F/P											
		MW12-06-04		12-Mar-18		14:45		Water		P F/P P F/P P F/P											
		MW12-06-05		12-Mar-18		15:00		Water		P F/P P F/P P F/P											
		MW12-06-06		12-Mar-18		15:30		Water		P F/P P F/P P F/P											
		Dup		12-Mar-18				Water		P F/P P F/P P F/P											
										P F/P P F/P P F/P											
Drinking Water (DW) Samples¹ (client use)				Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)				SAMPLE CONDITION AS RECEIVED (lab use only)													
Are samples taken from a Regulated DW System? ☐ YES ☒ NO								Frozen ☐ SIF Observations Yes ☐ No ☐													
Are samples for human drinking water use? ☐ YES ☒ NO								Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐													
								Cooling Initiated ☐													
								INITIAL COOLER TEMPERATURES °C: 4°C 4°C 5°C 8.9 4 5													
								FINAL COOLER TEMPERATURES °C: 4°C 4°C 5°C 8.9 4 5													
SHIPMENT RELEASE (client use)				INITIAL SHIPMENT RECEPTION (lab use only)				FINAL SHIPMENT RECEPTION (lab use only)													
Released by: Corey Roberts		Date: 2018-03-13		Time:		Received by: [Signature]		Date: MAR 14/18		Time: 15:25		Received by: [Signature]		Date: MAR 15 2018		Time: 11:15 AM					

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 21-MAR-18
Report Date: 16-APR-18 12:49 (MT)
Version: FINAL REV. 4

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2070757
Project P.O. #: 229097
Job Reference:
C of C Numbers: 2018-03-21 A
Legal Site Desc:

Comments: 5-APR-2018 Please note, client IDs of samples L2070757-1 and 2 have been updated as requested.
9-APR-2018 Testing has been revised for sample 4 with total Hg replaced with dissolved Hg.
16-APR-2018 Total metals have been replaced with dissolved metals as requested.

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2070757-1 Water 16-MAR-18 13:35 MW12-07-01	L2070757-2 Water 16-MAR-18 14:00 MW12-07-02	L2070757-3 Water 16-MAR-18 15:20 MW09-03-01	L2070757-4 Water 16-MAR-18 15:55 MW09-03-02	
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	1370	981	310	269	
	Hardness (as CaCO3) (mg/L)	680 ^{HTC}	508 ^{HTC}	156 ^{HTC}	139 ^{HTC}	
	pH (pH)	8.04	8.04	8.28	8.22	
	Total Suspended Solids (mg/L)	5.8	<3.0	<3.0	<3.0	
	TDS (Calculated) (mg/L)	1020	736	172	152	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	238	142	138	119	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Total (as CaCO3) (mg/L)	238	142	138	119	
	Ammonia, Total (as N) (mg/L)	1.91	0.0209	0.0443	0.0107	
	Chloride (Cl) (mg/L)	<2.5 ^{DLDS}	<2.5 ^{DLDS}	<0.50	<0.50	
	Nitrate and Nitrite (as N) (mg/L)	2.96	1.26	0.410	2.78	
	Nitrate (as N) (mg/L)	0.881	0.368	0.0088	2.49	
	Nitrite (as N) (mg/L)	2.08	0.894	0.401	0.297	
	Sulfate (SO4) (mg/L)	505	406	19.5	8.25	
	Anion Sum (meq/L)	15.5	11.4	3.20	2.74	
	Cation Sum (meq/L)	18.1	12.6	3.66	3.11	
	Cation - Anion Balance (%)	7.9	4.9	6.7	6.2	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0231	0.0140	0.0198	0.0187	
	Antimony (Sb)-Dissolved (mg/L)	0.00028	0.00053	0.00036	0.00034	
	Arsenic (As)-Dissolved (mg/L)	0.00108	0.00136	0.00073	0.00011	
	Barium (Ba)-Dissolved (mg/L)	0.0895	0.0200	0.0652	0.0240	
	Beryllium (Be)-Dissolved (mg/L)	0.000072	<0.000020	<0.000020	<0.000020	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	1.91	0.975	0.513	0.337	
	Cadmium (Cd)-Dissolved (mg/L)	0.000107	0.0000694	0.000110	0.0000963	
	Calcium (Ca)-Dissolved (mg/L)	233	147	46.6	47.4	
	Chromium (Cr)-Dissolved (mg/L)	0.00166	0.00071	0.00073	0.00064	
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00025	<0.00010	0.00014	
	Copper (Cu)-Dissolved (mg/L)	0.00038	0.00370	0.00392	0.00380	
	Iron (Fe)-Dissolved (mg/L)	0.153	0.088	0.413	0.056	
	Lead (Pb)-Dissolved (mg/L)	0.000544	0.000213	0.000088	0.000087	
	Lithium (Li)-Dissolved (mg/L)	0.0232	0.0178	0.0035	0.0011	
	Magnesium (Mg)-Dissolved (mg/L)	22.5	27.5	10.8	5.59	
	Manganese (Mn)-Dissolved (mg/L)	0.131	0.856	0.0838	0.00999	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2070757-1 Water 16-MAR-18 13:35 MW12-07-01	L2070757-2 Water 16-MAR-18 14:00 MW12-07-02	L2070757-3 Water 16-MAR-18 15:20 MW09-03-01	L2070757-4 Water 16-MAR-18 15:55 MW09-03-02	
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Dissolved (mg/L)	0.00224	0.0373	0.00672	0.00568	
	Nickel (Ni)-Dissolved (mg/L)	0.00108	0.00061	0.00132	0.00054	
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Potassium (K)-Dissolved (mg/L)	2.82	2.85	2.16	2.05	
	Selenium (Se)-Dissolved (mg/L)	0.00188	0.000848	0.000116	0.000376	
	Silicon (Si)-Dissolved (mg/L)	7.51	5.88	5.19	4.75	
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	0.000016	
	Sodium (Na)-Dissolved (mg/L)	97.6	52.0	10.8	6.08	
	Strontium (Sr)-Dissolved (mg/L)	10.4	5.12	1.06	0.337	
	Sulfur (S)-Dissolved (mg/L)	171	131	5.76	2.78	
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Tin (Sn)-Dissolved (mg/L)	0.00015	0.00016	0.00028	<0.00010	
	Titanium (Ti)-Dissolved (mg/L)	0.00127	<0.00090 ^{DLM}	<0.0015 ^{DLM}	0.00140	
	Uranium (U)-Dissolved (mg/L)	0.000098	0.00287	0.000863	0.00192	
	Vanadium (V)-Dissolved (mg/L)	0.00134	<0.00050	<0.00050	<0.00050	
	Zinc (Zn)-Dissolved (mg/L)	0.672	0.375	0.0913	0.105	
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Qualifiers for Individual Parameters Listed:			
Qualifier	Description		
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.		
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).		
HTC	Hardness was calculated from Total Ca and/or Mg concentrations and may be biased high (dissolved Ca/Mg results unavailable).		

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			

Reference Information

NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
SO4-IC-N-VA	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)
This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".			
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.			
TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
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VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
----	---

Chain of Custody Numbers:

2018-03-21 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2070757-COFC

COC Number: 2018-03-21 A

Page 1 of 1

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REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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YELLOW - CLIENT COPY

DECEMBER 2015 PAGE

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white-report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 16-APR-18
Report Date: 30-APR-18 18:35 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2080385
Project P.O. #: 229097
Job Reference:
C of C Numbers: 2018-04-14 A
Legal Site Desc:

Shane Stack
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2080385-1 Water 13-APR-18 10:35 MW12-07-01	L2080385-2 Water 13-APR-18 11:00 MW12-07-02	L2080385-3 Water 13-APR-18 14:00 MW09-03-01	L2080385-4 Water 13-APR-18 14:25 MW09-03-02	
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	1420	935	308	260	
	Hardness (as CaCO3) (mg/L)	618	436	145	117	
	pH (pH)	8.28	8.24	8.38	8.29	
	Total Suspended Solids (mg/L)	12.7	3.3	3.3	4.7	
	TDS (Calculated) (mg/L)	1050	690	171	146	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	190	156	143	125	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	7.4	<1.0	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Total (as CaCO3) (mg/L)	190	156	151	125	
	Ammonia, Total (as N) (mg/L)	0.984	0.0128	0.0368	0.0145	
	Chloride (Cl) (mg/L)	<2.5 ^{DLDS}	<2.5 ^{DLDS}	<0.50	<0.50	
	Nitrate and Nitrite (as N) (mg/L)	6.23	0.505	0.170	2.54	
	Nitrate (as N) (mg/L)	1.82	0.206	0.0130	2.36	
	Nitrite (as N) (mg/L)	4.41	0.298	0.157	0.177	
	Sulfate (SO4) (mg/L)	575	391	18.6	8.28	
	Anion Sum (meq/L)	16.2	11.3	3.41	2.85	
	Cation Sum (meq/L)	17.2	10.8	3.37	2.67	
	Cation - Anion Balance (%)	3.0	-2.5	-0.5	-3.1	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0377	0.0131	0.0193	0.0136	
	Antimony (Sb)-Dissolved (mg/L)	0.00110	0.00020	0.00016	0.00033	
	Arsenic (As)-Dissolved (mg/L)	0.00573	0.00032	0.00084	0.00013	
	Barium (Ba)-Dissolved (mg/L)	0.0692	0.0202	0.0677	0.0203	
	Beryllium (Be)-Dissolved (mg/L)	0.000050	<0.000020	<0.000020	<0.000020	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	3.24	0.376	0.214	0.398	
	Cadmium (Cd)-Dissolved (mg/L)	0.000146	0.0000405	0.0000837	0.0000774	
	Calcium (Ca)-Dissolved (mg/L)	204	125	38.0	37.4	
	Chromium (Cr)-Dissolved (mg/L)	0.00216	0.00023	0.00045	0.00041	
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00027	<0.00010	<0.00010	
	Copper (Cu)-Dissolved (mg/L)	0.00856	0.00461	0.00411	0.00494	
	Iron (Fe)-Dissolved (mg/L)	0.229	0.068	0.418	0.038	
	Lead (Pb)-Dissolved (mg/L)	0.000812	0.000114	0.000082	0.000073	
	Lithium (Li)-Dissolved (mg/L)	0.0216	0.0185	0.0036	0.0012	
	Magnesium (Mg)-Dissolved (mg/L)	26.4	30.1	12.1	5.62	
	Manganese (Mn)-Dissolved (mg/L)	0.133	0.853	0.0915	0.00480	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2080385-1 Water 13-APR-18 10:35 MW12-07-01	L2080385-2 Water 13-APR-18 11:00 MW12-07-02	L2080385-3 Water 13-APR-18 14:00 MW09-03-01	L2080385-4 Water 13-APR-18 14:25 MW09-03-02	
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Dissolved (mg/L)	0.00708	0.0371	0.00499	0.00571	
	Nickel (Ni)-Dissolved (mg/L)	0.00150	<0.00050	0.00120	0.00066	
	Phosphorus (P)-Dissolved (mg/L)	0.118	<0.050	<0.050	<0.050	
	Potassium (K)-Dissolved (mg/L)	3.00	2.95	2.25	2.08	
	Selenium (Se)-Dissolved (mg/L)	0.00226	0.000486	0.000093	0.000531	
	Silicon (Si)-Dissolved (mg/L)	7.84	6.57	5.70	5.29	
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Sodium (Na)-Dissolved (mg/L)	107	44.2	8.87	6.52	
	Strontium (Sr)-Dissolved (mg/L)	10.0	4.62	0.988	0.314	
	Sulfur (S)-Dissolved (mg/L)	227	141	6.53	3.11	
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Tin (Sn)-Dissolved (mg/L)	0.00051	0.00023	0.00010	<0.00010	
	Titanium (Ti)-Dissolved (mg/L)	0.00159	<0.00090 ^{DLM}	0.00121	<0.0012 ^{DLM}	
	Uranium (U)-Dissolved (mg/L)	0.000187	0.00317	0.000933	0.00188	
	Vanadium (V)-Dissolved (mg/L)	0.00077	<0.00050	<0.00050	<0.00050	
	Zinc (Zn)-Dissolved (mg/L)	1.24	0.154	0.0648	0.0809	
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Copper (Cu)-Dissolved	MB-LOR	L2080385-1, -2, -3, -4
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2080385-1, -2, -3, -4
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2080385-1, -2, -3, -4
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2080385-1, -2, -3, -4
Matrix Spike	Boron (B)-Dissolved	MS-B	L2080385-1, -2, -3, -4
Matrix Spike	Boron (B)-Dissolved	MS-B	L2080385-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2080385-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2080385-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2080385-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2080385-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2080385-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2080385-1, -2, -3, -4
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2080385-1, -2, -3, -4
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2080385-1, -2, -3, -4
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2080385-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2080385-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2080385-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2080385-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2080385-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2080385-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2080385-1, -2, -3, -4
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2080385-1, -2, -3, -4
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2080385-1, -2, -3, -4
Matrix Spike	Zinc (Zn)-Dissolved	MS-B	L2080385-1, -2, -3, -4
Matrix Spike	Zinc (Zn)-Dissolved	MS-B	L2080385-1, -2, -3, -4

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Reference Information

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 µm), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-MAN-WR Water Total Suspended Solids by Gravimetric APHA 2540 D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids are determined by filtering a sample through a glass fibre filter and drying the filter at 104 degrees celsius.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
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WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
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VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
----	---

Chain of Custody Numbers:

2018-04-14 A

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lw - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

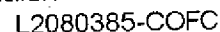
Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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Page 1 of 1

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OCTOBER 2015 PROA

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 07-MAY-18
Report Date: 17-MAY-18 17:52 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2090244
Project P.O. #: 229097 (GW)
Job Reference:
C of C Numbers: 2018-05-07 B
Legal Site Desc:

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2090244-1 Water 04-MAY-18 16:20 MW09-03-01	L2090244-2 Water 04-MAY-18 16:40 MW09-03-02	L2090244-3 Water 05-MAY-18 08:50 MW17-11-01	L2090244-4 Water 05-MAY-18 09:15 MW17-11-02	L2090244-5 Water 05-MAY-18 09:30 MW17-11-03
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (umhos/cm)	315	260	330	348	325
	Hardness (as CaCO3) (mg/L)	154	123	125	145	148
	pH (pH units)	8.25	8.21	8.25	8.28	8.20
	Total Suspended Solids (mg/L)	5.8	<3.0	7.4	<3.0	<3.0
	TDS (Calculated) (mg/L)	175	150	191	199	181
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	150	124	136	151	153
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	150	124	136	151	153
	Ammonia, Total (as N) (mg/L)	0.0403	<0.0050	0.0098	<0.0050	<0.0050
	Chloride (Cl) (mg/L)	<0.50	<0.50	0.80	<0.50	<0.50
	Nitrate and Nitrite (as N) (mg/L)	0.164	2.42	<0.0051	<0.0051	<0.0051
	Nitrate (as N) (mg/L)	0.0079	2.25	<0.0050	<0.0050	<0.0050
	Nitrite (as N) (mg/L)	0.156	0.169	0.0036	<0.0010	0.0014
	Sulfate (SO4) (mg/L)	18.9	8.86	39.5	37.0	22.5
	Anion Sum (meq/L)	3.40	2.83	3.56	3.80	3.53
	Cation Sum (meq/L)	3.53	2.87	3.56	3.72	3.56
	Cation - Anion Balance (%)	1.9	0.6	0.1	-1.0	0.5
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0022	0.0017	0.0054	0.0021	0.0038
	Antimony (Sb)-Dissolved (mg/L)	0.00010	0.00040	0.00012	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00087	0.00036	0.00169	0.00064	0.00048
	Barium (Ba)-Dissolved (mg/L)	0.0632	0.0182	0.0431	0.0396	0.0600
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.154	0.693	0.027	0.019	0.014
	Cadmium (Cd)-Dissolved (mg/L)	0.0000342	0.0000342	<0.0000050	0.0000086	0.0000083
	Calcium (Ca)-Dissolved (mg/L)	43.1	40.7	35.0	39.9	39.7
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00022	<0.00010	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00042	0.00127	0.00052	0.00023	<0.00020
	Iron (Fe)-Dissolved (mg/L)	0.408	<0.010	0.614	0.051	0.042
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0037	0.0014	0.0057	0.0057	0.0053
	Magnesium (Mg)-Dissolved (mg/L)	11.2	5.20	9.23	11.2	12.0
	Manganese (Mn)-Dissolved (mg/L)	0.0975	0.00303	0.0504	0.0483	0.0923

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2090244-6 Water 05-MAY-18 09:45 MW17-11-04	L2090244-7 Water 05-MAY-18 10:45 MW17-11-05	L2090244-8 Water 05-MAY-18 13:40 MW12-07-02	L2090244-9 Water 06-MAY-18 15:50 MW17-10-01	L2090244-10 Water 06-MAY-18 16:10 MW17-10-02
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (umhos/cm)	360	1200	939	384	428
	Hardness (as CaCO3) (mg/L)	195	1070	438	177	201
	pH (pH units)	8.31	7.48	8.17	8.19	8.22
	Total Suspended Solids (mg/L)	47.4	<3.0	3.6	12.4	4.0
	TDS (Calculated) (mg/L)	209	958	665	229	267
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	176	582	161	125	116
	Alkalinity, Carbonate (as CaCO3) (mg/L)	2.6	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	179	582	161	125	116
	Ammonia, Total (as N) (mg/L)	<0.0050	0.0081	0.0124 ^{DLDS}	0.0421	<0.0050
	Chloride (Cl) (mg/L)	<0.50	2.7	<2.5	0.90	0.87
	Nitrate and Nitrite (as N) (mg/L)	0.0194	29.0	0.176	5.67	21.1
	Nitrate (as N) (mg/L)	0.0173	29.0	0.080	5.64	21.1
	Nitrite (as N) (mg/L)	0.0020	0.0089	0.0963	0.0288	0.0037
	Sulfate (SO4) (mg/L)	21.4	17.8	365	56.1	23.8
	Anion Sum (meq/L)	4.02	14.2	10.8	4.09	4.35
	Cation Sum (meq/L)	4.30	23.6	10.6	4.02	4.35
	Cation - Anion Balance (%)	3.4	25.0	-0.9	-0.9	0.0
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0037	0.0021	0.0025	0.0061	0.0038
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	0.00062	<0.00010	0.00011	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00028	0.00037	0.00043	0.00033	0.00018
	Barium (Ba)-Dissolved (mg/L)	0.121	1.17	0.0218	0.0252	0.0305
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.011	0.031	0.189 ^{DLM}	0.055	0.012
	Cadmium (Cd)-Dissolved (mg/L)	0.0000093	0.0000230	<0.000015	0.0000367	0.0000241
	Calcium (Ca)-Dissolved (mg/L)	56.7	358	131	44.5	55.0
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00039	0.00022	0.00032	0.00050
	Copper (Cu)-Dissolved (mg/L)	0.00080	0.00342	0.00151	0.00448	0.00524
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	0.019	<0.010	<0.010
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0051	0.0237	0.0182	0.0017	0.0013
	Magnesium (Mg)-Dissolved (mg/L)	13.0	42.9	27.1	15.9	15.4
	Manganese (Mn)-Dissolved (mg/L)	0.111	0.00658	0.719	0.0566	0.00441

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2090244-11 Water 06-MAY-18 16:30 MW17-10-03	L2090244-12 Water 05-MAY-18 DUP		
Grouping	Analyte				
WATER					
Physical Tests	Conductivity (umhos/cm)	440	1050		
	Hardness (as CaCO3) (mg/L)	189	962		
	pH (pH units)	8.11	7.51		
	Total Suspended Solids (mg/L)	<3.0	<3.0		
	TDS (Calculated) (mg/L)	269	833		
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	118	526		
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0		
	Alkalinity, Total (as CaCO3) (mg/L)	118	526		
	Ammonia, Total (as N) (mg/L)	<0.0050	0.0064		
	Chloride (Cl) (mg/L)	0.90	<2.5	DLDS	
	Nitrate and Nitrite (as N) (mg/L)	22.9	20.4		
	Nitrate (as N) (mg/L)	22.9	20.3		
	Nitrite (as N) (mg/L)	0.0038	0.0089		
	Sulfate (SO4) (mg/L)	22.4	13.0		
	Anion Sum (meq/L)	4.47	12.2		
	Cation Sum (meq/L)	4.11	21.2		
	Cation - Anion Balance (%)	-4.2	26.9		
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD		
	Dissolved Metals Filtration Location	FIELD	FIELD		
	Aluminum (Al)-Dissolved (mg/L)	0.0077	0.0016		
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	0.00057		
	Arsenic (As)-Dissolved (mg/L)	0.00014	0.00035		
	Barium (Ba)-Dissolved (mg/L)	0.0319	1.11		
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020		
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050		
	Boron (B)-Dissolved (mg/L)	<0.010	0.029		
	Cadmium (Cd)-Dissolved (mg/L)	0.0000158	0.0000454		
	Calcium (Ca)-Dissolved (mg/L)	51.0	318		
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010		
	Cobalt (Co)-Dissolved (mg/L)	0.00070	0.00041		
	Copper (Cu)-Dissolved (mg/L)	0.00216	0.00346		
	Iron (Fe)-Dissolved (mg/L)	0.012	<0.010		
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050		
	Lithium (Li)-Dissolved (mg/L)	<0.0010	0.0219		
	Magnesium (Mg)-Dissolved (mg/L)	14.9	40.5		
	Manganese (Mn)-Dissolved (mg/L)	0.00301	0.00659		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2090244-1 Water 04-MAY-18 16:20 MW09-03-01	L2090244-2 Water 04-MAY-18 16:40 MW09-03-02	L2090244-3 Water 05-MAY-18 08:50 MW17-11-01	L2090244-4 Water 05-MAY-18 09:15 MW17-11-02	L2090244-5 Water 05-MAY-18 09:30 MW17-11-03
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00499	0.00625	0.0225	0.00657	0.00601
	Nickel (Ni)-Dissolved (mg/L)	0.00086	<0.00050	<0.00050	0.00099	0.00107
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	2.28	2.11	2.53	2.67	3.44
	Selenium (Se)-Dissolved (mg/L)	<0.000050	0.000481	0.000471	0.000126	0.000139
	Silicon (Si)-Dissolved (mg/L)	5.19	4.73	5.10	5.13	5.13
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	8.61	8.06	22.0	17.0	11.6
	Strontium (Sr)-Dissolved (mg/L)	1.01	0.303	0.894	0.999	1.01
	Sulfur (S)-Dissolved (mg/L)	5.49	2.51	12.1	11.2	6.52
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	0.00012	0.00012	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.000730	0.00158	0.000163	0.000436	0.00157
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0130	0.0329	0.0200	0.0178	0.0166
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2090244-6 Water 05-MAY-18 09:45 MW17-11-04	L2090244-7 Water 05-MAY-18 10:45 MW17-11-05	L2090244-8 Water 05-MAY-18 13:40 MW12-07-02	L2090244-9 Water 06-MAY-18 15:50 MW17-10-01	L2090244-10 Water 06-MAY-18 16:10 MW17-10-02
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00557	0.00688	0.0331	0.0258	0.00771
	Nickel (Ni)-Dissolved (mg/L)	0.00121	0.00561	<0.00050	0.0104	0.00336
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	3.16	21.9	2.92	1.70	1.71
	Selenium (Se)-Dissolved (mg/L)	0.000139	0.00121	0.000470	0.000817	0.00134
	Silicon (Si)-Dissolved (mg/L)	5.62	40.3	6.04	5.27	5.23
	Silver (Ag)-Dissolved (mg/L)	<0.000010	0.000063	<0.000010	0.000013	<0.000010
	Sodium (Na)-Dissolved (mg/L)	7.22	37.2	40.7	10.1	6.80
	Strontium (Sr)-Dissolved (mg/L)	0.875	2.14	4.22	1.17	0.897
	Sulfur (S)-Dissolved (mg/L)	6.93	9.48	115	18.2	7.53
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	0.000018	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	0.00087	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00195	0.0151	0.00274	0.00214	0.00110
	Vanadium (V)-Dissolved (mg/L)	<0.00050	0.00153	<0.00050	0.00088	0.00058
	Zinc (Zn)-Dissolved (mg/L)	0.0289	0.0665	0.0280	0.0290	0.0258
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2090244-11 Water 06-MAY-18 16:30 MW17-10-03	L2090244-12 Water 05-MAY-18 DUP			
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	0.0000057			
	Molybdenum (Mo)-Dissolved (mg/L)	0.00775	0.00627			
	Nickel (Ni)-Dissolved (mg/L)	0.00362	0.00531			
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050			
	Potassium (K)-Dissolved (mg/L)	1.75	20.5			
	Selenium (Se)-Dissolved (mg/L)	0.00148	0.00139			
	Silicon (Si)-Dissolved (mg/L)	5.22	39.9			
	Silver (Ag)-Dissolved (mg/L)	<0.000010	0.000054			
	Sodium (Na)-Dissolved (mg/L)	6.68	34.5			
	Strontium (Sr)-Dissolved (mg/L)	0.853	1.84			
	Sulfur (S)-Dissolved (mg/L)	6.99	9.87			
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	0.000017			
	Tin (Sn)-Dissolved (mg/L)	<0.00010	0.00077			
	Titanium (Ti)-Dissolved (mg/L)	0.00096	<0.00030			
	Uranium (U)-Dissolved (mg/L)	0.00106	0.0143			
	Vanadium (V)-Dissolved (mg/L)	0.00065	0.00141			
	Zinc (Zn)-Dissolved (mg/L)	0.0303	0.0834			
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Boron (B)-Dissolved	MS-B	L2090244-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2090244-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2090244-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2090244-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2090244-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Nitrate (as N)	MS-B	L2090244-10, -11, -12, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-CO3-CALC-WP	Water	Alkalinity, Carbonate (as CaCO ₃)	CALCULATION
The Alkalinity of water is a measure of its acid neutralizing capacity. Alkalinity is imparted by bicarbonate, carbonate and hydroxide components of water. The fraction of alkalinity contributed by carbonate is calculated and reported as mg/L CaCO ₃ .			
ALK-HCO3-CALC-WP	Water	Alkalinity, Bicarbonate (as CaCO ₃)	CALCULATION
The Alkalinity of water is a measure of its acid neutralizing capacity. Alkalinity is imparted by bicarbonate, carbonate and hydroxide components of water. The fraction of alkalinity contributed by bicarbonate is calculated and reported as mg/L CaCO ₃ .			
ALK-OH-CALC-WP	Water	Alkalinity, Hydroxide (as CaCO ₃)	CALCULATION
The Alkalinity of water is a measure of its acid neutralizing capacity. Alkalinity is imparted by bicarbonate, carbonate and hydroxide components of water. The fraction of alkalinity contributed by hydroxide is calculated and reported as mg/L CaCO ₃ .			
ALK-TITR-WP	Water	Alkalinity, Total (as CaCO ₃)	APHA 2320B
The Alkalinity of water is a measure of its acid neutralizing capacity. Alkalinity is imparted by bicarbonate, carbonate and hydroxide components of water. Total alkalinity is determined by titration with a strong standard mineral acid to the successive HCO ₃ ⁻ and H ₂ CO ₃ endpoints indicated electrometrically.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by CRC ICPMS.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
EC-WP	Water	Conductivity	APHA 2510B
Conductivity of an aqueous solution refers to its ability to carry an electric current. Conductance of a solution is measured between two spatially fixed and chemically inert electrodes.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 µm), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions)			

Reference Information

should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-WP Water pH APHA 4500H

The pH of a sample is the determination of the activity of the hydrogen ions by potentiometric measurement using a standard hydrogen electrode and a reference electrode.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WP	ALS ENVIRONMENTAL - WINNIPEG, MANITOBA, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-05-07 B

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lw - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

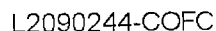
Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Canada Toll Free: 1 800 668 9878



COC Number: 2018-05-07 B

Page 1 of 1

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Report To			Contact and companyname below will appear on the final report			Report Format / Distribution						Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply																													
Company:			Minto Explorations Ltd.			Select Report Format: ☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)						Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply																													
Contact:			Minto Environment - Coordinator			Quality Control (QC) Report with Report ☒ YES ☐ NO						PRIORITY (Business days) 4 day [P4] ☐ 3 day [P3] ☐ 2 day [P2] ☐																													
Phone:			1-604-759-4659			☒ Compare Results to Criteria on Report - provide details below if box checked						EMERGENCY 1 Business day [E1] ☐ Same Day, Weekend or Statutory holiday [EO] ☐																													
Company address below will appear on the final report						Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX						Date and Time Required for all E&P TATs: For tests that can not be performed according to the service level selected, you will be contacted.																													
Street:			2100-510 West Georgia St.			Email 1 or Fax minto_environment@mintomine.com																																			
City/Province:			Vancouver, British Columbia			Email 2																																			
Postal Code:			V6B 0M3			Email 3																																			
Invoice To			Same as Report To ☐ YES ☒ NO			Invoice Distribution						Indicate Filtered (F), Preserved (P) or Filtered and Reserved (F/P) below																													
			Copy of Invoice with Report ☐ YES ☒ NO			Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX						P F/P P F/P P F/P																													
Company:			Minto Explorations Ltd.			Email 1 or Fax ap@mintomine.com																																			
Contact:			Ruth Cayetano			Email 2																																			
Project Information						Oil and Gas Required Fields (client use)																																			
ALS Account # / Quote #:						AFE/Cost Center:			PO#																																
Job #:						Major/Minor Code:			Routing Code:																																
PO / AFE: 229097 (GW)						Requisitioner:																																			
LSD:						Location:																																			
ALS Lab Work Order # (lab use only)						ALS Contact:			Sampler:			CR/CH/EB																													
ALS Sample # (lab use only)		Sample Identification and/or Coordinates (This description will appear on the report)				Date (dd-mm-yy)		Time (hh:mm)		Sample Type		Total Metals (TM)		Dissolved Metals (DM)		Total Mercury, Hardness		Dissolved Mercury		Ammonia (Total Nutrients)		Dissolved Organic Carbon (DOC)		pH, Cond., TSS, Alkalinity, Anions		Dissolved Bromide (Br-D)														Number of Containers	
	MW09-03-01					4-May-18		16:20		Water			R		R	R	R		R																			4			
	MW09-03-02					4-May-18		16:40		Water			R		R	R		R																				4			
	MW17-11-01					5-May-18		8:50		Water			R		R	R		R																				4			
	MW17-11-02					5-May-18		9:15		Water			R		R	R		R																				4			
	MW17-11-03					5-May-18		9:30		Water			R		R	R		R																				4			
	MW17-11-04					5-May-18		9:45		Water			R		R	R		R																				4			
	MW17-11-05					5-May-18		10:45		Water			R		R	R		R																				4			
	MW12-07-02					5-May-18		13:40		Water			R		R	R		R																				4			
	MW17-10-01					5-May-18		15:50		Water			R		R	R		R																				4			
	MW17-10-02					5-May-18		16:10		Water			R		R	R		R																				4			
	MW17-10-03					5-May-18		16:30		Water			R		R	R		R																				4			
	DUP					5-May-18				Water			R		R	R		R																				4			
Drinking Water (DW) Samples ¹ (client use)			Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)									SAMPLE CONDITION AS RECEIVED (lab use only)																													
Are samples taken from a Regulated DW System? ☐ YES ☒ NO												Frozen ☐ SIF Observations Yes ☐ No ☐																													
Are samples for human drinking water use? ☐ YES ☒ NO												Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐																													
												Cooling Initiated ☐																													
												INITIAL COOLER TEMPERATURES °C 5°C 6°C																													
												FINAL COOLER TEMPERATURES °C 11																													
SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)									FINAL SHIPMENT RECEPTION (lab use only)																													
Released by: Corey Roberts			Date: 2018-05-07			Time:			Received by:			Date: MAY 7 / 18																													

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

OCTOBER 2015 FRONT



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 08-MAY-18
Report Date: 18-MAY-18 17:44 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2091096
Project P.O. #: 229097
Job Reference:
C of C Numbers: 2018-05-08 B
Legal Site Desc:

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2091096-1 Water 07-MAY-18 15:20 MW17-08-01	L2091096-2 Water 07-MAY-18 15:40 MW17-08-02	L2091096-3 Water 07-MAY-18 16:15 MW17-08-03	L2091096-4 Water 07-MAY-18 DUP	
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	470	308	269	306	
	Hardness (as CaCO3) (mg/L)	258	162	143	168	
	pH (pH)	8.47	8.38	8.37	8.42	
	Total Suspended Solids (mg/L)	<3.0	<3.0	4.3	3.1	
	TDS (Calculated) (mg/L)	269	168	148	173	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	214	150	138	153	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	11.4	4.8	4.2	6.4	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Total (as CaCO3) (mg/L)	226	155	142	159	
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	Chloride (Cl) (mg/L)	<0.50	<0.50	<0.50	<0.50	
	Nitrate and Nitrite (as N) (mg/L)	0.389	0.705	0.807	0.710	
	Nitrate (as N) (mg/L)	0.387	0.703	0.804	0.710	
	Nitrite (as N) (mg/L)	0.0025	0.0023	0.0028	<0.0010	
	Sulfate (SO4) (mg/L)	39.1	11.9	5.15	12.0	
	Anion Sum (meq/L)	5.35	3.39	3.00	3.48	
	Cation Sum (meq/L)	5.51	3.47	3.04	3.59	
	Cation - Anion Balance (%)	1.4	1.2	0.7	1.6	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0028	0.0022	0.0034	0.0022	
	Antimony (Sb)-Dissolved (mg/L)	0.00023	<0.00020 ^{DLAI}	<0.00010	0.00013	
	Arsenic (As)-Dissolved (mg/L)	0.00013	0.00022	0.00016	0.00019	
	Barium (Ba)-Dissolved (mg/L)	0.00880	0.0888	0.0796	0.0908	
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	0.023	0.014	<0.010	0.014	
	Cadmium (Cd)-Dissolved (mg/L)	0.0000570	0.0000293	0.0000175	0.0000314	
	Calcium (Ca)-Dissolved (mg/L)	53.8	38.4	37.5	39.9	
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Copper (Cu)-Dissolved (mg/L)	0.00049	0.00227	0.00044	0.00235	
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.0021	<0.0010	<0.0010	<0.0010	
	Magnesium (Mg)-Dissolved (mg/L)	30.0	16.0	11.9	16.5	
	Manganese (Mn)-Dissolved (mg/L)	0.00261	0.00168	0.00062	0.00183	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2091096-1 Water 07-MAY-18 15:20 MW17-08-01	L2091096-2 Water 07-MAY-18 15:40 MW17-08-02	L2091096-3 Water 07-MAY-18 16:15 MW17-08-03	L2091096-4 Water 07-MAY-18 DUP	
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Dissolved (mg/L)	0.00868	0.00312	0.000972	0.00321	
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Potassium (K)-Dissolved (mg/L)	1.58	0.94	0.99	0.98	
	Selenium (Se)-Dissolved (mg/L)	0.000510	0.000638	0.000344	0.000606	
	Silicon (Si)-Dissolved (mg/L)	4.81	4.48	4.25	4.54	
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Sodium (Na)-Dissolved (mg/L)	7.22	4.84	3.78	5.03	
	Strontium (Sr)-Dissolved (mg/L)	7.06	1.08	0.701	1.13	
	Sulfur (S)-Dissolved (mg/L)	11.3	3.38	1.34	3.26	
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Tin (Sn)-Dissolved (mg/L)	<0.00010	0.00035	<0.00010	0.00037	
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	
	Uranium (U)-Dissolved (mg/L)	0.000258	0.000161	0.000139	0.000174	
	Vanadium (V)-Dissolved (mg/L)	<0.00050	0.00071	0.00056	0.00072	
	Zinc (Zn)-Dissolved (mg/L)	0.0539	0.0178	0.0143	0.0212	
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2091096-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2091096-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2091096-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2091096-1, -2, -3, -4

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLAI	Detection limit raised due to low level analytical interference or background.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)

Reference Information

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
----------------------------	---------------------

VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
----	---

Chain of Custody Numbers:

2018-05-08 B

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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Page 1 of 1

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1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 10-MAY-18
Report Date: 24-MAY-18 16:03 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2092686
Project P.O. #: 229097
Job Reference:
C of C Numbers: 2018-05-10 B
Legal Site Desc:

Shane Stack
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

24-MAY-18 16:03 (MT)

Version: FINAL

Sample ID Description Sampled Date Sampled Time Client ID		L2092686-1 Water 09-MAY-18 10:15 MW12-06-01	L2092686-2 Water 09-MAY-18 10:50 MW12-06-02	L2092686-3 Water 09-MAY-18 11:10 MW12-06-03	L2092686-4 Water 09-MAY-18 11:25 MW12-06-04	L2092686-5 Water 09-MAY-18 11:55 MW12-06-05
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	720	958	981	961	968
	Hardness (as CaCO3) (mg/L)	284	464	488	480	500
	pH (pH)	8.28	8.23	8.34	8.37	8.37
	Total Suspended Solids (mg/L)	3.7	30.1	<3.0	3.5	<3.0
	TDS (Calculated) (mg/L)	405	630	636	620	622
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	398	351	365	387	386
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	8.8	12.2	11.4
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	398	351	374	399	397
	Ammonia, Total (as N) (mg/L)	0.128	0.0478	0.0511	0.0069	0.0089
	Chloride (Cl) (mg/L)	4.95	<2.5 ^{DLDS}	<2.5 ^{DLDS}	<2.5 ^{DLDS}	<2.5 ^{DLDS}
	Nitrate and Nitrite (as N) (mg/L)	0.138	0.081	0.069	0.135	0.057
	Nitrate (as N) (mg/L)	0.031	<0.025 ^{DLDS}	<0.025 ^{DLDS}	0.028	<0.025 ^{DLDS}
	Nitrite (as N) (mg/L)	0.108	0.0811	0.0692	0.107	0.0568
	Sulfate (SO4) (mg/L)	0.42	213	210	186	182
	Anion Sum (meq/L)	8.11	11.5	11.9	11.9	11.7
	Cation Sum (meq/L)	8.15	11.0	11.4	11.2	11.6
	Cation - Anion Balance (%)	0.2	-1.9	-1.9	-3.0	-0.4
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0181	<0.0010	<0.0010	<0.0010	0.0015
	Antimony (Sb)-Dissolved (mg/L)	0.00030	0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00950	0.00389	0.00077	0.00246	0.00100
	Barium (Ba)-Dissolved (mg/L)	0.193	0.0278	0.0241	0.0171	0.0418
	Beryllium (Be)-Dissolved (mg/L)	0.000128	0.000041	0.000031	0.000031	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.249	0.135	0.092	0.087	0.093
	Cadmium (Cd)-Dissolved (mg/L)	0.0000065	<0.0000050	<0.0000050	<0.0000050	0.0000071
	Calcium (Ca)-Dissolved (mg/L)	84.7	130	110	102	103
	Chromium (Cr)-Dissolved (mg/L)	0.00362	<0.00010	0.00017	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	0.00114
	Copper (Cu)-Dissolved (mg/L)	0.00077	0.00023	0.00031	<0.00020	<0.00020
	Iron (Fe)-Dissolved (mg/L)	0.323	1.11	1.27	0.764	0.140
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	0.000058	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0102	0.0083	0.0075	0.0061	0.0061
	Magnesium (Mg)-Dissolved (mg/L)	17.7	34.2	52.0	54.6	58.6
	Manganese (Mn)-Dissolved (mg/L)	0.0819	0.0259	0.0156	0.0424	0.373

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2092686-6 Water 09-MAY-18 12:10 MW12-06-06	L2092686-7 Water 09-MAY-18 DUP			
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	834	973			
	Hardness (as CaCO3) (mg/L)	391	489			
	pH (pH)	8.39	8.35			
	Total Suspended Solids (mg/L)	<3.0	4.1			
	TDS (Calculated) (mg/L)	516	626			
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	309	392			
	Alkalinity, Carbonate (as CaCO3) (mg/L)	12.4	10.0			
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0			
	Alkalinity, Total (as CaCO3) (mg/L)	322	402			
	Ammonia, Total (as N) (mg/L)	<0.0050	0.0121			
	Chloride (Cl) (mg/L)	6.9	<2.5		DLDS	
	Nitrate and Nitrite (as N) (mg/L)	1.03	0.101			
	Nitrate (as N) (mg/L)	0.959	<0.025		DLDS	
	Nitrite (as N) (mg/L)	0.0755	0.101			
	Sulfate (SO4) (mg/L)	153	186			
	Anion Sum (meq/L)	9.88	11.9			
	Cation Sum (meq/L)	9.17	11.4			
	Cation - Anion Balance (%)	-3.7	-2.3			
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD			
	Dissolved Metals Filtration Location	FIELD	FIELD			
	Aluminum (Al)-Dissolved (mg/L)	<0.0010	<0.0010			
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010			
	Arsenic (As)-Dissolved (mg/L)	0.00026	0.00239			
	Barium (Ba)-Dissolved (mg/L)	0.0135	0.0174			
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	0.000023			
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050			
	Boron (B)-Dissolved (mg/L)	0.085	0.096			
	Cadmium (Cd)-Dissolved (mg/L)	0.0000092	0.0000061			
	Calcium (Ca)-Dissolved (mg/L)	77.5	104			
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010			
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010			
	Copper (Cu)-Dissolved (mg/L)	<0.00020	<0.00020			
	Iron (Fe)-Dissolved (mg/L)	<0.010	0.768			
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050			
	Lithium (Li)-Dissolved (mg/L)	0.0048	0.0063			
	Magnesium (Mg)-Dissolved (mg/L)	47.9	55.9			
	Manganese (Mn)-Dissolved (mg/L)	0.0340	0.0429			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2092686-1 Water 09-MAY-18 10:15 MW12-06-01	L2092686-2 Water 09-MAY-18 10:50 MW12-06-02	L2092686-3 Water 09-MAY-18 11:10 MW12-06-03	L2092686-4 Water 09-MAY-18 11:25 MW12-06-04	L2092686-5 Water 09-MAY-18 11:55 MW12-06-05
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00146	0.00838	0.00322	0.00842	0.00948
	Nickel (Ni)-Dissolved (mg/L)	0.00080	<0.00050	<0.00050	<0.00050	0.00056
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	2.51	3.44	3.82	3.60	3.80
	Selenium (Se)-Dissolved (mg/L)	0.000262	0.000182	0.000132	0.000122	0.000065
	Silicon (Si)-Dissolved (mg/L)	7.88	10.3	9.49	8.66	8.72
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	54.6	37.0	34.7	33.2	35.0
	Strontium (Sr)-Dissolved (mg/L)	3.45	9.48	4.47	2.92	2.71
	Sulfur (S)-Dissolved (mg/L)	0.85	75.5	73.5	64.7	64.7
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	0.00017	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00300	<0.00030	<0.00030	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.000723	0.00248	0.00251	0.00572	0.00603
	Vanadium (V)-Dissolved (mg/L)	0.0145	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0037	0.0072	0.0057	0.0176	0.0326
	Zirconium (Zr)-Dissolved (mg/L)	0.00118	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2092686-6 Water 09-MAY-18 12:10 MW12-06-06	L2092686-7 Water 09-MAY-18 DUP			
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050			
	Molybdenum (Mo)-Dissolved (mg/L)	0.00570	0.00852			
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050			
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050			
	Potassium (K)-Dissolved (mg/L)	3.25	3.60			
	Selenium (Se)-Dissolved (mg/L)	0.000331	0.000137			
	Silicon (Si)-Dissolved (mg/L)	6.92	8.86			
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010			
	Sodium (Na)-Dissolved (mg/L)	29.4	33.7			
	Strontium (Sr)-Dissolved (mg/L)	1.49	2.98			
	Sulfur (S)-Dissolved (mg/L)	53.7	62.3			
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010			
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010			
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030			
	Uranium (U)-Dissolved (mg/L)	0.00402	0.00579			
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050			
	Zinc (Zn)-Dissolved (mg/L)	0.0340	0.0210			
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Alkalinity, Total (as CaCO ₃)	B	L2092686-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2092686-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Boron (B)-Dissolved	MS-B	L2092686-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2092686-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2092686-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2092686-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2092686-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2092686-1, -2, -3, -4, -5, -6, -7

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

Reference Information

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)
 Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)
 Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value
 This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode
 It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)
 Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)
 This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
 The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC
 This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-05-10 B

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Report To			Report Format / Distribution													
Company: Minto Explorations Ltd.			Select Report Format: ☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)													
Contact: Minto Environment - Coordinator			Quality Control (QC) Report with Report ☒ YES ☐ NO													
Phone: 1-604-759-4659			☒ Compare Results to Criteria on Report - provide details below if box checked													
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City/Province: Vancouver, British Columbia			Email 2													
Postal Code: V6B 0M3			Email 3													
Invoice To Same as Report To ☐ YES ☒ NO			Invoice Distribution													
Copy of Invoice with Report ☐ YES ☒ NO			Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX													
Company: Minto Explorations Ltd.			Email 1 or Fax ap@mintomine.com													
Contact: Ruth Cayetano			Email 2													
Project Information			Oil and Gas Required Fields (client use)													
ALS Account # / Quote #:			AFE/Cost Center:		PO#											
Job #:			Major/Minor Code:		Routing Code:											
PO / AFE: 229097 (GW)			Requisitioner:													
LSD:			Location:													
ALS Lab Work Order # (lab use only)			ALS Contact:		Sampler:		CR/EB									
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)		Date (dd-mm-yy)	Time (hh:mm)	Sample Type		Total Metals(TM)	Disolved Metals (DM)	Total Mercury, Hardness	Disolved Mercury	Ammonia (Total Nutrients)	Disolved Organic Carbon (DOC)	pH, Cond., TSS, TDS, Alkalinity, Anions	Disolved Bromide (Br-D)	Number of Containers	
MW12-06-01			9-May-18	10:15	Water		R	R	R	R	R	R	R	R	4	
MW12-06-02			9-May-18	10:50	Water		R	R	R	R	R	R	R	R	4	
MW12-06-03			9-May-18	11:10	Water		R	R	R	R	R	R	R	R	4	
MW12-06-04			9-May-18	11:25	Water		R	R	R	R	R	R	R	R	4	
MW12-06-05			9-May-18	11:55	Water		R	R	R	R	R	R	R	R	4	
MW12-06-06			9-May-18	12:10	Water		R	R	R	R	R	R	R	R	4	
Dup			9-may-18		Water		R	R	R	R	R	R	R	R	4	
Drinking Water (DW) Samples ¹ (client use)			Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)						SAMPLE CONDITION AS RECEIVED (lab-use only)							
Are samples taken from a Regulated DW System? ☐ YES ☒ NO									Frozen ☐ SIF Observations Yes ☐ No ☐							
Are samples for human drinking water use? ☐ YES ☒ NO									Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐							
									Cooling Initiated ☐							
INITIAL SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)						FINAL SHIPMENT RECEPTION (lab use only)							
Released by: Corey Roberts		Date: 2018-05-10	Time:	Received by: [Signature]		Date: May 10/18	Time: 4:00	Received by: HA		Date: 5/11	Time: 1pm					

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FROM

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 14-MAY-18
Report Date: 25-MAY-18 18:09 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2094078

Project P.O. #: 229097

Job Reference:

C of C Numbers: 2018-05-14 A 1 of 2, 2018-05-14 A 2 of 2

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Shane Stack
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2094078-1 Water 10-MAY-18 10:40 MW12-05-01	L2094078-2 Water 10-MAY-18 11:10 MW12-05-02	L2094078-3 Water 10-MAY-18 11:30 MW12-05-03	L2094078-4 Water 10-MAY-18 11:50 MW12-05-04	L2094078-5 Water 10-MAY-18 13:50 MW12-05-05
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	2130	2050	1590	500	491
	Hardness (as CaCO3) (mg/L)	1010	1060	882	260	259
	pH (pH)	8.13	8.28	8.29	8.41	8.37
	Total Suspended Solids (mg/L)	7.6	8.4	5.2	<3.0	3.8
	TDS (Calculated) (mg/L)	1840	1800	1300	296	295
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	124	178	249	234	219
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	2.0	10.2	8.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	124	178	251	244	227
	Ammonia, Total (as N) (mg/L)	0.0215	0.0203	0.0145	0.0095	0.0069
	Chloride (Cl) (mg/L)	13	13	8.3	4.98	5.02
	Nitrate and Nitrite (as N) (mg/L)	<0.10	<0.10	<0.051	<0.0051	0.0876
	Nitrate (as N) (mg/L)	<0.10 ^{DLDS}	<0.10 ^{DLDS}	<0.050 ^{DLDS}	<0.0050	0.0825
	Nitrite (as N) (mg/L)	<0.020 ^{DLDS}	<0.020 ^{DLDS}	0.032	<0.0010	0.0051
	Sulfate (SO4) (mg/L)	1200	1140	730	37.4	49.0
	Anion Sum (meq/L)	27.9	27.6	20.4	5.80	5.70
	Cation Sum (meq/L)	27.5	27.8	22.6	6.19	6.01
	Cation - Anion Balance (%)	-0.7	0.3	5.1	3.2	2.6
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0055	0.0042	0.0039	0.0030	0.0025
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	0.00043	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00067	0.00057	0.00028	0.00017	0.00015
	Barium (Ba)-Dissolved (mg/L)	0.0357	0.0787	0.0446	0.0622	0.0735
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.069	0.086	0.064	0.034	0.029
	Cadmium (Cd)-Dissolved (mg/L)	0.0000076	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	334	328	216	51.6	52.9
	Chromium (Cr)-Dissolved (mg/L)	0.00014	0.00019	0.00026	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	0.00099
	Iron (Fe)-Dissolved (mg/L)	0.036	0.074	0.434	0.148	0.018
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0077	0.0052	0.0042	0.0036	0.0039
	Magnesium (Mg)-Dissolved (mg/L)	41.9	59.2	83.3	31.9	30.9
	Manganese (Mn)-Dissolved (mg/L)	0.151	0.854	2.34	0.394	0.144

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2094078-6 Water 10-MAY-18 14:05 MW12-05-06	L2094078-7 Water 10-MAY-18 14:25 MW12-05-07	L2094078-8 Water 11-MAY-18 09:05 MW-17-12-01	L2094078-9 Water 11-MAY-18 09:25 MW-17-12-02	L2094078-10 Water 11-MAY-18 09:50 MW-17-12-03
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	492	535	2490	2190	856
	Hardness (as CaCO3) (mg/L)	264	282	1070	836	392
	pH (pH)	8.35	8.44	8.11	8.19	8.34
	Total Suspended Solids (mg/L)	<3.0	7.4	7.9	7.5	<3.0
	TDS (Calculated) (mg/L)	298	321	2160	1810	559
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	220	241	211	235	342
	Alkalinity, Carbonate (as CaCO3) (mg/L)	6.2	13.0	<1.0	<1.0	9.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	227	254	211	235	351
	Ammonia, Total (as N) (mg/L)	<0.0050	0.154	<0.0050	<0.0050	<0.0050
	Chloride (Cl) (mg/L)	4.98	5.33	13	12	<2.5
	Nitrate and Nitrite (as N) (mg/L)	0.109	0.0209	<0.10	<0.10	<0.025
	Nitrate (as N) (mg/L)	0.0879	0.0105	<0.10	<0.10	<0.025
	Nitrite (as N) (mg/L)	0.0213	0.0104	0.044	<0.020	<0.0050
	Sulfate (SO4) (mg/L)	50.2	47.6	1340	1100	142
	Anion Sum (meq/L)	5.72	6.21	32.5	27.9	9.96
	Cation Sum (meq/L)	6.13	6.63	33.8	27.9	11.1
	Cation - Anion Balance (%)	3.4	3.3	1.9	0.1	5.5
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0029	0.0024	0.0031	0.0027	0.0027
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00020	<0.00020	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00020	0.00115	0.00250	0.00208	0.00107
	Barium (Ba)-Dissolved (mg/L)	0.0679	1.01	0.0119	0.0119	0.0176
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	0.000085	0.000042	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.00010	<0.00010	<0.000050
	Boron (B)-Dissolved (mg/L)	0.038	0.031	0.171	0.152	0.053
	Cadmium (Cd)-Dissolved (mg/L)	0.0000077	<0.0000050	<0.000010	<0.000010	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	54.6	59.7	330	254	88.5
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00014	<0.00020	<0.00020	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	0.00012	<0.00010	<0.00020	<0.00020	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00129	0.00025	<0.00040	<0.00040	<0.00020
	Iron (Fe)-Dissolved (mg/L)	0.012	1.70	2.98	2.16	0.097
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.00010	<0.00010	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0040	0.0038	0.0167	0.0164	0.0095
	Magnesium (Mg)-Dissolved (mg/L)	31.1	32.4	61.1	48.9	41.5
	Manganese (Mn)-Dissolved (mg/L)	0.0947	0.497	0.108	0.0623	0.132

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2094078-11 Water 11-MAY-18 10:10 MW-17-12-04	L2094078-12 Water 11-MAY-18 10:30 MW-17-12-05	L2094078-13 Water 11-MAY-18 10:45 MW-17-12-06	L2094078-14 Water 11-MAY-18 11:10 MW-17-12-07	L2094078-15 Water 11-MAY-18 11:30 MW-17-12-08
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	716	750	742	568	565
	Hardness (as CaCO3) (mg/L)	370	411	391	299	292
	pH (pH)	8.46	8.48	8.48	8.42	8.44
	Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0	<3.0	3.1
	TDS (Calculated) (mg/L)	450	466	466	343	344
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	311	331	334	246	247
	Alkalinity, Carbonate (as CaCO3) (mg/L)	18.6	21.2	21.4	11.8	13.4
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	330	352	356	257	261
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Chloride (Cl) (mg/L)	<2.5 ^{DLDS}	<2.5 ^{DLDS}	<2.5 ^{DLDS}	4.20	4.14
	Nitrate and Nitrite (as N) (mg/L)	0.285	0.285	0.086	0.864	0.863
	Nitrate (as N) (mg/L)	0.285	0.285	0.071	0.862	0.862
	Nitrite (as N) (mg/L)	<0.0050 ^{DLDS}	<0.0050 ^{DLDS}	0.0152	0.0012	0.0013
	Sulfate (SO4) (mg/L)	97.8	87.6	92.1	62.4	62.2
	Anion Sum (meq/L)	8.65	8.88	9.03	6.62	6.68
	Cation Sum (meq/L)	9.01	9.78	9.40	7.04	6.92
	Cation - Anion Balance (%)	2.1	4.8	2.0	3.0	1.8
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0035	0.0068	0.0036	0.0040	0.0024
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00021	<0.00010	<0.00010	0.00014	0.00013
	Barium (Ba)-Dissolved (mg/L)	0.0287	0.0559	0.0789	0.0252	0.0250
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.035	0.032	0.033	0.024	0.025
	Cadmium (Cd)-Dissolved (mg/L)	0.0000052	0.0000191	<0.000025 ^{DLM}	<0.0000050	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	62.8	71.4	68.1	51.6	50.4
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00016	0.00043	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00189	0.00189	0.00141	0.00083	0.00082
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0075	0.0087	0.0105	0.0064	0.0065
	Magnesium (Mg)-Dissolved (mg/L)	51.7	56.6	53.6	41.2	40.3
	Manganese (Mn)-Dissolved (mg/L)	0.00270	0.106	0.332	0.00205	0.00160

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2094078-16 Water 11-MAY-18 DUP				
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	752				
	Hardness (as CaCO3) (mg/L)	402				
	pH (pH)	8.52				
	Total Suspended Solids (mg/L)	3.3				
	TDS (Calculated) (mg/L)	477				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	332				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	24.6				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Total (as CaCO3) (mg/L)	356				
	Ammonia, Total (as N) (mg/L)	<0.0050				
	Chloride (Cl) (mg/L)	2.5				
	Nitrate and Nitrite (as N) (mg/L)	0.113				
	Nitrate (as N) (mg/L)	0.100				
	Nitrite (as N) (mg/L)	0.0124				
	Sulfate (SO4) (mg/L)	95.4				
	Anion Sum (meq/L)	9.18				
	Cation Sum (meq/L)	9.66				
	Cation - Anion Balance (%)	2.5				
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD				
	Dissolved Metals Filtration Location	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	0.0058				
	Antimony (Sb)-Dissolved (mg/L)	<0.00010				
	Arsenic (As)-Dissolved (mg/L)	<0.00010				
	Barium (Ba)-Dissolved (mg/L)	0.0787				
	Beryllium (Be)-Dissolved (mg/L)	<0.000020				
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050				
	Boron (B)-Dissolved (mg/L)	0.032				
	Cadmium (Cd)-Dissolved (mg/L)	<0.000025 ^{DLM}				
	Calcium (Ca)-Dissolved (mg/L)	69.6				
	Chromium (Cr)-Dissolved (mg/L)	<0.00010				
	Cobalt (Co)-Dissolved (mg/L)	0.00039				
	Copper (Cu)-Dissolved (mg/L)	0.00238				
	Iron (Fe)-Dissolved (mg/L)	<0.010				
	Lead (Pb)-Dissolved (mg/L)	<0.000050				
	Lithium (Li)-Dissolved (mg/L)	0.0103				
	Magnesium (Mg)-Dissolved (mg/L)	55.5				
	Manganese (Mn)-Dissolved (mg/L)	0.318				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2094078-1 Water 10-MAY-18 10:40 MW12-05-01	L2094078-2 Water 10-MAY-18 11:10 MW12-05-02	L2094078-3 Water 10-MAY-18 11:30 MW12-05-03	L2094078-4 Water 10-MAY-18 11:50 MW12-05-04	L2094078-5 Water 10-MAY-18 13:50 MW12-05-05
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.000159	0.000264	0.000177	0.00418	0.00409
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	3.78	4.13	4.26	2.30	2.27
	Selenium (Se)-Dissolved (mg/L)	0.00139	0.00028	0.000273	0.000687	0.000145
	Silicon (Si)-Dissolved (mg/L)	7.19	6.87	7.92	6.42	6.26
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	168	147	110	20.8	17.7
	Strontium (Sr)-Dissolved (mg/L)	9.51	11.9	7.58	0.958	0.838
	Sulfur (S)-Dissolved (mg/L)	426	419	267	14.4	16.1
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.000864	0.000611	0.00168	0.00224	0.00320
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	0.00051
	Zinc (Zn)-Dissolved (mg/L)	0.0025	0.0011	0.0012	0.0011	0.0033
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2094078-6 Water 10-MAY-18 14:05 MW12-05-06	L2094078-7 Water 10-MAY-18 14:25 MW12-05-07	L2094078-8 Water 11-MAY-18 09:05 MW-17-12-01	L2094078-9 Water 11-MAY-18 09:25 MW-17-12-02	L2094078-10 Water 11-MAY-18 09:50 MW-17-12-03
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00427	0.00259	0.00839	0.00827	0.00592
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.0010 ^{DLA}	<0.0010 ^{DLA}	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	0.059	<0.10 ^{DLA}	<0.10 ^{DLA}	<0.050
	Potassium (K)-Dissolved (mg/L)	2.27	2.33	3.74	3.52	3.35
	Selenium (Se)-Dissolved (mg/L)	0.000103	0.000135	<0.00010 ^{DLA}	<0.00010 ^{DLA}	<0.000050
	Silicon (Si)-Dissolved (mg/L)	6.20	7.30	8.04	8.18	8.30
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000020 ^{DLA}	<0.000020 ^{DLA}	<0.000010
	Sodium (Na)-Dissolved (mg/L)	18.0	18.7	277	253	73.7
	Strontium (Sr)-Dissolved (mg/L)	0.844	0.838	10.5	10.4	3.79
	Sulfur (S)-Dissolved (mg/L)	16.8	16.6	511	411	48.4
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000020 ^{DLA}	<0.000020 ^{DLA}	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00020 ^{DLA}	<0.00020 ^{DLA}	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	0.00031	<0.00060 ^{DLA}	<0.00060 ^{DLA}	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00343	0.00294	0.000296 ^{DLA}	0.000579 ^{DLA}	0.00481
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.0010 ^{DLA}	<0.0010 ^{DLA}	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0108	0.0033	0.0164	0.0127	0.0103
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2094078-11 Water 11-MAY-18 10:10 MW-17-12-04	L2094078-12 Water 11-MAY-18 10:30 MW-17-12-05	L2094078-13 Water 11-MAY-18 10:45 MW-17-12-06	L2094078-14 Water 11-MAY-18 11:10 MW-17-12-07	L2094078-15 Water 11-MAY-18 11:30 MW-17-12-08
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00616	0.0131	0.0298	0.00695	0.00879
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	0.00225	0.00447	<0.00050	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	3.48	4.53	5.19	2.97	2.97
	Selenium (Se)-Dissolved (mg/L)	0.000650	0.000363	0.000300	0.000233	0.000243
	Silicon (Si)-Dissolved (mg/L)	7.33	7.17	7.16	6.76	7.14
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	35.4	33.2	33.2	22.8	23.4
	Strontium (Sr)-Dissolved (mg/L)	1.42	1.65	1.66	1.04	0.999
	Sulfur (S)-Dissolved (mg/L)	35.3	31.5	33.8	21.6	22.9
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00398	0.00455	0.00380	0.00287	0.00273
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	0.00072	0.00077
	Zinc (Zn)-Dissolved (mg/L)	0.0105	0.0130	0.0110	0.0126	0.0121
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2094078-16 Water 11-MAY-18 DUP				
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050				
	Molybdenum (Mo)-Dissolved (mg/L)	0.0279				
	Nickel (Ni)-Dissolved (mg/L)	0.00438				
	Phosphorus (P)-Dissolved (mg/L)	<0.050				
	Potassium (K)-Dissolved (mg/L)	5.20				
	Selenium (Se)-Dissolved (mg/L)	0.000235				
	Silicon (Si)-Dissolved (mg/L)	7.08				
	Silver (Ag)-Dissolved (mg/L)	<0.000010				
	Sodium (Na)-Dissolved (mg/L)	33.9				
	Strontium (Sr)-Dissolved (mg/L)	1.69				
	Sulfur (S)-Dissolved (mg/L)	32.4				
	Thallium (Tl)-Dissolved (mg/L)	<0.000010				
	Tin (Sn)-Dissolved (mg/L)	<0.00010				
	Titanium (Ti)-Dissolved (mg/L)	0.00036				
	Uranium (U)-Dissolved (mg/L)	0.00404				
	Vanadium (V)-Dissolved (mg/L)	<0.00050				
	Zinc (Zn)-Dissolved (mg/L)	0.0099				
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2094078-1, -10, -11, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2094078-1, -10, -11, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2094078-1, -10, -11, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2094078-1, -10, -11, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2094078-1, -10, -11, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2094078-1, -10, -11, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2094078-1, -10, -11, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Reference Information

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
SO4-IC-N-VA	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)
This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".			
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.			
TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.			
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-05-14 A 1 of 2 2018-05-14 A 2 of 2

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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1 2094078-COFC

Number: 2018-05-14 A

Page 1 of 2

Report To		Report Format / Distribution			Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply																
Company: Minto Explorations Ltd.		Select Report Format: ☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)			Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply																
Contact: Minto Environment - Coordinator		Quality Control (QC) Report with Report ☒ YES ☐ NO			1 Business day [E1] ☐																
Phone: 1-604-759-4659		☒ Compare Results to Criteria on Report - provide details below if box checked			Same Day, Weekend or Statutory holiday [E0] ☐																
Company address below will appear on the final report		Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX			Date and Time Required for all E&P TATs: dd-mm-yy hh:mm																
Street: 2100-510 West Georgia St.		Email 1 or Fax minto_environment@mintomine.com			For tests that can not be performed according to the service level selected, you will be contacted.																
City/Province: Vancouver, British Columbia		Email 2			Analysis Request																
Postal Code: V6B 0M3		Email 3			Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below																
Invoice To: Same as Report To ☐ YES ☒ NO		Invoice Distribution			Number of Containers																
Copy of Invoice with Report ☐ YES ☒ NO		Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX																			
Company: Minto Explorations Ltd.		Email 1 or Fax ap@mintomine.com																			
Contact: Ruth Cayetano		Email 2																			
Project Information		Oil and Gas Required Fields (client use)																			
ALS Account # / Quote #:		AFE/Cost Center:																			
Job #:		Major/Minor Code:																			
PO / AFE: 229097 (GW)		Requisitioner:																			
LSD:		Location:																			
ALS Lab Work Order # (lab use only)		ALS Contact:			Sampler:			CR/CP/EB													
ALS Sample # (lab use only)		Sample Identification and/or Coordinates (This description will appear on the report)		Date (dd-mm-yy)	Time (hh:mm)	Sample Type	Total Metals (TM)	Dissolved Metals (DM)	Total Mercury, Hardness	Dissolved Mercury	Ammonia (Total Nutrients)	Dissolved Organic Carbon (DOC)	pH, Cond., TSS, TDS, Alkalinity, Antions	Dissolved Bromide (Br-D)							
MW12-05-01				10-May-18	10:40	Water	R	R	R	R	R	R	R	R	4						
MW12-05-02				10-May-18	11:10	Water	R	R	R	R	R	R	R	R	4						
MW12-05-03				10-May-18	11:30	Water	R	R	R	R	R	R	R	R	4						
MW12-05-04				10-May-18	11:50	Water	R	R	R	R	R	R	R	R	4						
MW12-05-05				10-May-18	13:50	Water	R	R	R	R	R	R	R	R	4						
MW12-05-06				10-May-18	14:05	Water	R	R	R	R	R	R	R	R	4						
MW12-05-07				10-May-18	14:25	Water	R	R	R	R	R	R	R	R	4						
MW-17-12-01				11-May-18	9:05	Water	R	R	R	R	R	R	R	R	4						
MW-17-12-02				11-May-18	9:25	Water	R	R	R	R	R	R	R	R	4						
MW-17-12-03				11-May-18	9:50	Water	R	R	R	R	R	R	R	R	4						
MW-17-12-04				11-May-18	10:10	Water	R	R	R	R	R	R	R	R	4						
MW-17-12-05				11-May-18	10:30	Water	R	R	R	R	R	R	R	R	4						
Drinking Water (DW) Samples ¹ (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)					SAMPLE CONDITION AS RECEIVED (lab use only)														
Are samples taken from a Regulated DW System? ☐ YES ☒ NO							Frozen ☐ SIF Observations Yes ☐ No ☐														
Are samples for human drinking water use? ☐ YES ☒ NO							Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐														
							Cooling Initiated ☒														
							INITIAL COOLER TEMPERATURES °C 7.0 FINAL COOLER TEMPERATURES °C 12														
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)					FINAL SHIPMENT RECEPTION (lab use only)														
Released by: Corey Roberts		Date: 2018-05-14		Time:	Received by: TEF		Date: 14 May, 2018		Time: 11:00	Received by: HA		Date: 5/15		Time: 4pm							

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form I-EGRI-Y. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

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OCTOBER 2015 FROM



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Report To		Contact and company name below will appear on the final report			
Company:		Minto Explorations Ltd.			
Contact:		Minto Environment - Coordinator			
Phone:		1-604-759-4659			
		Company address below will appear on the final report			
Street:		2100-510 West Georgia St.			
City/Province:		Vancouver, British Columbia			
Postal Code:		V6B 0M3			
Invoice To		Same as Report To ☐ YES ☒ NO		Invoice Distribution	
		Copy of Invoice with Report ☐ YES ☒ NO		Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX	
Company:		Minto Explorations Ltd.		Email 1 or Fax ap@mintomine.com	
Contact:		Ruth Cayetano		Email 2	
				Email 3	
Project Information		Oil and Gas Required Fields (client use)			
ALS Account # / Quote #:		AFE/Cost Center:		PO#	
Job #:		Major/Minor Code:		Routing Code:	
PO / AFE: 229097 (GW)		Requisitioner:			
LSD:		Location:			
ALS Lab Work Order # (lab use only)		ALS Contact:		Sampler: CR/CP	
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mm-yy)	Time (hh:mm)	Sample Type	
	MW17-12-06	11-May-18	10:45	Water	
	MW17-12-07	11-May-18	11:10	Water	
	MW17-12-08	11-May-18	11:30	Water	
	DUP	11-May-18		Water	
Drinking Water (DW) Samples¹ (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)			
Are samples taken from a Regulated DW System? ☐ YES ☒ NO					
Are samples for human drinking water use? ☐ YES ☒ NO					
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)			
Released by: Corey Roberts	Date: 2018-05-14	Time:	Received by: RHE	Date: 14 May 2018	Time: 16:00
		FINAL SHIPMENT RECEPTION (lab use only)			
		Received by: HA Date: 5/15 Time: 4pm			

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 14-MAY-18
Report Date: 25-MAY-18 17:57 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2094083
Project P.O. #: 229097
Job Reference:
C of C Numbers: 2018-05-14 B
Legal Site Desc:

Shane Stack
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2094083-1 Water 13-MAY-18 11:00 MW17-DP01	L2094083-2 Water 13-MAY-18 11:10 MW17-DP02		
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	997	1160			
	Hardness (as CaCO3) (mg/L)	291	520			
	pH (pH)	8.43	8.43			
	Total Suspended Solids (mg/L)	103	190			
	TDS (Calculated) (mg/L)	678	786			
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	234	251			
	Alkalinity, Carbonate (as CaCO3) (mg/L)	10.6	14.2			
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0			
	Alkalinity, Total (as CaCO3) (mg/L)	245	265			
	Ammonia, Total (as N) (mg/L)	2.07	6.76			
	Chloride (Cl) (mg/L)	25.5	70.6			
	Nitrate and Nitrite (as N) (mg/L)	<0.025 ^{DLDS}	6.28			
	Nitrate (as N) (mg/L)	<0.025 ^{DLDS}	5.25			
	Nitrite (as N) (mg/L)	<0.0050 ^{DLDS}	1.02			
	Sulfate (SO4) (mg/L)	247	259			
	Anion Sum (meq/L)	10.8	13.1			
	Cation Sum (meq/L)	12.1	13.9			
	Cation - Anion Balance (%)	5.9	3.0			
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD			
	Dissolved Metals Filtration Location	FIELD	FIELD			
	Aluminum (Al)-Dissolved (mg/L)	0.0031	0.0020			
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	0.00018			
	Arsenic (As)-Dissolved (mg/L)	0.00066	0.00094			
	Barium (Ba)-Dissolved (mg/L)	0.0313	0.0417			
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020			
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050			
	Boron (B)-Dissolved (mg/L)	0.085	0.124			
	Cadmium (Cd)-Dissolved (mg/L)	0.000263	0.000504			
	Calcium (Ca)-Dissolved (mg/L)	77.2	142			
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00046			
	Cobalt (Co)-Dissolved (mg/L)	0.00090	0.00266			
	Copper (Cu)-Dissolved (mg/L)	0.186	0.414			
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010			
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050			
	Lithium (Li)-Dissolved (mg/L)	0.0065	0.0101			
	Magnesium (Mg)-Dissolved (mg/L)	23.9	40.3			
	Manganese (Mn)-Dissolved (mg/L)	0.819	1.22			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2094083-1 Water 13-MAY-18 11:00 MW17-DP01	L2094083-2 Water 13-MAY-18 11:10 MW17-DP02			
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050			
	Molybdenum (Mo)-Dissolved (mg/L)	0.0435	0.0939			
	Nickel (Ni)-Dissolved (mg/L)	0.00552	0.00630			
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050			
	Potassium (K)-Dissolved (mg/L)	31.9	23.3			
	Selenium (Se)-Dissolved (mg/L)	0.000440	0.00271			
	Silicon (Si)-Dissolved (mg/L)	2.72	3.59			
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010			
	Sodium (Na)-Dissolved (mg/L)	121	55.4			
	Strontium (Sr)-Dissolved (mg/L)	5.79	17.9			
	Sulfur (S)-Dissolved (mg/L)	87.0	83.2			
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	0.000027			
	Tin (Sn)-Dissolved (mg/L)	0.00016	0.00015			
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030			
	Uranium (U)-Dissolved (mg/L)	0.00211	0.00159			
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050			
	Zinc (Zn)-Dissolved (mg/L)	0.0044	0.0056			
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2094083-1, -2
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2094083-1, -2
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2094083-1, -2
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2094083-1, -2

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)

Reference Information

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
----------------------------	---------------------

VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
----	---

Chain of Custody Numbers:

2018-05-14 B

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

[illegible]

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 05-JUN-18
Report Date: 18-JUN-18 13:19 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2106486
Project P.O. #: 229097
Job Reference:
C of C Numbers: 2018-06-04 C
Legal Site Desc:

Shane Stack
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2106486-1 Water 01-JUN-18 14:40 MW09-03-01	L2106486-2 Water 01-JUN-18 14:50 MW09-03-02	L2106486-3 Water 01-JUN-18 15:50 MW12-07-02		
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	314	332	909		
	Hardness (as CaCO3) (mg/L)	156	161	435		
	pH (pH)	8.09	8.12	7.98		
	Total Suspended Solids (mg/L)	4.2	4.2	7.2		
	TDS (Calculated) (mg/L)	172	185	630		
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	141	155	151		
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0		
	Alkalinity, Total (as CaCO3) (mg/L)	141	155	151		
	Ammonia, Total (as N) (mg/L)	0.0414	<0.0050	0.0102		
	Chloride (Cl) (mg/L)	<0.50	0.57	0.63		
	Nitrate and Nitrite (as N) (mg/L)	0.169	3.49	0.333		
	Nitrate (as N) (mg/L)	0.0092	3.30	0.129		
	Nitrite (as N) (mg/L)	0.160	0.197	0.204		
	Sulfate (SO4) (mg/L)	19.4	8.83	334		
	Anion Sum (meq/L)	3.24	3.54	10.0		
	Cation Sum (meq/L)	3.64	3.52	10.7		
	Cation - Anion Balance (%)	5.8	-0.2	3.3		
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD		
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD		
	Aluminum (Al)-Dissolved (mg/L)	0.0066	0.0091	0.0043		
	Antimony (Sb)-Dissolved (mg/L)	0.00014	0.00012	<0.00010		
	Arsenic (As)-Dissolved (mg/L)	0.00092	0.00013	0.00037		
	Barium (Ba)-Dissolved (mg/L)	0.0736	0.0292	0.0251		
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020		
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050		
	Boron (B)-Dissolved (mg/L)	0.118	0.143	0.217		
	Cadmium (Cd)-Dissolved (mg/L)	0.0000233	0.0000453	0.0000486		
	Calcium (Ca)-Dissolved (mg/L)	42.5	52.9	126		
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010		
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	0.00025		
	Copper (Cu)-Dissolved (mg/L)	0.00088	0.00384	0.00278		
	Iron (Fe)-Dissolved (mg/L)	0.455	0.023	0.018		
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050		
	Lithium (Li)-Dissolved (mg/L)	0.0038	0.0014	0.0181		
	Magnesium (Mg)-Dissolved (mg/L)	12.1	6.99	29.1		
	Manganese (Mn)-Dissolved (mg/L)	0.100	0.00546	0.796		

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2106486-1 Water 01-JUN-18 14:40 MW09-03-01	L2106486-2 Water 01-JUN-18 14:50 MW09-03-02	L2106486-3 Water 01-JUN-18 15:50 MW12-07-02		
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Dissolved (mg/L)	0.00478	0.00428	0.0314		
	Nickel (Ni)-Dissolved (mg/L)	0.00087	<0.00050	<0.00050		
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050		
	Potassium (K)-Dissolved (mg/L)	2.37	2.35	3.04		
	Selenium (Se)-Dissolved (mg/L)	0.000187	0.000363	0.000706		
	Silicon (Si)-Dissolved (mg/L)	5.57	5.28	6.58		
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010		
	Sodium (Na)-Dissolved (mg/L)	9.76	5.58	43.8		
	Strontium (Sr)-Dissolved (mg/L)	1.09	0.387	4.15		
	Sulfur (S)-Dissolved (mg/L)	6.99	3.03	117		
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010		
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010		
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	0.00073	<0.00030		
	Uranium (U)-Dissolved (mg/L)	0.000726	0.00256	0.00308		
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050		
	Zinc (Zn)-Dissolved (mg/L)	0.0096	0.0191	0.0318		
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030		

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
CL-IC-N-WR	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NO2-L-IC-N-WR	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-WR	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
SO4-IC-WR	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)
This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".			
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.			

Reference Information

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-06-04 C

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



12106486-COFC

COC Number: 2018-06-04 C

Page 1 of 1

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OCTOBER 2015 FROM

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1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW CQC form**.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 15-AUG-18
Report Date: 04-SEP-18 12:27 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2147414
Project P.O. #: 229097
Job Reference:
C of C Numbers: 2018-08-15 D
Legal Site Desc:

Shane Stack
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

04-SEP-18 12:27 (MT)

Version: FINAL

Sample ID Description Sampled Date Sampled Time Client ID		L2147414-1 Water 10-AUG-18 17:20 MW09-03-01	L2147414-2 Water 10-AUG-18 17:40 MW09-03-02	L2147414-3 Water 13-AUG-18 16:00 MW17-10-01	L2147414-4 Water 13-AUG-18 16:25 MW17-10-02	L2147414-5 Water 12-AUG-18 16:10 MW17-11-01
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	325	335	408		338
	Hardness (as CaCO3) (mg/L)	153	169	197	212	135
	pH (pH)	8.23	8.20	8.18		8.20
	Total Suspended Solids (mg/L)	4.8	4.8	4.6		7.0
	TDS (Calculated) (mg/L)	179	185	245		189
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	141	156	117		132
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0		<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0		<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	141	156	117		132
	Ammonia, Total (as N) (mg/L)	0.0454	<0.0050	0.0120	0.0053	0.0202
	Chloride (Cl) (mg/L)	0.74	0.83	1.18		0.88
	Nitrate and Nitrite (as N) (mg/L)	0.539	3.27	7.94		0.0212
	Nitrate (as N) (mg/L)	0.0091	3.21	7.46		0.0133
	Nitrite (as N) (mg/L)	0.530	0.0599	0.476		0.0080
	Sulfate (SO4) (mg/L)	18.7	6.17	55.2		36.2
	Anion Sum (meq/L)	3.27	3.49	4.08		3.42
	Cation Sum (meq/L)	3.89	3.67	4.65		3.78
	Cation - Anion Balance (%)	8.6	2.4	6.5		5.0
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD		FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0062	0.0017	0.0062	0.0030	0.0082
	Antimony (Sb)-Dissolved (mg/L)	0.00052	<0.00010	0.00024	<0.00010	0.00015
	Arsenic (As)-Dissolved (mg/L)	0.00116	0.00013	0.00053	0.00024	0.00136
	Barium (Ba)-Dissolved (mg/L)	0.0659	0.0345	0.0279	0.0331	0.0436
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	1.59	0.119	0.573	0.020	0.038
	Cadmium (Cd)-Dissolved (mg/L)	0.0000280	0.0000550	0.000196	0.000164	0.000673
	Calcium (Ca)-Dissolved (mg/L)	41.0	55.5	48.2	55.6	36.3
	Chromium (Cr)-Dissolved (mg/L)	0.00023	<0.00010	<0.00010	<0.00010	0.00021
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	0.00037	0.00048	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00243	0.00210	0.00430	0.00199	0.00317
	Iron (Fe)-Dissolved (mg/L)	0.300	<0.010	<0.010	<0.010	0.423
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0036	0.0012	0.0018	0.0012	0.0054
	Magnesium (Mg)-Dissolved (mg/L)	12.4	7.35	18.7	17.8	10.7
	Manganese (Mn)-Dissolved (mg/L)	0.0988	0.0166	0.0522	0.00577	0.0554

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2147414-6 Water 12-AUG-18 16:55 MW17-11-02	L2147414-7 Water 12-AUG-18 17:10 MW17-11-03	L2147414-8 Water 12-AUG-18 17:25 MW17-11-04	L2147414-9 Water 12-AUG-18 18:10 MW17-11-05	L2147414-10 Water 12-AUG-18 DUP
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	352	309	815	1320	345
	Hardness (as CaCO3) (mg/L)	155	147	609	1080	132
	pH (pH)	8.12	8.24	8.02	7.47	8.27
	Total Suspended Solids (mg/L)	6.8	<3.0	39.2	7.2	7.4
	TDS (Calculated) (mg/L)	197	166	557	971	191
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	138	140	369	648	139
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	138	140	369	648	139
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	0.0207	0.0122	<0.0050
	Chloride (Cl) (mg/L)	0.58	<0.50	1.43	<2.5 ^{DLDS}	0.66
	Nitrate and Nitrite (as N) (mg/L)	<0.0051	<0.0051	11.1	22.7	<0.0051
	Nitrate (as N) (mg/L)	<0.0050	<0.0050	11.1	22.7	<0.0050
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	0.0038	0.0227	0.0010
	Sulfate (SO4) (mg/L)	38.9	18.6	29.0	17.2	36.0
	Anion Sum (meq/L)	3.59	3.18	8.82	14.9	3.55
	Cation Sum (meq/L)	3.97	3.47	13.6	24.0	3.69
	Cation - Anion Balance (%)	4.9	4.4	21.3	23.3	2.0
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD		FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0042	0.0048	0.0057	0.0034	0.0060
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	0.00019	0.00074	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00058	0.00041	0.00065	0.00054	0.00134
	Barium (Ba)-Dissolved (mg/L)	0.0440	0.0602	0.324	1.27	0.0433
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.021	0.011	0.025	0.037	0.025
	Cadmium (Cd)-Dissolved (mg/L)	0.0000633	0.0000190	0.0000707	0.0000834	0.0000587
	Calcium (Ca)-Dissolved (mg/L)	41.3	37.9	178	346	35.6
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	0.00021	0.00038	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00065	0.00029	0.00253	0.00341	0.00083
	Iron (Fe)-Dissolved (mg/L)	0.072	0.016	0.018	0.013	0.402
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0055	0.0044	0.0138	0.0279	0.0052
	Magnesium (Mg)-Dissolved (mg/L)	12.7	12.7	39.6	52.1	10.4
	Manganese (Mn)-Dissolved (mg/L)	0.0535	0.109	0.0628	0.00941	0.0527

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2147414-1 Water 10-AUG-18 17:20 MW09-03-01	L2147414-2 Water 10-AUG-18 17:40 MW09-03-02	L2147414-3 Water 13-AUG-18 16:00 MW17-10-01	L2147414-4 Water 13-AUG-18 16:25 MW17-10-02	L2147414-5 Water 12-AUG-18 16:10 MW17-11-01
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050		<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00960	0.00779	0.0224	0.00822	0.0197
	Nickel (Ni)-Dissolved (mg/L)	0.00067	<0.00050	0.0101	0.00318	0.00101
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	2.44	2.43	1.76	1.75	2.71
	Selenium (Se)-Dissolved (mg/L)	0.000972	0.000246	0.00197	0.00171	0.000063
	Silicon (Si)-Dissolved (mg/L)	5.63	4.98	5.20	5.10	5.43
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	0.000017	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	16.9	5.30	15.2	7.39	22.8
	Strontium (Sr)-Dissolved (mg/L)	0.987	0.353	1.23	0.983	0.946
	Sulfur (S)-Dissolved (mg/L)	5.70	1.72	17.6	7.85	11.3
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	0.00014	0.00028	0.00011	<0.00010	0.00013
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.000570	0.00243	0.00231	0.00112	0.000149
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	0.00102	0.00054	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0137	0.0199	0.0326	0.0429	0.0429
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2147414-6 Water 12-AUG-18 16:55 MW17-11-02	L2147414-7 Water 12-AUG-18 17:10 MW17-11-03	L2147414-8 Water 12-AUG-18 17:25 MW17-11-04	L2147414-9 Water 12-AUG-18 18:10 MW17-11-05	L2147414-10 Water 12-AUG-18 DUP
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050		<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00659	0.00475	0.0165	0.00952	0.0195
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	0.00061	0.00520	0.00789	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	2.60	2.67	13.8	25.5	2.45
	Selenium (Se)-Dissolved (mg/L)	0.000109	0.000054	0.000580	0.00155	0.000060
	Silicon (Si)-Dissolved (mg/L)	5.10	4.95	19.0	37.7	5.34
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	0.000033	0.000050	<0.000010
	Sodium (Na)-Dissolved (mg/L)	18.1	10.6	24.4	40.8	22.3
	Strontium (Sr)-Dissolved (mg/L)	1.04	0.971	2.36	2.25	0.914
	Sulfur (S)-Dissolved (mg/L)	12.3	5.73	15.5	10.8	11.4
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	0.000014	0.000021	<0.000010
	Tin (Sn)-Dissolved (mg/L)	0.00122	<0.00010	0.00016	0.00080	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.000371	0.00132	0.00720	0.0151	0.000144
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	0.00082	0.00161	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0267	0.0153	0.0834	0.101	0.0213
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2147414-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2147414-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Copper (Cu)-Dissolved	MS-B	L2147414-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2147414-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2147414-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2147414-1, -10, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-WR	Water	Nitrite & Nitrate Nitrogen	EPA 300.1
Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance.			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
CL-IC-N-WR	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Weston et al.			
NO2-L-IC-N-WR	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)

Reference Information

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-08-15 D

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Canada Toll Free: 1 800 668 9878

[illegible]

L2147414-COFC

COC Number: 2018-08-15 D

Page of

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 EBC



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 27-AUG-18
Report Date: 06-SEP-18 17:46 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2153574
Project P.O. #: 229097
Job Reference:
C of C Numbers: 2018-08-22 B
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2153574-1 Water 18-AUG-18 09:30 MW17-10-01	L2153574-2 Water 18-AUG-18 09:55 MW17-10-02	L2153574-3 Water 18-AUG-18 10:00 MW17-10-03	L2153574-4 Water 19-AUG-18 16:30 MW12-07-02	
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	398	446	453	880	
	Hardness (as CaCO3) (mg/L)	178	199	184	382	
	pH (pH)	8.19	8.15	8.14	8.16	
	Total Suspended Solids (mg/L)	4.4	6.4	<3.0	<3.0	
	TDS (Calculated) (mg/L)	232	271	271	590	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	123	116	115	166	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Total (as CaCO3) (mg/L)	123	116	115	166	
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	0.0193	
	Chloride (Cl) (mg/L)	0.82	0.94	0.93	1.32	
	Nitrate and Nitrite (as N) (mg/L)	7.48	22.5	23.9	0.270	
	Nitrate (as N) (mg/L)	7.47	22.5	23.9	0.128	
	Nitrite (as N) (mg/L)	0.0057	0.0013	<0.0010	0.142	
	Sulfate (SO4) (mg/L)	52.9	23.7	22.5	306	
	Anion Sum (meq/L)	4.12	4.44	4.51	9.74	
	Cation Sum (meq/L)	4.01	4.33	3.99	9.62	
	Cation - Anion Balance (%)	-1.3	-1.2	-6.1	-0.6	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0041	0.0025	0.0028	0.0021	
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00031	
	Arsenic (As)-Dissolved (mg/L)	0.00014	0.00023	<0.00010	0.00064	
	Barium (Ba)-Dissolved (mg/L)	0.0279	0.0342	0.0335	0.0236	
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	0.027	0.010	<0.010	0.866	
	Cadmium (Cd)-Dissolved (mg/L)	0.0000342	0.0000435	0.0000299	0.0000171	
	Calcium (Ca)-Dissolved (mg/L)	43.7	51.5	50.9	109	
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Cobalt (Co)-Dissolved (mg/L)	0.00031	0.00053	0.00059	0.00022	
	Copper (Cu)-Dissolved (mg/L)	0.00428	0.00180	0.00173	0.00219	
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	<0.010	0.010	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.0017	0.0012	0.0011	0.0165	
	Magnesium (Mg)-Dissolved (mg/L)	16.8	17.0	13.9	26.8	
	Manganese (Mn)-Dissolved (mg/L)	0.0457	0.00377	0.00181	0.886	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2153574-1 Water 18-AUG-18 09:30 MW17-10-01	L2153574-2 Water 18-AUG-18 09:55 MW17-10-02	L2153574-3 Water 18-AUG-18 10:00 MW17-10-03	L2153574-4 Water 19-AUG-18 16:30 MW12-07-02	
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Dissolved (mg/L)	0.0218	0.00775	0.00675	0.0304	
	Nickel (Ni)-Dissolved (mg/L)	0.00890	0.00291	0.00392	<0.00050	
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Potassium (K)-Dissolved (mg/L)	1.55	1.74	1.64	2.72	
	Selenium (Se)-Dissolved (mg/L)	0.000718	0.00185	0.00174	0.00134	
	Silicon (Si)-Dissolved (mg/L)	5.27	5.24	4.93	6.17	
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Sodium (Na)-Dissolved (mg/L)	9.23	7.27	6.07	43.3	
	Strontium (Sr)-Dissolved (mg/L)	1.18	0.943	0.768	3.58	
	Sulfur (S)-Dissolved (mg/L)	18.1	8.27	7.05	110	
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00011	
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	
	Uranium (U)-Dissolved (mg/L)	0.00236	0.00114	0.00104	0.00311	
	Vanadium (V)-Dissolved (mg/L)	0.00095	0.00058	0.00060	<0.00050	
	Zinc (Zn)-Dissolved (mg/L)	0.0205	0.0475	0.0372	0.0684	
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2153574-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2153574-1, -2, -3, -4
Matrix Spike	Copper (Cu)-Dissolved	MS-B	L2153574-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2153574-1, -2, -3, -4
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2153574-1, -2, -3, -4
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2153574-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2153574-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2153574-1, -2, -3, -4
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2153574-1, -2, -3, -4

Qualifiers for Individual Parameters Listed:

Qualifier	Description
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-WR	Water	Nitrite & Nitrate Nitrogen	EPA 300.1
Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance.			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
CL-IC-N-WR	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Weston et			

Reference Information

al.

NO2-L-IC-N-WR Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-08-22 B

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2153574-COFC

OC Number: 2018-08-22 B

Page 1 of 1

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[illegible]

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white-report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 EDITION



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 27-AUG-18
Report Date: 06-SEP-18 17:54 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2153614
Project P.O. #: 229097
Job Reference:
C of C Numbers: 2018-08-24 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

06-SEP-18 17:54 (MT)

Version: FINAL

Sample ID Description Sampled Date Sampled Time Client ID		L2153614-1 Water 23-AUG-18 15:00 MW12-05-01	L2153614-2 Water 23-AUG-18 15:15 MW12-05-02	L2153614-3 Water 23-AUG-18 15:30 MW12-05-03	L2153614-4 Water 23-AUG-18 15:45 MW12-05-04	L2153614-5 Water 23-AUG-18 16:00 MW12-05-05
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	2230	2200	1820	525	517
	Hardness (as CaCO3) (mg/L)	1050	999	716	241	242
	pH (pH)	7.94	8.10	8.03	8.12	8.06
	Total Suspended Solids (mg/L)	3.1	5.9	3.9	<3.0	<3.0
	TDS (Calculated) (mg/L)	1830	1760	1330	289	295
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	117	166	227	234	231
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	117	166	227	234	231
	Ammonia, Total (as N) (mg/L)	0.0673	0.0779	0.0268	0.0238	0.0443
	Chloride (Cl) (mg/L)	12.7	12.0	8.9	4.99	5.22
	Nitrate and Nitrite (as N) (mg/L)	<0.025	<0.025	<0.025	0.0366	0.0411
	Nitrate (as N) (mg/L)	<0.025 ^{DLDS}	<0.025 ^{DLDS}	<0.025 ^{DLDS}	0.0089	0.0265
	Nitrite (as N) (mg/L)	0.0082	0.0114	0.0119	0.0277	0.0146
	Sulfate (SO4) (mg/L)	1190	1150	838	43.2	49.8
	Anion Sum (meq/L)	27.5	27.5	22.2	5.72	5.81
	Cation Sum (meq/L)	27.8	25.8	18.7	5.70	5.73
	Cation - Anion Balance (%)	0.5	-3.2	-8.5	-0.2	-0.7
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0092	0.0060	0.0144	0.0338	0.0072
	Antimony (Sb)-Dissolved (mg/L)	<0.00020 ^{DLA}	<0.00050 ^{DLA}	<0.00020 ^{DLA}	<0.00010	0.00060
	Arsenic (As)-Dissolved (mg/L)	0.00063	<0.00050 ^{DLA}	<0.00020 ^{DLA}	0.00012	0.00151
	Barium (Ba)-Dissolved (mg/L)	0.0359	0.0873	0.0402	0.0574	0.0682
	Beryllium (Be)-Dissolved (mg/L)	<0.000040 ^{DLA}	<0.00010 ^{DLA}	<0.000040 ^{DLA}	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.00010 ^{DLA}	<0.00025 ^{DLA}	<0.00010 ^{DLA}	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.103	0.120	0.066	0.041	0.428
	Cadmium (Cd)-Dissolved (mg/L)	0.000029	<0.000025 ^{DLA}	0.000021	0.0000114	0.0000138
	Calcium (Ca)-Dissolved (mg/L)	358	314	180	51.5	53.0
	Chromium (Cr)-Dissolved (mg/L)	0.00028	<0.00050 ^{DLA}	<0.00020 ^{DLA}	<0.00010	0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00020 ^{DLA}	<0.00050 ^{DLA}	<0.00020 ^{DLA}	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	<0.00040 ^{DLA}	<0.0010 ^{DLA}	0.00170	0.00171	0.00141
	Iron (Fe)-Dissolved (mg/L)	0.040	<0.050 ^{DLA}	0.433	0.114	0.048
	Lead (Pb)-Dissolved (mg/L)	<0.00010 ^{DLA}	<0.00025 ^{DLA}	<0.00010 ^{DLA}	0.000104	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0077	0.0053	0.0038	0.0033	0.0037
	Magnesium (Mg)-Dissolved (mg/L)	38.1	51.9	65.0	27.2	26.5
	Manganese (Mn)-Dissolved (mg/L)	0.149	0.719	2.02	0.254	0.144

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2153614-6 Water 23-AUG-18 16:15 MW12-05-06	L2153614-7 Water 23-AUG-18 16:30 MW12-05-07	L2153614-8 Water 23-AUG-18 DUP		
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	519	517	518		
	Hardness (as CaCO3) (mg/L)	243	240	245		
	pH (pH)	8.02	7.94	7.95		
	Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0		
	TDS (Calculated) (mg/L)	289	277	285		
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	223	204	212		
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0		
	Alkalinity, Total (as CaCO3) (mg/L)	223	204	212		
	Ammonia, Total (as N) (mg/L)	<0.0050	0.119	0.0388		
	Chloride (Cl) (mg/L)	5.20	5.70	5.19		
	Nitrate and Nitrite (as N) (mg/L)	0.0648	<0.0051	0.0415		
	Nitrate (as N) (mg/L)	0.0510	<0.0050	0.0263		
	Nitrite (as N) (mg/L)	0.0138	0.0044	0.0152		
	Sulfate (SO4) (mg/L)	50.9	51.9	49.7		
	Anion Sum (meq/L)	5.67	5.31	5.42		
	Cation Sum (meq/L)	5.62	5.54	5.81		
	Cation - Anion Balance (%)	-0.4	2.0	3.5		
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD		
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD		
	Aluminum (Al)-Dissolved (mg/L)	0.0263	0.0067	0.0044		
	Antimony (Sb)-Dissolved (mg/L)	0.00017	<0.00010	0.00059		
	Arsenic (As)-Dissolved (mg/L)	0.00027	0.00035	0.00133		
	Barium (Ba)-Dissolved (mg/L)	0.0663	0.143	0.0687		
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020		
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050		
	Boron (B)-Dissolved (mg/L)	0.073	0.031	0.423		
	Cadmium (Cd)-Dissolved (mg/L)	0.0000175	<0.0000050	0.0000111		
	Calcium (Ca)-Dissolved (mg/L)	53.8	53.0	53.7		
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00023	0.00012		
	Cobalt (Co)-Dissolved (mg/L)	0.00014	<0.00010	<0.00010		
	Copper (Cu)-Dissolved (mg/L)	0.00466	0.00060	0.00160		
	Iron (Fe)-Dissolved (mg/L)	0.072	0.228	0.046		
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050		
	Lithium (Li)-Dissolved (mg/L)	0.0036	0.0036	0.0037		
	Magnesium (Mg)-Dissolved (mg/L)	26.4	26.0	26.9		
	Manganese (Mn)-Dissolved (mg/L)	0.135	0.150	0.144		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2153614-1 Water 23-AUG-18 15:00 MW12-05-01	L2153614-2 Water 23-AUG-18 15:15 MW12-05-02	L2153614-3 Water 23-AUG-18 15:30 MW12-05-03	L2153614-4 Water 23-AUG-18 15:45 MW12-05-04	L2153614-5 Water 23-AUG-18 16:00 MW12-05-05
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050 ^{DLA}	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00022	<0.00025 ^{DLA}	0.00017	0.00230	0.00463
	Nickel (Ni)-Dissolved (mg/L)	<0.0010 ^{DLA}	<0.0025 ^{DLA}	<0.0010 ^{DLA}	<0.00050	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.10 ^{DLA}	<0.25 ^{DLA}	<0.10 ^{DLA}	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	3.50	3.70	3.80	2.11	2.10
	Selenium (Se)-Dissolved (mg/L)	0.00066	0.00134	<0.00010 ^{DLA}	0.000884	0.00112
	Silicon (Si)-Dissolved (mg/L)	7.25	6.67	7.43	6.27	5.96
	Silver (Ag)-Dissolved (mg/L)	<0.000020 ^{DLA}	<0.000050 ^{DLA}	<0.000020 ^{DLA}	<0.000010	0.000010
	Sodium (Na)-Dissolved (mg/L)	155	131	97.7	18.7	19.2
	Strontium (Sr)-Dissolved (mg/L)	9.69	11.0	7.19	0.990	0.861
	Sulfur (S)-Dissolved (mg/L)	429	372	299	20.5	18.1
	Thallium (Tl)-Dissolved (mg/L)	<0.000020 ^{DLA}	<0.000050 ^{DLA}	<0.000020 ^{DLA}	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00020 ^{DLA}	<0.00050 ^{DLA}	<0.00020 ^{DLA}	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00060 ^{DLA}	<0.0015 ^{DLA}	<0.0015 ^{DLM}	0.00399	0.00074
	Uranium (U)-Dissolved (mg/L)	0.000897	0.000337 ^{DLA}	0.00123	0.00234	0.00304
	Vanadium (V)-Dissolved (mg/L)	<0.0010 ^{DLA}	<0.0025 ^{DLA}	<0.0010 ^{DLA}	0.00060	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0153	0.0065	0.0059	0.0032	0.0628
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2153614-6 Water 23-AUG-18 16:15 MW12-05-06	L2153614-7 Water 23-AUG-18 16:30 MW12-05-07	L2153614-8 Water 23-AUG-18 DUP		
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Dissolved (mg/L)	0.00521	0.00273	0.00478		
	Nickel (Ni)-Dissolved (mg/L)	0.00171	<0.00050	<0.00050		
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050		
	Potassium (K)-Dissolved (mg/L)	2.04	2.02	2.16		
	Selenium (Se)-Dissolved (mg/L)	0.000376	0.000274	0.000581		
	Silicon (Si)-Dissolved (mg/L)	5.85	5.26	6.03		
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010		
	Sodium (Na)-Dissolved (mg/L)	16.1	15.4	19.7		
	Strontium (Sr)-Dissolved (mg/L)	0.835	0.780	0.874		
	Sulfur (S)-Dissolved (mg/L)	16.9	14.4	18.1		
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010		
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010		
	Titanium (Ti)-Dissolved (mg/L)	0.00271	<0.00030	<0.00030		
	Uranium (U)-Dissolved (mg/L)	0.00333	0.00271	0.00316		
	Vanadium (V)-Dissolved (mg/L)	0.00055	<0.00050	<0.00050		
	Zinc (Zn)-Dissolved (mg/L)	0.0214	0.0034	0.0568		
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Magnesium (Mg)-Dissolved	MB-LOR	L2153614-1, -2, -3, -4, -5, -6, -7, -8
Method Blank	Manganese (Mn)-Dissolved	MB-LOR	L2153614-1, -2, -3, -4, -5, -6, -7, -8

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-WR	Water	Nitrite & Nitrate Nitrogen	EPA 300.1
Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance.			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
CL-IC-N-WR	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NO2-L-IC-N-WR	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-WR	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)

Reference Information

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-WR Water Sulfate in Water by IC EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)
This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-08-24 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2153614-COFC

COC Number: 2018-08-24 A

Page 1 of 1

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OCTOBER 2015 FRONT



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 28-AUG-18
Report Date: 07-SEP-18 17:02 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2154209

Project P.O. #: 229097

Job Reference:

C of C Numbers: 2018-08-27 B 1 of 2, 2018-08-27 B 2 of 2

Legal Site Desc:

Shane Stack
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2154209-1 Water 24-AUG-18 14:40 MW17-12-01	L2154209-2 Water 24-AUG-18 15:00 MW17-12-02	L2154209-3 Water 24-AUG-18 15:15 MW17-12-03	L2154209-4 Water 24-AUG-18 15:35 MW17-12-04	L2154209-5 Water 24-AUG-18 15:50 MW17-12-05
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	2530	2210	882	747	768
	Hardness (as CaCO3) (mg/L)	965	740	329	321	352
	pH (pH)	8.00	8.03	8.20	8.17	8.25
	Total Suspended Solids (mg/L)	12.0	12.2	<3.0	<3.0	<3.0
	TDS (Calculated) (mg/L)	2040	1670	526	432	450
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	206	228	358	324	350
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	206	228	358	324	350
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Chloride (Cl) (mg/L)	12.3	10.9	1.87	1.62	2.34
	Nitrate and Nitrite (as N) (mg/L)	<0.051	<0.025	0.0075	0.245	0.205
	Nitrate (as N) (mg/L)	<0.050 ^{DLDS}	<0.025 ^{DLDS}	0.0060	0.245	0.205
	Nitrite (as N) (mg/L)	<0.010 ^{DLDS}	<0.0050 ^{DLDS}	0.0016	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	1300	1020	137	99.1	93.1
	Anion Sum (meq/L)	31.5	26.2	10.0	8.60	9.00
	Cation Sum (meq/L)	30.4	24.5	9.29	7.92	8.47
	Cation - Anion Balance (%)	-1.8	-3.3	-3.9	-4.1	-3.1
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0157	0.0134	0.0106	0.0033	0.0177
	Antimony (Sb)-Dissolved (mg/L)	<0.00050 ^{DLA}	<0.00050 ^{DLA}	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00273	0.00211	0.00097	0.00037	0.00022
	Barium (Ba)-Dissolved (mg/L)	0.0127	0.0101	0.0143	0.0231	0.0660
	Beryllium (Be)-Dissolved (mg/L)	<0.00010 ^{DLA}	<0.00010 ^{DLA}	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.00025 ^{DLA}	<0.00025 ^{DLA}	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.173	0.148	0.052	0.035	0.031
	Cadmium (Cd)-Dissolved (mg/L)	<0.000025 ^{DLA}	<0.000025 ^{DLA}	0.0000136	0.0000142	0.0000192
	Calcium (Ca)-Dissolved (mg/L)	296	227	75.0	55.9	60.3
	Chromium (Cr)-Dissolved (mg/L)	<0.00050 ^{DLA}	<0.00050 ^{DLA}	<0.00010	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00050 ^{DLA}	<0.00050 ^{DLA}	<0.00010	<0.00010	0.00027
	Copper (Cu)-Dissolved (mg/L)	0.0028	<0.0010 ^{DLA}	0.00137	0.00152	0.00308
	Iron (Fe)-Dissolved (mg/L)	2.91	2.03	0.082	<0.010	0.031
	Lead (Pb)-Dissolved (mg/L)	<0.00025 ^{DLA}	<0.00025 ^{DLA}	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0146	0.0138	0.0080	0.0064	0.0087
	Magnesium (Mg)-Dissolved (mg/L)	54.5	42.1	34.3	44.1	48.9
	Manganese (Mn)-Dissolved (mg/L)	0.0981	0.0538	0.110	0.00370	0.241

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2154209-6 Water 24-AUG-18 16:05 MW17-12-06	L2154209-7 Water 24-AUG-18 16:20 MW17-12-07	L2154209-8 Water 24-AUG-18 16:45 MW17-12-08	L2154209-9 Water 24-AUG-18 DUP	L2154209-10 Water 25-AUG-18 14:30 MW12-06-01
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	774	589	575	581	909
	Hardness (as CaCO3) (mg/L)	353	262	279	278	350
	pH (pH)	8.26	8.23	8.26	8.27	7.76
	Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0	<3.0	<3.0
	TDS (Calculated) (mg/L)	457	334	333	332	460
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	337	251	251	251	447
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	337	251	251	251	447
	Ammonia, Total (as N) (mg/L)	0.0094	<0.0050	<0.0050	<0.0050	0.113
	Chloride (Cl) (mg/L)	3.36	4.91	4.42	4.49	4.85
	Nitrate and Nitrite (as N) (mg/L)	0.258	0.765	0.756	0.753	0.0687
	Nitrate (as N) (mg/L)	0.247	0.763	0.756	0.753	0.0165
	Nitrite (as N) (mg/L)	0.0119	0.0014	<0.0010	<0.0010	0.0522
	Sulfate (SO4) (mg/L)	101	67.4	63.1	62.8	0.71
	Anion Sum (meq/L)	8.95	6.61	6.50	6.50	9.08
	Cation Sum (meq/L)	8.69	6.31	6.61	6.55	9.53
	Cation - Anion Balance (%)	-1.5	-2.3	0.8	0.4	2.4
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0093	0.0135	0.0113	0.0025	0.0268
	Antimony (Sb)-Dissolved (mg/L)	0.00012	<0.00010	<0.00010	<0.00010	0.00021
	Arsenic (As)-Dissolved (mg/L)	0.00058	0.00048	0.00017	0.00018	0.00667
	Barium (Ba)-Dissolved (mg/L)	0.0553	0.0220	0.0229	0.0214	0.276
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	0.000152
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.056	0.029	0.025	0.025	0.260
	Cadmium (Cd)-Dissolved (mg/L)	0.0000598	0.0000292	0.0000137	0.0000379	0.0000248
	Calcium (Ca)-Dissolved (mg/L)	62.2	46.6	49.0	48.9	106
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	0.00406
	Cobalt (Co)-Dissolved (mg/L)	0.00026	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00292	0.00127	0.00494	0.00078	0.00078
	Iron (Fe)-Dissolved (mg/L)	0.020	0.029	0.024	<0.010	0.496
	Lead (Pb)-Dissolved (mg/L)	0.000056	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0088	0.0058	0.0061	0.0060	0.0097
	Magnesium (Mg)-Dissolved (mg/L)	48.0	35.3	38.0	37.8	20.9
	Manganese (Mn)-Dissolved (mg/L)	0.157	0.00641	0.00169	0.00080	0.276

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2154209-11 Water 25-AUG-18 15:30 MW12-06-02	L2154209-12 Water 25-AUG-18 15:45 MW12-06-03	L2154209-13 Water 25-AUG-18 16:00 MW12-06-04	L2154209-14 Water 25-AUG-18 16:15 MW12-06-05	L2154209-15 Water 25-AUG-18 16:30 MW12-06-06
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	1010	1020	1020	1020	861
	Hardness (as CaCO3) (mg/L)	468	456	479	507	414
	pH (pH)	8.11	8.14	8.18	8.30	8.33
	Total Suspended Solids (mg/L)	24.0	5.4	10.8	<3.0	<3.0
	TDS (Calculated) (mg/L)	641	623	622	635	528
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	368	381	404	409	318
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	3.4	7.2
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	368	381	404	413	326
	Ammonia, Total (as N) (mg/L)	0.0663	0.0791	0.0130	0.0083	<0.0050
	Chloride (Cl) (mg/L)	<0.50	<0.50	<0.50	<0.50	7.26
	Nitrate and Nitrite (as N) (mg/L)	0.0507	0.0437	0.0611	0.0804	1.02
	Nitrate (as N) (mg/L)	0.0105	0.0094	0.0129	0.0168	0.963
	Nitrite (as N) (mg/L)	0.0401	0.0342	0.0482	0.0637	0.0528
	Sulfate (SO4) (mg/L)	214	206	185	183	154
	Anion Sum (meq/L)	11.8	11.9	11.9	12.1	9.98
	Cation Sum (meq/L)	11.1	10.7	11.2	11.8	9.76
	Cation - Anion Balance (%)	-3.1	-5.3	-3.2	-1.1	-1.1
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	<0.0050 ^{DLA}	0.0177	0.0021	0.0024	0.0074
	Antimony (Sb)-Dissolved (mg/L)	<0.00050 ^{DLA}	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00380	0.00071	0.00229	0.00079	0.00020
	Barium (Ba)-Dissolved (mg/L)	0.0304	0.0227	0.0168	0.0412	0.0151
	Beryllium (Be)-Dissolved (mg/L)	<0.00010 ^{DLA}	0.000020	0.000023	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.00025 ^{DLA}	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.180	0.140	0.153	0.099	0.083
	Cadmium (Cd)-Dissolved (mg/L)	0.000160	<0.0000050	<0.0000050	0.0000187	0.0000250
	Calcium (Ca)-Dissolved (mg/L)	127	101	102	104	80.0
	Chromium (Cr)-Dissolved (mg/L)	<0.00050 ^{DLA}	0.00020	<0.00010	<0.00010	0.00016
	Cobalt (Co)-Dissolved (mg/L)	<0.00050 ^{DLA}	<0.00010	<0.00010	0.00114	<0.00010
	Copper (Cu)-Dissolved (mg/L)	<0.0010 ^{DLA}	0.00267	<0.00020	0.00027	0.00095
	Iron (Fe)-Dissolved (mg/L)	1.07	0.943	0.773	0.140	0.025
	Lead (Pb)-Dissolved (mg/L)	<0.00025 ^{DLA}	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0081	0.0069	0.0060	0.0060	0.0049
	Magnesium (Mg)-Dissolved (mg/L)	36.6	49.6	54.7	60.3	52.1
	Manganese (Mn)-Dissolved (mg/L)	0.0290	0.0152	0.0403	0.369	0.0395

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2154209-1 Water 24-AUG-18 14:40 MW17-12-01	L2154209-2 Water 24-AUG-18 15:00 MW17-12-02	L2154209-3 Water 24-AUG-18 15:15 MW17-12-03	L2154209-4 Water 24-AUG-18 15:35 MW17-12-04	L2154209-5 Water 24-AUG-18 15:50 MW17-12-05
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00792	0.00780	0.00521	0.00532	0.0207
	Nickel (Ni)-Dissolved (mg/L)	<0.0025 ^{DLA}	<0.0025 ^{DLA}	<0.00050	<0.00050	0.00379
	Phosphorus (P)-Dissolved (mg/L)	<0.25 ^{DLA}	<0.25 ^{DLA}	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	3.51	3.16	2.85	2.96	4.20
	Selenium (Se)-Dissolved (mg/L)	<0.00025 ^{DLA}	<0.00025 ^{DLA}	0.000120	0.000607	0.000255
	Silicon (Si)-Dissolved (mg/L)	7.63	7.46	7.59	6.78	6.80
	Silver (Ag)-Dissolved (mg/L)	<0.000050 ^{DLA}	<0.000050 ^{DLA}	<0.000010	0.000015	<0.000010
	Sodium (Na)-Dissolved (mg/L)	250	219	60.6	32.9	30.3
	Strontium (Sr)-Dissolved (mg/L)	9.93	9.45	3.24	1.32	1.61
	Sulfur (S)-Dissolved (mg/L)	467	370	45.3	32.0	30.2
	Thallium (Tl)-Dissolved (mg/L)	<0.000050 ^{DLA}	<0.000050 ^{DLA}	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00050 ^{DLA}	<0.00050 ^{DLA}	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.0016	<0.0015 ^{DLA}	<0.00060 ^{DLM}	<0.00030	0.00137
	Uranium (U)-Dissolved (mg/L)	0.000298	0.000539	0.00431	0.00371	0.00399
	Vanadium (V)-Dissolved (mg/L)	<0.0025 ^{DLA}	<0.0025 ^{DLA}	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0427	0.0437	0.0480	0.0508	0.0260
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2154209-6 Water 24-AUG-18 16:05 MW17-12-06	L2154209-7 Water 24-AUG-18 16:20 MW17-12-07	L2154209-8 Water 24-AUG-18 16:45 MW17-12-08	L2154209-9 Water 24-AUG-18 DUP	L2154209-10 Water 25-AUG-18 14:30 MW12-06-01
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.0220	0.00651	0.00803	0.00656	0.000954
	Nickel (Ni)-Dissolved (mg/L)	0.00342	0.00057	<0.00050	<0.00050	0.00086
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	4.41	2.59	2.89	2.78	2.68
	Selenium (Se)-Dissolved (mg/L)	0.000850	0.000809	0.000224	0.000219	0.000534
	Silicon (Si)-Dissolved (mg/L)	6.57	6.42	6.85	6.79	7.52
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	34.6	23.0	22.1	21.3	55.8
	Strontium (Sr)-Dissolved (mg/L)	1.56	1.04	1.05	1.02	4.28
	Sulfur (S)-Dissolved (mg/L)	31.7	22.5	20.3	20.8	5.73
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	0.00014	0.00011	<0.00010	<0.00010	0.00029
	Titanium (Ti)-Dissolved (mg/L)	0.00071	0.00094	0.00095	<0.00030	0.00384
	Uranium (U)-Dissolved (mg/L)	0.00306	0.00236	0.00280	0.00280	0.000758
	Vanadium (V)-Dissolved (mg/L)	<0.00050	0.00062	0.00069	0.00059	0.0161
	Zinc (Zn)-Dissolved (mg/L)	0.524	0.281	0.0628	0.0455	0.0155
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	0.00108

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2154209-11 Water 25-AUG-18 15:30 MW12-06-02	L2154209-12 Water 25-AUG-18 15:45 MW12-06-03	L2154209-13 Water 25-AUG-18 16:00 MW12-06-04	L2154209-14 Water 25-AUG-18 16:15 MW12-06-05	L2154209-15 Water 25-AUG-18 16:30 MW12-06-06
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00858	0.00155	0.00817	0.00948	0.00612
	Nickel (Ni)-Dissolved (mg/L)	<0.0025 ^{DLA}	<0.00050	<0.00050	0.00061	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.25 ^{DLA}	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	3.38	3.66	3.49	3.91	3.61
	Selenium (Se)-Dissolved (mg/L)	<0.00025 ^{DLA}	0.000063	0.000081	<0.000050	0.000239
	Silicon (Si)-Dissolved (mg/L)	10.2	8.92	8.56	8.42	7.13
	Silver (Ag)-Dissolved (mg/L)	<0.000050 ^{DLA}	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	37.4	33.0	33.6	35.4	31.8
	Strontium (Sr)-Dissolved (mg/L)	9.63	4.38	3.01	2.93	1.69
	Sulfur (S)-Dissolved (mg/L)	72.8	64.8	60.4	61.2	50.7
	Thallium (Tl)-Dissolved (mg/L)	<0.000050 ^{DLA}	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00050 ^{DLA}	0.00012	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.0017	0.00149	<0.00030	<0.00030	0.00103
	Uranium (U)-Dissolved (mg/L)	0.00257	0.00218	0.00551	0.00620	0.00419
	Vanadium (V)-Dissolved (mg/L)	<0.0025 ^{DLA}	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0050 ^{DLA}	0.0057	0.0218	0.0206	0.0260
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Sulfate (SO4)	MS-B	L2154209-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-WR	Water	Nitrite & Nitrate Nitrogen	EPA 300.1
Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance.			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
CL-IC-N-WR	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NO2-L-IC-N-WR	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-WR	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)

Reference Information

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value
 This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-WR Water Sulfate in Water by IC EPA 300.1 (mod)
 Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)
 This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
 The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC
 This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-08-27 B 1 of 2 2018-08-27 B 2 of 2

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2154209-COFC

COC Number: 2018-08-27 B

Page 1 of 2

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[illegible]

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

WHITE - LABORATORY COPY

YELLOW - CLIENT COPY

OCTOBER 2015 FROM



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 29-AUG-18
Report Date: 10-SEP-18 13:30 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2155550
Project P.O. #: 229097
Job Reference:
C of C Numbers: 2018-08-29 C
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

10-SEP-18 13:30 (MT)

Version: FINAL

Sample ID Description Sampled Date Sampled Time Client ID		L2155550-1 Water 27-AUG-18 16:15 MW17-08-01	L2155550-2 Water 27-AUG-18 16:45 MW17-08-02	L2155550-3 Water 27-AUG-18 17:10 MW17-08-03	L2155550-4 Water 27-AUG-18 17:20 MW17-08-04	L2155550-5 Water 27-AUG-18 DUP
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	473	305	253	150	287
	Hardness (as CaCO3) (mg/L)	245	147	133	75.4	152
	pH (pH)	7.81	7.93	8.09	8.03	8.19
	Total Suspended Solids (mg/L)	11.2	3.4	3.8	4.0	<3.0
	TDS (Calculated) (mg/L)	260	162	141	81.6	163
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	220	154	137	76.6	152
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	220	154	137	76.6	152
	Ammonia, Total (as N) (mg/L)	0.0068	<0.0050	<0.0050	0.0184	<0.0050
	Chloride (Cl) (mg/L)	0.59	<0.50	<0.50	<0.50	<0.50
	Nitrate and Nitrite (as N) (mg/L)	0.373	0.669	0.775	0.603	0.675
	Nitrate (as N) (mg/L)	0.369	0.669	0.773	0.603	0.675
	Nitrite (as N) (mg/L)	0.0038	<0.0010	0.0018	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	37.3	12.0	5.16	2.33	11.8
	Anion Sum (meq/L)	5.22	3.37	2.90	1.62	3.33
	Cation Sum (meq/L)	5.26	3.16	2.85	1.64	3.29
	Cation - Anion Balance (%)	0.3	-3.2	-0.9	0.6	-0.6
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0016	0.0022	0.0042	0.0035	0.0019
	Antimony (Sb)-Dissolved (mg/L)	0.00013	<0.00010	<0.00010	<0.00010	0.00011
	Arsenic (As)-Dissolved (mg/L)	0.00015	0.00033	0.00018	0.00013	0.00028
	Barium (Ba)-Dissolved (mg/L)	0.00700	0.0894	0.0822	0.0249	0.0892
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.021	0.010	<0.010	<0.010	0.010
	Cadmium (Cd)-Dissolved (mg/L)	0.000201	0.0000170	0.0000369	0.0000227	0.0000270
	Calcium (Ca)-Dissolved (mg/L)	49.0	32.9	34.0	22.8	35.5
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00129	0.00245	0.00073	0.00036	0.00271
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0020	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)-Dissolved (mg/L)	29.8	15.6	11.7	4.48	15.5
	Manganese (Mn)-Dissolved (mg/L)	0.00114	0.00115	0.00039	0.00081	0.00134

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2155550-6 Water 28-AUG-18 11:10 MW17-DP01	L2155550-7 Water 28-AUG-18 11:25 MW17-DP02	L2155550-8 Water 28-AUG-18 11:35 MW17-DP03		
Grouping	Analyte						
WATER							
Physical Tests	Conductivity (uS/cm)		785	1550	1680		
	Hardness (as CaCO3) (mg/L)		166	668	698		
	pH (pH)		8.17	8.03	7.91		
	Total Suspended Solids (mg/L)		22.2	44.0	21.6		
	TDS (Calculated) (mg/L)		504	1160	1320		
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)		203	185	166		
	Alkalinity, Carbonate (as CaCO3) (mg/L)		<1.0	<1.0	<1.0		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)		<1.0	<1.0	<1.0		
	Alkalinity, Total (as CaCO3) (mg/L)		203	185	166		
	Ammonia, Total (as N) (mg/L)		1.33	7.40	4.53		
	Chloride (Cl) (mg/L)		24.8	50.6	24.9		
	Nitrate and Nitrite (as N) (mg/L)		<0.0051	11.7	1.77		
	Nitrate (as N) (mg/L)		<0.0050	9.59	0.308		
	Nitrite (as N) (mg/L)		<0.0010	2.09	1.46		
	Sulfate (SO4) (mg/L)		171	616	778		
	Anion Sum (meq/L)		8.30	18.8	20.4		
	Cation Sum (meq/L)		8.46	17.1	20.1		
	Cation - Anion Balance (%)		0.9	-4.7	-0.7		
Dissolved Metals	Dissolved Mercury Filtration Location		FIELD	FIELD	FIELD		
	Dissolved Metals Filtration Location		FIELD	FIELD	FIELD		
	Aluminum (Al)-Dissolved (mg/L)		0.0142	<0.0050 ^{DLA}	0.0045		
	Antimony (Sb)-Dissolved (mg/L)		0.00021	<0.00050 ^{DLA}	0.00027		
	Arsenic (As)-Dissolved (mg/L)		0.00071	0.00114	0.00052		
	Barium (Ba)-Dissolved (mg/L)		0.0300	0.0243	0.0174		
	Beryllium (Be)-Dissolved (mg/L)		<0.000020	<0.00010 ^{DLA}	<0.000020		
	Bismuth (Bi)-Dissolved (mg/L)		<0.000050	<0.00025 ^{DLA}	<0.000050		
	Boron (B)-Dissolved (mg/L)		0.073	0.157	0.163		
	Cadmium (Cd)-Dissolved (mg/L)		0.000241	0.000734	0.00106		
	Calcium (Ca)-Dissolved (mg/L)		44.1	177	197		
	Chromium (Cr)-Dissolved (mg/L)		0.00017	<0.00050 ^{DLA}	0.00025		
	Cobalt (Co)-Dissolved (mg/L)		0.00033	0.00260	0.00205		
	Copper (Cu)-Dissolved (mg/L)		0.0847	0.176	0.0816		
	Iron (Fe)-Dissolved (mg/L)		0.026	<0.050 ^{DLA}	<0.010		
	Lead (Pb)-Dissolved (mg/L)		<0.000050	<0.00025 ^{DLA}	<0.000050		
	Lithium (Li)-Dissolved (mg/L)		0.0047	0.0127	0.0096		
	Magnesium (Mg)-Dissolved (mg/L)		13.5	54.6	49.8		
	Manganese (Mn)-Dissolved (mg/L)		0.372	1.58	2.69		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2155550-1 Water 27-AUG-18 16:15 MW17-08-01	L2155550-2 Water 27-AUG-18 16:45 MW17-08-02	L2155550-3 Water 27-AUG-18 17:10 MW17-08-03	L2155550-4 Water 27-AUG-18 17:20 MW17-08-04	L2155550-5 Water 27-AUG-18 DUP
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00870	0.00299	0.000979	0.000433	0.00301
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	1.75	0.98	1.06	0.71	1.03
	Selenium (Se)-Dissolved (mg/L)	0.000498	0.000520	0.000441	0.000308	0.000800
	Silicon (Si)-Dissolved (mg/L)	5.34	4.70	4.43	4.09	4.75
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	7.27	4.80	3.78	2.63	4.93
	Strontium (Sr)-Dissolved (mg/L)	6.62	0.989	0.683	0.138	1.00
	Sulfur (S)-Dissolved (mg/L)	12.4	3.70	1.73	0.65	3.72
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.000247	0.000180	0.000141	0.000064	0.000166
	Vanadium (V)-Dissolved (mg/L)	<0.00050	0.00078	0.00064	0.00109	0.00079
	Zinc (Zn)-Dissolved (mg/L)	0.0300	0.0084	0.0158	0.0085	0.0175
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2155550-6 Water 28-AUG-18 11:10 MW17-DP01	L2155550-7 Water 28-AUG-18 11:25 MW17-DP02	L2155550-8 Water 28-AUG-18 11:35 MW17-DP03		
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Dissolved (mg/L)	0.0547	0.160	0.0380		
	Nickel (Ni)-Dissolved (mg/L)	0.00324	0.0067	0.00758		
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.25 ^{DLA}	<0.050		
	Potassium (K)-Dissolved (mg/L)	27.2	32.4	57.9		
	Selenium (Se)-Dissolved (mg/L)	0.000988	0.00276	0.00248		
	Silicon (Si)-Dissolved (mg/L)	2.73	3.33	4.24		
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000050 ^{DLA}	<0.000010		
	Sodium (Na)-Dissolved (mg/L)	99.7	54.0	97.6		
	Strontium (Sr)-Dissolved (mg/L)	3.60	24.1	16.3		
	Sulfur (S)-Dissolved (mg/L)	57.2	203	272		
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000050 ^{DLA}	0.000026		
	Tin (Sn)-Dissolved (mg/L)	0.00026	<0.00050 ^{DLA}	<0.00010		
	Titanium (Ti)-Dissolved (mg/L)	0.00098	<0.0015 ^{DLA}	<0.00039 ^{DLM}		
	Uranium (U)-Dissolved (mg/L)	0.000935	0.0112	0.00732		
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.0025 ^{DLA}	<0.00050		
	Zinc (Zn)-Dissolved (mg/L)	0.0061	0.0057	0.0047		
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2155550-1, -3, -4, -5, -6, -7, -8
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2155550-2
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2155550-1, -3, -4, -5, -6, -7, -8
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2155550-2
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2155550-1, -3, -4, -5, -6, -7, -8
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2155550-2
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2155550-1, -3, -4, -5, -6, -7, -8
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2155550-2
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2155550-1, -3, -4, -5, -6, -7, -8
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2155550-2
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2155550-2

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-WR	Water	Nitrite & Nitrate Nitrogen	EPA 300.1
Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance.			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
CL-IC-N-WR	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			

Reference Information

NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NO2-L-IC-N-WR	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-WR	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
SO4-IC-WR	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)
This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".			
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.			
TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.			
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-08-29 C

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 03-OCT-18
Report Date: 15-OCT-18 14:43 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2175233
Project P.O. #: 229097
Job Reference:
C of C Numbers: 2018-10-03 D
Legal Site Desc:

Shane Stack
Account Manager

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ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2175233-1 Water 28-SEP-18 13:40 MW12-07-02	L2175233-2 Water 28-SEP-18 15:05 MW09-03-01	L2175233-3 Water 28-SEP-18 15:40 MW09-03-02		
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	890	333	547		
	Hardness (as CaCO3) (mg/L)	389	145	240		
	pH (pH)	8.02	8.30	8.31		
	Total Suspended Solids (mg/L)	3.3	<3.0	<3.0		
	TDS (Calculated) (mg/L)	594	175	301		
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	168	152	262		
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	4.8	5.8		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0		
	Alkalinity, Total (as CaCO3) (mg/L)	168	157	268		
	Ammonia, Total (as N) (mg/L)	0.0232	0.0544	0.0056		
	Chloride (Cl) (mg/L)	<2.5 ^{DLDS}	<0.50	0.89		
	Nitrate and Nitrite (as N) (mg/L)	0.199	0.0261	8.05		
	Nitrate (as N) (mg/L)	0.154	<0.0050	8.02		
	Nitrite (as N) (mg/L)	0.0453	0.0261	0.0339		
	Sulfate (SO4) (mg/L)	312	18.2	5.64		
	Anion Sum (meq/L)	9.87	3.52	6.07		
	Cation Sum (meq/L)	9.56	3.37	5.13		
	Cation - Anion Balance (%)	-1.6	-2.1	-8.4		
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD		
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD		
	Aluminum (Al)-Dissolved (mg/L)	0.0018	0.0033	0.0017		
	Antimony (Sb)-Dissolved (mg/L)	0.00017	0.00017	0.00011		
	Arsenic (As)-Dissolved (mg/L)	0.00096	0.00099	0.00025		
	Barium (Ba)-Dissolved (mg/L)	0.0226	0.0585	0.0356		
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020		
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050		
	Boron (B)-Dissolved (mg/L)	0.332	0.253	0.150		
	Cadmium (Cd)-Dissolved (mg/L)	<0.000055 ^{DLM}	0.0000627	0.0000561		
	Calcium (Ca)-Dissolved (mg/L)	111	39.7	79.9		
	Chromium (Cr)-Dissolved (mg/L)	0.00019	0.00017	0.00021		
	Cobalt (Co)-Dissolved (mg/L)	0.00026	<0.00010	<0.00010		
	Copper (Cu)-Dissolved (mg/L)	0.00147	0.00213	0.00326		
	Iron (Fe)-Dissolved (mg/L)	<0.010	0.401	<0.010		
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050		
	Lithium (Li)-Dissolved (mg/L)	0.0172	0.0036	0.0014		
	Magnesium (Mg)-Dissolved (mg/L)	27.0	11.2	9.85		
	Manganese (Mn)-Dissolved (mg/L)	0.809	0.100	0.0115		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2175233-1 Water 28-SEP-18 13:40 MW12-07-02	L2175233-2 Water 28-SEP-18 15:05 MW09-03-01	L2175233-3 Water 28-SEP-18 15:40 MW09-03-02		
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Dissolved (mg/L)	0.0287	0.00517	0.00393		
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	0.00119	<0.00050		
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050		
	Potassium (K)-Dissolved (mg/L)	2.74	2.25	2.57		
	Selenium (Se)-Dissolved (mg/L)	0.000623	0.000076	0.000163		
	Silicon (Si)-Dissolved (mg/L)	6.22	5.28	5.19		
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010		
	Sodium (Na)-Dissolved (mg/L)	38.7	8.82	5.99		
	Strontium (Sr)-Dissolved (mg/L)	3.31	0.900	0.461		
	Sulfur (S)-Dissolved (mg/L)	103	6.06	1.96		
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010		
	Tin (Sn)-Dissolved (mg/L)	<0.00010	0.00012	<0.00010		
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030		
	Uranium (U)-Dissolved (mg/L)	0.00301	0.000789	0.00367		
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050		
	Zinc (Zn)-Dissolved (mg/L)	0.0771	0.0340	0.0452		
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2175233-1, -2
Matrix Spike	Boron (B)-Dissolved	MS-B	L2175233-1, -2
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2175233-1, -2
Matrix Spike	Iron (Fe)-Dissolved	MS-B	L2175233-1, -2
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2175233-1, -2
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2175233-1, -2
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2175233-1, -2
Matrix Spike	Silicon (Si)-Dissolved	MS-B	L2175233-1, -2
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2175233-1, -2
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2175233-1, -2

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			

Reference Information

NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
SO4-IC-N-VA	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)
This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".			
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.			
TSS-MAN-WR	Water	Total Suspended Solids by Gravimetric	APHA 2540 D
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids are determined by filtering a sample through a glass fibre filter and drying the filter at 104 degrees celsius.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-10-03 D

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

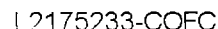
Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Canada Toll Free: 1 800 668 9878



COC Number: 2018-10-03 D

Page 1 of 1

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REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 29-OCT-18
Report Date: 07-NOV-18 16:58 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2188456
Project P.O. #: 229097
Job Reference:
C of C Numbers: 2018-10-27 A
Legal Site Desc:

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2188456-1 Water 19-OCT-18 14:30 MW09-03-01	L2188456-2 Water 19-OCT-18 14:55 MW09-03-02	L2188456-3 Water 20-OCT-18 11:40 MW12-07-02	L2188456-4 Water 22-OCT-18 10:45 MW12-05-01	L2188456-5 Water 22-OCT-18 11:15 MW12-05-02
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	301	385	812	2170	2150
	Hardness (as CaCO3) (mg/L)	147	199	380	928	933
	pH (pH)	8.06	7.98	8.05	7.97	8.11
	Total Suspended Solids (mg/L)	7.6	4.8	<3.0	5.6	8.2
	TDS (Calculated) (mg/L)	165	222	551	1810	1810
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	139	186	124	90.9	156
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	139	186	124	90.9	156
	Ammonia, Total (as N) (mg/L)	0.0441	<0.0050	0.0081	0.0470	0.0418
	Chloride (Cl) (mg/L)	0.54	0.86	2.6	14	14
	Nitrate and Nitrite (as N) (mg/L)	0.0486	4.89	0.342	<0.10	<0.10
	Nitrate (as N) (mg/L)	0.0094	4.85	0.235	<0.10 ^{DLDS}	<0.10 ^{DLDS}
	Nitrite (as N) (mg/L)	0.0392	0.0383	0.107	<0.020 ^{DLDS}	<0.020 ^{DLDS}
	Sulfate (SO4) (mg/L)	17.9	5.77	298	1240	1210
	Anion Sum (meq/L)	3.16	4.21	8.76	28.0	28.8
	Cation Sum (meq/L)	3.38	4.27	9.25	25.4	24.9
	Cation - Anion Balance (%)	3.4	0.7	2.7	-4.9	-7.3
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0147	0.0081	0.0215	0.0049	0.0088
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00020 ^{DLA}	<0.00020 ^{DLA}
	Arsenic (As)-Dissolved (mg/L)	0.00933	0.00040	0.00592	0.00498	0.00190
	Barium (Ba)-Dissolved (mg/L)	0.0699	0.0286	0.0257	0.0353	0.0843
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000040 ^{DLA}	<0.000040 ^{DLA}
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.00010 ^{DLA}	<0.00010 ^{DLA}
	Boron (B)-Dissolved (mg/L)	0.090	0.045	0.126	0.108	0.081
	Cadmium (Cd)-Dissolved (mg/L)	0.0000786	0.0000372	0.000102	0.000025	<0.000010 ^{DLA}
	Calcium (Ca)-Dissolved (mg/L)	40.5	66.2	110	308	285
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00023 ^{DLA}	0.00030 ^{DLA}
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	0.00028	<0.00020 ^{DLA}	<0.00020 ^{DLA}
	Copper (Cu)-Dissolved (mg/L)	0.00313	0.00362	0.00494	<0.00040 ^{DLA}	<0.00040 ^{DLA}
	Iron (Fe)-Dissolved (mg/L)	0.411	0.027	0.047	0.041	0.043
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.00010 ^{DLA}	<0.00010 ^{DLA}
	Lithium (Li)-Dissolved (mg/L)	0.0036	0.0014	0.0165	0.0073	0.0049
	Magnesium (Mg)-Dissolved (mg/L)	11.1	8.12	25.5	38.4	53.7
	Manganese (Mn)-Dissolved (mg/L)	0.0954	0.00418	0.771	0.156	0.825

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2188456-6 Water 22-OCT-18 13:30 MW12-05-03	L2188456-7 Water 22-OCT-18 13:50 MW12-05-04	L2188456-8 Water 22-OCT-18 14:15 MW12-05-05	L2188456-9 Water 22-OCT-18 14:30 MW12-05-06	L2188456-10 Water 22-OCT-18 14:45 MW12-05-07
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	1760	498	497	505	498
	Hardness (as CaCO3) (mg/L)	808	236	244	245	245
	pH (pH)	7.98	8.10	7.98	8.01	8.03
	Total Suspended Solids (mg/L)	4.6	<3.0	<3.0	<3.0	3.0
	TDS (Calculated) (mg/L)	1370	271	269	278	278
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	214	203	191	202	201
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	214	203	191	202	201
	Ammonia, Total (as N) (mg/L)	0.0413	0.0405	0.0095	<0.0050	0.114
	Chloride (Cl) (mg/L)	9.6	5.02	5.31	5.15	5.57
	Nitrate and Nitrite (as N) (mg/L)	0.143	0.0835	0.0244	0.0823	<0.0051
	Nitrate (as N) (mg/L)	0.105	0.0677	0.0147	0.0678	<0.0050
	Nitrite (as N) (mg/L)	0.038	0.0158	0.0097	0.0145	0.0047
	Sulfate (SO4) (mg/L)	844	44.3	50.1	51.8	52.0
	Anion Sum (meq/L)	22.1	5.13	5.01	5.26	5.26
	Cation Sum (meq/L)	20.9	5.68	5.67	5.68	5.70
	Cation - Anion Balance (%)	-2.9	5.1	6.2	3.8	4.0
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0043	0.0107	0.0062	0.0808	0.0160
	Antimony (Sb)-Dissolved (mg/L)	<0.00020 ^{DLA}	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00220	0.00330	0.00058	0.00054	0.00095
	Barium (Ba)-Dissolved (mg/L)	0.0395	0.0562	0.0724	0.0744	0.129
	Beryllium (Be)-Dissolved (mg/L)	<0.000040 ^{DLA}	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.00010 ^{DLA}	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.087	0.059	0.031	0.030	0.036
	Cadmium (Cd)-Dissolved (mg/L)	0.000040	0.0000054	0.0000146	0.0000209	0.0000057
	Calcium (Ca)-Dissolved (mg/L)	205	47.3	52.0	53.1	53.5
	Chromium (Cr)-Dissolved (mg/L)	<0.00020 ^{DLA}	0.00013	<0.00010	<0.00010	0.00016
	Cobalt (Co)-Dissolved (mg/L)	<0.00020 ^{DLA}	<0.00010	<0.00010	0.00028	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00056	0.00062	0.00139	0.0148	0.00186
	Iron (Fe)-Dissolved (mg/L)	0.435	0.063	0.059	0.175	0.335
	Lead (Pb)-Dissolved (mg/L)	<0.00010 ^{DLA}	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0041	0.0032	0.0036	0.0036	0.0037
	Magnesium (Mg)-Dissolved (mg/L)	71.6	28.5	27.7	27.3	27.0
	Manganese (Mn)-Dissolved (mg/L)	2.16	0.223	0.141	0.205	0.165

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2188456-1 Water 19-OCT-18 14:30 MW09-03-01	L2188456-2 Water 19-OCT-18 14:55 MW09-03-02	L2188456-3 Water 20-OCT-18 11:40 MW12-07-02	L2188456-4 Water 22-OCT-18 10:45 MW12-05-01	L2188456-5 Water 22-OCT-18 11:15 MW12-05-02
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00445	0.00322	0.0279	0.00023	0.00014
	Nickel (Ni)-Dissolved (mg/L)	0.00102	<0.00050	<0.00050	<0.0010 ^{DLA}	<0.0010 ^{DLA}
	Phosphorus (P)-Dissolved (mg/L)	<0.050	0.170	<0.050	<0.10 ^{DLA}	<0.10 ^{DLA}
	Potassium (K)-Dissolved (mg/L)	2.30	2.91	3.01	3.56	3.88
	Selenium (Se)-Dissolved (mg/L)	<0.000050	0.000184	0.000439	0.00018	<0.00010 ^{DLA}
	Silicon (Si)-Dissolved (mg/L)	5.29	5.42	6.16	7.31	7.07
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000020 ^{DLA}	<0.000020 ^{DLA}
	Sodium (Na)-Dissolved (mg/L)	8.17	5.03	35.4	154	140
	Strontium (Sr)-Dissolved (mg/L)	0.911	0.397	3.34	9.12	10.5
	Sulfur (S)-Dissolved (mg/L)	6.06	1.43	106	474	440
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000020 ^{DLA}	<0.000020 ^{DLA}
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00020 ^{DLA}	<0.00020 ^{DLA}
	Titanium (Ti)-Dissolved (mg/L)	0.00096	0.00108	0.00257	<0.00060 ^{DLA}	<0.00060 ^{DLA}
	Uranium (U)-Dissolved (mg/L)	0.000993	0.00311	0.00328	0.000915	0.000467
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.0010 ^{DLA}	<0.0010 ^{DLA}
	Zinc (Zn)-Dissolved (mg/L)	0.0390	0.0306	0.0619	0.0056	0.0044
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2188456-6 Water 22-OCT-18 13:30 MW12-05-03	L2188456-7 Water 22-OCT-18 13:50 MW12-05-04	L2188456-8 Water 22-OCT-18 14:15 MW12-05-05	L2188456-9 Water 22-OCT-18 14:30 MW12-05-06	L2188456-10 Water 22-OCT-18 14:45 MW12-05-07
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00021	0.00215	0.00434	0.00508	0.00272
	Nickel (Ni)-Dissolved (mg/L)	<0.0010 ^{DLA}	<0.00050	0.00056	0.00195	0.00096
	Phosphorus (P)-Dissolved (mg/L)	<0.10 ^{DLA}	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	3.83	2.30	2.26	2.22	2.26
	Selenium (Se)-Dissolved (mg/L)	<0.00010 ^{DLA}	0.000247	<0.000050	0.000089	0.000141
	Silicon (Si)-Dissolved (mg/L)	7.82	6.26	6.08	6.21	6.48
	Silver (Ag)-Dissolved (mg/L)	<0.000020 ^{DLA}	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	105	20.7	16.9	16.2	16.5
	Strontium (Sr)-Dissolved (mg/L)	7.78	0.950	0.820	0.817	0.806
	Sulfur (S)-Dissolved (mg/L)	327	21.2	17.7	18.1	19.6
	Thallium (Tl)-Dissolved (mg/L)	<0.000020 ^{DLA}	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00020 ^{DLA}	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00060 ^{DLA}	<0.0012 ^{DLM}	0.00050	0.00812	0.00162
	Uranium (U)-Dissolved (mg/L)	0.00133	0.00269	0.00342	0.00350	0.00282
	Vanadium (V)-Dissolved (mg/L)	<0.0010 ^{DLA}	0.00057	<0.00050	0.00077	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0190	0.0032	0.0063	0.0066	0.0046
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2188456-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2188456-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2188456-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2188456-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2188456-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Nitrate (as N)	MS-B	L2188456-1, -10, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Weston et			

Reference Information

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NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
SO4-IC-N-VA	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)
This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".			
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.			
TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.			
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-10-27 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Report To			Contact and companyname below will appear on the final report			Report Format / Distribution			Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply											
Company:			Minto Explorations Ltd.			Select Report Format: ☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)			Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply											
Contact:			Minto Environment - Coordinator			Quality Control (QC) Report with Report ☒ YES ☐ NO			PRIORITY (Business Days) 4 day [P4] ☐ 3 day [P3] ☐ 2 day [P2] ☐ EMERGENCY 1 Business day [E1] ☐ Same Day, Weekend or Statutory holiday [E0] ☐											
Phone:			1-604-759-4659			☒ Compare Results to Criteria on Report - provide details below if box checked														
			Companyaddress below will appear on the final report			Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX														
Street:			2100-510 West Georgia St.			Email 1 or Fax mintoenvironment@mintomine.com			Date and Time Required for all E&P TATs:											
City/Province:			Vancouver, British Columbia			Email 2			For tests that can not be performed according to the service level selected, you will be contacted.											
Postal Code:			V6B 0M3			Email 3			Analysis Request											
Invoice To			Same as Report To ☐ YES ☒ NO			Invoice Distribution			Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below											
			Copy of Invoice with Report ☐ YES ☒ NO			Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX			P F/P P F/P P F/P											
Company:			Minto Explorations Ltd.			Email 1 or Fax ap@mintomine.com			Total Metals (TW) Dissolved Metals (DM) Total Mercury, Hardness Dissolved Mercury Ammonia (Total Nutrients) Dissolved Organic Carbon (DOC) pH, Cond., TSS, TDS, Alkalinity, Anions Dissolved Bromide (Br-D) Number of Containers											
Contact:			Ruth Cayetano			Email 2														
Project Information			Oil and Gas Required Fields (client use)																	
ALS Account # / Quote #:			AFE/Cost Center:			PO#														
Job #:			Major/Minor Code:			Routing Code:														
PO / AFE:			229097 (GW)			Requisitioner:														
LSD:						Location:														
ALS Lab Work Order # (lab use only)						ALS Contact:			Sampler:			CR/CH								
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)				Date (dd-mm-yy)	Time (hh:mm)	Sample Type													
	MW09-03-01				19-Oct-18	14:30	Water	4												
	MW09-03-02				19-Oct-18	14:55	Water	4												
	MW12-07-02				20-Oct-18	11:40	Water	4												
	MW12-05-01				22-Oct-18	10:45	Water	4												
	MW12-05-02				22-Oct-18	11:15	Water	4												
	MW12-05-03				22-Oct-18	13:30	Water	4												
	MW12-05-04				22-Oct-18	13:50	Water	4												
	MW12-05-05				22-Oct-18	14:15	Water	4												
	MW12-05-06				22-Oct-18	14:30	Water	4												
	MW12-05-07				22-Oct-18	14:45	Water	4												
Drinking Water (DW) Samples ¹ (client use)			Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)			SAMPLE CONDITION AS RECEIVED (lab use only)														
Are samples taken from a Regulated DW System? ☐ YES ☒ NO						Frozen ☐ SIF Observations Yes ☐ No ☐														
Are samples for human drinking water use? ☐ YES ☒ NO						Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐														
						Cooling Initiated ☐														
						INITIAL COOLER TEMPERATURES °C 3.0 FINAL COOLER TEMPERATURES °C 5														
SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)														
Released by: Corey Roberts	Date: 2018-10-27	Time:	Received by: EHF	Date: 29 Oct 2018	Time: 09:40	Received by: HA	Date: 10/30	Time: 2pm												

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FROM

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 29-OCT-18
Report Date: 07-NOV-18 17:58 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2188487
Project P.O. #: 229097
Job Reference:
C of C Numbers: 2018-10-27 C
Legal Site Desc:

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2188487-1 Water 23-OCT-18 14:25 MW17-12-01	L2188487-2 Water 23-OCT-18 14:40 MW17-12-02	L2188487-3 Water 23-OCT-18 14:55 MW17-12-03	L2188487-4 Water 23-OCT-18 15:15 MW17-12-04	L2188487-5 Water 23-OCT-18 15:35 MW17-12-05
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	2490	2180	865	737	753
	Hardness (as CaCO3) (mg/L)	942	726	344	343	376
	pH (pH)	8.09	8.13	7.85	7.86	7.94
	Total Suspended Solids (mg/L)	9.8	8.6	<3.0	<3.0	<3.0
	TDS (Calculated) (mg/L)	2040	1680	522	436	441
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	209	237	336	313	325
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	209	237	336	313	325
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Chloride (Cl) (mg/L)	13	11.4	<2.5 ^{DLDS}	<2.5 ^{DLDS}	2.5
	Nitrate and Nitrite (as N) (mg/L)	<0.10 ^{DLDS}	<0.051 ^{DLDS}	<0.025 ^{DLDS}	0.222	0.199
	Nitrate (as N) (mg/L)	<0.10 ^{DLDS}	<0.050 ^{DLDS}	<0.025 ^{DLDS}	0.222	0.199
	Nitrite (as N) (mg/L)	<0.020 ^{DLDS}	<0.010 ^{DLDS}	<0.0050 ^{DLDS}	<0.0050 ^{DLDS}	<0.0050 ^{DLDS}
	Sulfate (SO4) (mg/L)	1310	1030	136	102	87.5
	Anion Sum (meq/L)	31.7	26.5	9.55	8.40	8.40
	Cation Sum (meq/L)	29.9	24.5	9.81	8.45	9.10
	Cation - Anion Balance (%)	-3.0	-4.0	1.3	0.3	4.0
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0024	0.0023	0.0019	0.0027	0.0046
	Antimony (Sb)-Dissolved (mg/L)	<0.00020 ^{DLA}	<0.00020 ^{DLA}	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00425	0.00405	0.00149	0.00226	0.00047
	Barium (Ba)-Dissolved (mg/L)	0.0103	0.00794	0.0158	0.0248	0.0784
	Beryllium (Be)-Dissolved (mg/L)	0.000056 ^{DLA}	<0.000040 ^{DLA}	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.00010 ^{DLA}	<0.00010 ^{DLA}	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.166	0.137	0.051	0.035	0.031
	Cadmium (Cd)-Dissolved (mg/L)	0.000067	0.000020	0.0000057	0.0000212	0.0000290
	Calcium (Ca)-Dissolved (mg/L)	289	219	79.9	60.1	64.3
	Chromium (Cr)-Dissolved (mg/L)	<0.00020 ^{DLA}	<0.00020 ^{DLA}	<0.00010	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00020 ^{DLA}	<0.00020 ^{DLA}	<0.00010	<0.00010	0.00032
	Copper (Cu)-Dissolved (mg/L)	<0.00040 ^{DLA}	<0.00040 ^{DLA}	<0.00020	0.00123	0.00318
	Iron (Fe)-Dissolved (mg/L)	3.01	2.20	0.102	<0.010	0.024
	Lead (Pb)-Dissolved (mg/L)	<0.00010 ^{DLA}	<0.00010 ^{DLA}	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0154	0.0142	0.0089	0.0069	0.0091
	Magnesium (Mg)-Dissolved (mg/L)	53.6	43.4	35.2	46.7	52.2
	Manganese (Mn)-Dissolved (mg/L)	0.105	0.0508	0.106	0.00228	0.274

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2188487-6 Water 23-OCT-18 15:50 MW17-12-06	L2188487-7 Water 23-OCT-18 16:05 MW17-12-07	L2188487-8 Water 23-OCT-18 16:30 MW17-12-08	L2188487-9 Water 23-OCT-18 DUP 2	
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	755	566	572	567	
	Hardness (as CaCO3) (mg/L)	369	268	275	271	
	pH (pH)	7.94	7.98	8.08	7.96	
	Total Suspended Solids (mg/L)	<3.0	<3.0	8.0	<3.0	
	TDS (Calculated) (mg/L)	443	316	327	322	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	323	231	243	239	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Total (as CaCO3) (mg/L)	323	231	243	239	
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	Chloride (Cl) (mg/L)	2.8	4.62	4.52	4.58	
	Nitrate and Nitrite (as N) (mg/L)	0.240	0.751	0.734	0.741	
	Nitrate (as N) (mg/L)	0.240	0.749	0.730	0.739	
	Nitrite (as N) (mg/L)	<0.0050 ^{DLDS}	0.0027	0.0036	0.0024	
	Sulfate (SO4) (mg/L)	93.6	61.9	62.4	62.2	
	Anion Sum (meq/L)	8.49	6.09	6.34	6.26	
	Cation Sum (meq/L)	8.88	6.35	6.53	6.36	
	Cation - Anion Balance (%)	2.2	2.0	1.4	0.8	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0052	0.0061	0.0099	0.0047	
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Arsenic (As)-Dissolved (mg/L)	0.00031	0.00047	0.00069	0.00040	
	Barium (Ba)-Dissolved (mg/L)	0.0620	0.0236	0.0247	0.0234	
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	0.032	0.024	0.025	0.023	
	Cadmium (Cd)-Dissolved (mg/L)	0.0000258	0.0000113	0.0000120	0.0000117	
	Calcium (Ca)-Dissolved (mg/L)	64.7	47.4	49.6	48.2	
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Cobalt (Co)-Dissolved (mg/L)	0.00022	<0.00010	<0.00010	<0.00010	
	Copper (Cu)-Dissolved (mg/L)	0.00296	0.00079	0.00152	0.00094	
	Iron (Fe)-Dissolved (mg/L)	<0.010	0.010	0.015	<0.010	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.0092	0.0063	0.0062	0.0057	
	Magnesium (Mg)-Dissolved (mg/L)	50.4	36.3	36.8	36.5	
	Manganese (Mn)-Dissolved (mg/L)	0.151	0.00400	0.00135	0.00094	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2188487-1 Water 23-OCT-18 14:25 MW17-12-01	L2188487-2 Water 23-OCT-18 14:40 MW17-12-02	L2188487-3 Water 23-OCT-18 14:55 MW17-12-03	L2188487-4 Water 23-OCT-18 15:15 MW17-12-04	L2188487-5 Water 23-OCT-18 15:35 MW17-12-05
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00801	0.00775	0.00536	0.00526	0.0201
	Nickel (Ni)-Dissolved (mg/L)	<0.0010 ^{DLA}	<0.0010 ^{DLA}	0.00144	<0.00050	0.00430
	Phosphorus (P)-Dissolved (mg/L)	<0.10 ^{DLA}	<0.10 ^{DLA}	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	3.56	3.18	3.23	3.26	4.73
	Selenium (Se)-Dissolved (mg/L)	<0.00010 ^{DLA}	<0.00010 ^{DLA}	<0.000050	0.000652	0.000257
	Silicon (Si)-Dissolved (mg/L)	7.83	7.74	8.03	7.04	6.92
	Silver (Ag)-Dissolved (mg/L)	<0.000020 ^{DLA}	<0.000020 ^{DLA}	<0.000010	0.000015	<0.000010
	Sodium (Na)-Dissolved (mg/L)	248	226	65.2	35.0	33.5
	Strontium (Sr)-Dissolved (mg/L)	9.61	9.27	3.42	1.37	1.66
	Sulfur (S)-Dissolved (mg/L)	529	417	50.4	36.3	31.7
	Thallium (Tl)-Dissolved (mg/L)	<0.000020 ^{DLA}	<0.000020 ^{DLA}	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00020 ^{DLA}	<0.00020 ^{DLA}	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00060 ^{DLA}	<0.00060 ^{DLA}	<0.00030	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.000272	0.000536	0.00445	0.00389	0.00395
	Vanadium (V)-Dissolved (mg/L)	<0.0010 ^{DLA}	<0.0010 ^{DLA}	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0574	0.0468	0.0195	0.101	0.0430
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2188487-6 Water 23-OCT-18 15:50 MW17-12-06	L2188487-7 Water 23-OCT-18 16:05 MW17-12-07	L2188487-8 Water 23-OCT-18 16:30 MW17-12-08	L2188487-9 Water 23-OCT-18 DUP 2	
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Dissolved (mg/L)	0.0216	0.00642	0.00787	0.00626	
	Nickel (Ni)-Dissolved (mg/L)	0.00326	<0.00050	<0.00050	<0.00050	
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Potassium (K)-Dissolved (mg/L)	4.88	2.91	3.15	2.89	
	Selenium (Se)-Dissolved (mg/L)	0.000197	0.000224	0.000225	0.000254	
	Silicon (Si)-Dissolved (mg/L)	7.08	6.65	6.69	6.67	
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	0.000011	<0.000010	
	Sodium (Na)-Dissolved (mg/L)	31.6	21.1	21.6	20.3	
	Strontium (Sr)-Dissolved (mg/L)	1.55	0.942	0.988	0.971	
	Sulfur (S)-Dissolved (mg/L)	32.8	22.2	22.7	23.1	
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	0.00046	<0.0015 ^{DLM}	0.00035	
	Uranium (U)-Dissolved (mg/L)	0.00401	0.00271	0.00271	0.00277	
	Vanadium (V)-Dissolved (mg/L)	0.00055	0.00067	0.00072	0.00067	
	Zinc (Zn)-Dissolved (mg/L)	0.0209	0.0188	0.0304	0.0217	
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Laboratory Control Sample	Sulfur (S)-Dissolved	MES	L2188487-1, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)

Reference Information

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
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VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
----	---

Chain of Custody Numbers:

2018-10-27 C

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 29-OCT-18
Report Date: 16-NOV-18 10:28 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2188498
Project P.O. #: 229097
Job Reference:
C of C Numbers: 2018-10-27 D
Legal Site Desc:

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2188498-1 Water 25-OCT-18 13:55 MW12-06-01	L2188498-2 Water 25-OCT-18 14:30 MW12-06-02	L2188498-3 Water 25-OCT-18 14:50 MW12-06-03	L2188498-4 Water 25-OCT-18 15:10 MW12-06-04	L2188498-5 Water 25-OCT-18 15:30 MW12-06-05
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	919	995	992	985	987
	Hardness (as CaCO3) (mg/L)	387	465	471	481	472
	pH (pH)	7.40	7.82	7.92	7.88	7.95
	Total Suspended Solids (mg/L)	<3.0	19.5	5.9	4.7	3.7
	TDS (Calculated) (mg/L)	491	635	627	619	614
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	473	367	378	407	401
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	473	367	378	407	401
	Ammonia, Total (as N) (mg/L)	0.0860	0.0379	0.0703	0.0103	<0.0050
	Chloride (Cl) (mg/L)	5.0	<2.5 ^{DLDS}	<2.5 ^{DLDS}	<2.5 ^{DLDS}	<2.5 ^{DLDS}
	Nitrate and Nitrite (as N) (mg/L)	0.057 ^{DLDS}	0.140	0.069 ^{DLDS}	0.058 ^{DLDS}	0.054 ^{DLDS}
	Nitrate (as N) (mg/L)	<0.025 ^{DLDS}	0.027	<0.025 ^{DLDS}	<0.025 ^{DLDS}	<0.025 ^{DLDS}
	Nitrite (as N) (mg/L)	0.0567 ^{DLDS}	0.114	0.0686	0.0579	0.0539
	Sulfate (SO4) (mg/L)	<1.5 ^{DLDS}	209	206	180	183
	Anion Sum (meq/L)	9.60	11.7	11.8	11.9	11.8
	Cation Sum (meq/L)	10.4	11.1	11.1	11.3	11.0
	Cation - Anion Balance (%)	3.8	-2.6	-3.3	-2.7	-3.7
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0277	<0.0020 ^{DLA}	<0.0010	0.0013	0.0014
	Antimony (Sb)-Dissolved (mg/L)	0.00018	<0.00020 ^{DLA}	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00892	0.00595	0.00156	0.00339	0.00146
	Barium (Ba)-Dissolved (mg/L)	0.345	0.0273	0.0245	0.0183	0.0416
	Beryllium (Be)-Dissolved (mg/L)	0.000165	<0.000040 ^{DLA}	0.000024	0.000024	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.00010 ^{DLA}	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.259	0.203 ^{DLA}	0.106	0.096	0.092
	Cadmium (Cd)-Dissolved (mg/L)	0.0000107	<0.000010 ^{DLA}	<0.0000050	<0.0000050	0.0000051
	Calcium (Ca)-Dissolved (mg/L)	118	124	104	99.1	97.4
	Chromium (Cr)-Dissolved (mg/L)	0.00449	<0.00020 ^{DLA}	0.00020	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00020 ^{DLA}	<0.00010	<0.00010	0.00113
	Copper (Cu)-Dissolved (mg/L)	<0.00020	<0.00040 ^{DLA}	<0.00020	<0.00020	<0.00020
	Iron (Fe)-Dissolved (mg/L)	0.489	1.19 ^{DLA}	1.07	0.825	0.136
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.00010 ^{DLA}	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0105	0.0083	0.0073	0.0062	0.0061
	Magnesium (Mg)-Dissolved (mg/L)	22.4	37.8	51.6	56.7	55.4
	Manganese (Mn)-Dissolved (mg/L)	0.341	0.0266	0.0154	0.0457	0.400

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2188498-6 Water 25-OCT-18 15:50 MW12-06-06	L2188498-7 Water 26-OCT-18 09:15 MW17-11-01	L2188498-8 Water 26-OCT-18 09:35 MW17-11-02	L2188498-9 Water 26-OCT-18 09:50 MW17-11-03	L2188498-10 Water 26-OCT-18 10:00 MW17-11-04
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	838	333	342	291	605
	Hardness (as CaCO3) (mg/L)	394	126	141	135	674
	pH (pH)	8.00	8.21	8.18	8.19	7.81
	Total Suspended Solids (mg/L)	3.7	4.5	<3.0	<3.0	4.3
	TDS (Calculated) (mg/L)	514	187	192	160	521
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	316	134	142	141	285
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	316	134	142	141	285
	Ammonia, Total (as N) (mg/L)	<0.0050	0.0073	<0.0050	<0.0050	0.106
	Chloride (Cl) (mg/L)	7.5	0.59	<0.50	<0.50	1.12
	Nitrate and Nitrite (as N) (mg/L)	1.00	<0.0051	0.0883	<0.0051	9.23
	Nitrate (as N) (mg/L)	0.952	<0.0050	0.0872	<0.0050	9.22
	Nitrite (as N) (mg/L)	0.0503	0.0033	0.0011	<0.0010	0.0044
	Sulfate (SO4) (mg/L)	153	36.6	39.2	16.9	18.5
	Anion Sum (meq/L)	9.79	3.46	3.65	3.17	6.77
	Cation Sum (meq/L)	9.27	3.57	3.57	3.18	15.0
	Cation - Anion Balance (%)	-2.7	1.6	-1.1	0.2	37.9
						BL:INT
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	<0.0010	0.0054	0.0024	0.0039	0.0030
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	0.00025
	Arsenic (As)-Dissolved (mg/L)	0.00065	0.00190	0.00126	0.00068	0.00067
	Barium (Ba)-Dissolved (mg/L)	0.0141	0.0399	0.0416	0.0569	0.329
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.081	0.026	0.019	<0.010	0.021
	Cadmium (Cd)-Dissolved (mg/L)	0.0000072	0.0000321	0.0000097	0.0000109	0.0000200
	Calcium (Ca)-Dissolved (mg/L)	76.9	34.3	38.4	35.6	211
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	0.00059
	Copper (Cu)-Dissolved (mg/L)	<0.00020	0.00054	0.00026	<0.00020	0.00680
	Iron (Fe)-Dissolved (mg/L)	<0.010	0.403	0.076	0.014	0.016
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0050	0.0057	0.0053	0.0041	0.0123
	Magnesium (Mg)-Dissolved (mg/L)	49.1	9.84	10.9	11.2	35.7
	Manganese (Mn)-Dissolved (mg/L)	0.0395	0.0494	0.0511	0.114	0.0712

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2188498-11 Water 25-OCT-18 DUP				
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	979				
	Hardness (as CaCO3) (mg/L)	505				
	pH (pH)	7.94				
	Total Suspended Solids (mg/L)	3.7				
	TDS (Calculated) (mg/L)	625				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	407				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Total (as CaCO3) (mg/L)	407				
	Ammonia, Total (as N) (mg/L)	0.0121				
	Chloride (Cl) (mg/L)	<2.5 ^{DLDS}				
	Nitrate and Nitrite (as N) (mg/L)	0.032				
	Nitrate (as N) (mg/L)	<0.025 ^{DLDS}				
	Nitrite (as N) (mg/L)	0.0315				
	Sulfate (SO4) (mg/L)	176				
	Anion Sum (meq/L)	11.8				
	Cation Sum (meq/L)	11.8				
	Cation - Anion Balance (%)	0.1				
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD				
	Dissolved Metals Filtration Location	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	0.0021				
	Antimony (Sb)-Dissolved (mg/L)	<0.00010				
	Arsenic (As)-Dissolved (mg/L)	0.00106				
	Barium (Ba)-Dissolved (mg/L)	0.0388				
	Beryllium (Be)-Dissolved (mg/L)	<0.000020				
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050				
	Boron (B)-Dissolved (mg/L)	0.107				
	Cadmium (Cd)-Dissolved (mg/L)	0.0000060				
	Calcium (Ca)-Dissolved (mg/L)	104				
	Chromium (Cr)-Dissolved (mg/L)	0.00014				
	Cobalt (Co)-Dissolved (mg/L)	0.00115				
	Copper (Cu)-Dissolved (mg/L)	<0.00020				
	Iron (Fe)-Dissolved (mg/L)	0.137				
	Lead (Pb)-Dissolved (mg/L)	<0.000050				
	Lithium (Li)-Dissolved (mg/L)	0.0067				
	Magnesium (Mg)-Dissolved (mg/L)	59.7				
	Manganese (Mn)-Dissolved (mg/L)	0.386				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2188498-1 Water 25-OCT-18 13:55 MW12-06-01	L2188498-2 Water 25-OCT-18 14:30 MW12-06-02	L2188498-3 Water 25-OCT-18 14:50 MW12-06-03	L2188498-4 Water 25-OCT-18 15:10 MW12-06-04	L2188498-5 Water 25-OCT-18 15:30 MW12-06-05
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00109	0.00922	0.00199	0.00831	0.00919
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.0010 ^{DLA}	<0.00050	<0.00050	0.00056
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.10 ^{DLA}	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	3.00	3.67	3.89	3.88	3.78
	Selenium (Se)-Dissolved (mg/L)	0.00115	0.00020	0.000095	<0.000050	<0.000050
	Silicon (Si)-Dissolved (mg/L)	8.05	10.3	9.01	8.45	8.17
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000020 ^{DLA}	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	57.6	38.2	34.3	34.4	33.2
	Strontium (Sr)-Dissolved (mg/L)	5.12	9.70	4.51	2.89	2.65
	Sulfur (S)-Dissolved (mg/L)	25.1	80.7	73.2	67.2	66.5
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000020 ^{DLA}	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	0.00017	<0.00020 ^{DLA}	0.00011	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00432	<0.00060 ^{DLA}	<0.00030	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.000696	0.00263	0.00221	0.00571	0.00603
	Vanadium (V)-Dissolved (mg/L)	0.0187	<0.0010 ^{DLA}	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0023	0.0061	0.0023	0.0114	0.0155
	Zirconium (Zr)-Dissolved (mg/L)	0.00116	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2188498-6 Water 25-OCT-18 15:50 MW12-06-06	L2188498-7 Water 26-OCT-18 09:15 MW17-11-01	L2188498-8 Water 26-OCT-18 09:35 MW17-11-02	L2188498-9 Water 26-OCT-18 09:50 MW17-11-03	L2188498-10 Water 26-OCT-18 10:00 MW17-11-04
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	0.0000051
	Molybdenum (Mo)-Dissolved (mg/L)	0.00569	0.0167	0.00593	0.00406	0.0198
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	0.00054	0.00823
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	3.39	2.31	2.27	2.20	15.8
	Selenium (Se)-Dissolved (mg/L)	0.000326	<0.000050	<0.000050	<0.000050	0.000929
	Silicon (Si)-Dissolved (mg/L)	6.74	5.55	4.98	4.91	23.9
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	0.000027
	Sodium (Na)-Dissolved (mg/L)	30.1	22.3	16.0	9.53	26.4
	Strontium (Sr)-Dissolved (mg/L)	1.46	0.907	0.906	0.951	1.84
	Sulfur (S)-Dissolved (mg/L)	55.6	11.5	13.6	4.91	8.18
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	0.000017
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	0.00033
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00393	0.000163	0.000347	0.00137	0.0111
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	0.00073
	Zinc (Zn)-Dissolved (mg/L)	0.0192	0.0119	0.0121	0.0106	0.0419
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2188498-11 Water 25-OCT-18 DUP				
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050				
	Molybdenum (Mo)-Dissolved (mg/L)	0.00926				
	Nickel (Ni)-Dissolved (mg/L)	0.00061				
	Phosphorus (P)-Dissolved (mg/L)	<0.050				
	Potassium (K)-Dissolved (mg/L)	3.98				
	Selenium (Se)-Dissolved (mg/L)	<0.000050				
	Silicon (Si)-Dissolved (mg/L)	8.81				
	Silver (Ag)-Dissolved (mg/L)	<0.000010				
	Sodium (Na)-Dissolved (mg/L)	37.0				
	Strontium (Sr)-Dissolved (mg/L)	2.75				
	Sulfur (S)-Dissolved (mg/L)	62.4				
	Thallium (Tl)-Dissolved (mg/L)	<0.000010				
	Tin (Sn)-Dissolved (mg/L)	<0.00010				
	Titanium (Ti)-Dissolved (mg/L)	<0.00030				
	Uranium (U)-Dissolved (mg/L)	0.00588				
	Vanadium (V)-Dissolved (mg/L)	<0.00050				
	Zinc (Zn)-Dissolved (mg/L)	0.0177				
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Laboratory Control Sample	Sulfur (S)-Dissolved	MES	L2188498-10, -11, -7, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2188498-10, -11, -7, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2188498-10, -11, -7, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2188498-10, -11, -7, -9
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2188498-10, -11, -7, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2188498-10, -11, -7, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2188498-10, -11, -7, -9
Matrix Spike	Nitrate (as N)	MS-B	L2188498-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
BL:INT	Balance Reviewed: Interference Or Non-Measured Component
DLA	Detection Limit adjusted for required dilution
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			

Reference Information

NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
SO4-IC-N-VA	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)
This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".			
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.			
TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.			
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
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VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
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Chain of Custody Numbers:

2018-10-27 D

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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Drinking Water (DW) Samples¹ (client use)					Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)					SAMPLE CONDITION AS RECEIVED (lab use only)																																																																																																																																																																																																				
Are samples taken from a Regulated DW System? ☐ YES ☒ NO										Frozen ☐ SIF Observations Yes ☐ No ☐																																																																																																																																																																																																				
Are samples for human drinking water use? ☐ YES ☒ NO										Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐																																																																																																																																																																																																				
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Released by: Corey Roberts		Date: 2018-10-27		Time:		Received by: EHF		Date: 29 Oct 2018		Time: 0740		Received by: H/A		Date: 10/30		Time: 2P																																																																																																																																																																																														

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy
1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 29-OCT-18
Report Date: 16-NOV-18 10:38 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2188505
Project P.O. #: 229097
Job Reference:
C of C Numbers: 2018-10-27 E
Legal Site Desc:

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

16-NOV-18 10:38 (MT)

Version: FINAL

Sample ID Description Sampled Date Sampled Time Client ID		L2188505-1 Water 26-OCT-18 13:50 MW17-10-01	L2188505-2 Water 26-OCT-18 14:10 MW17-10-02	L2188505-3 Water 26-OCT-18 14:30 MW17-10-03	L2188505-4 Water 26-OCT-18 16:15 MW17-08-01	L2188505-5 Water 26-OCT-18 16:55 MW17-08-02
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	387	435	450	454	298
	Hardness (as CaCO3) (mg/L)	183	204	198	232	156
	pH (pH)	8.10	8.07	8.09	8.15	8.16
	Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0	5.9	4.1
	TDS (Calculated) (mg/L)	225	266	274	224	138
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	99.9	108	108	169	108
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	99.9	108	108	169	108
	Ammonia, Total (as N) (mg/L)	0.0062	<0.0050	<0.0050	<0.0050	<0.0050
	Chloride (Cl) (mg/L)	0.86	0.98	1.00	<0.50	<0.50
	Nitrate and Nitrite (as N) (mg/L)	8.45	21.7	24.4	0.379	0.669
	Nitrate (as N) (mg/L)	8.45	21.7	24.4	0.379	0.669
	Nitrite (as N) (mg/L)	0.0014	0.0011	0.0022	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	53.7	24.1	23.2	36.9	12.0
	Anion Sum (meq/L)	3.74	4.24	4.40	4.18	2.46
	Cation Sum (meq/L)	4.10	4.41	4.29	5.00	3.36
	Cation - Anion Balance (%)	4.6	2.1	-1.3	8.9	15.6
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0048	0.0024	0.0026	<0.0010	0.0019
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00244	0.00654	0.00502	0.00523	0.00479
	Barium (Ba)-Dissolved (mg/L)	0.0301	0.0331	0.0360	0.00949	0.0927
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.015	<0.010	<0.010	0.021	0.010
	Cadmium (Cd)-Dissolved (mg/L)	0.0000301	0.0000144	0.0000268	0.0000294	0.0000114
	Calcium (Ca)-Dissolved (mg/L)	45.5	55.2	54.7	45.8	37.1
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	0.00040	0.00070	0.00053	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00429	0.00172	0.00174	0.00033	0.00245
	Iron (Fe)-Dissolved (mg/L)	0.016	<0.010	<0.010	<0.010	<0.010
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0017	0.0011	0.0011	0.0020	<0.0010
	Magnesium (Mg)-Dissolved (mg/L)	16.8	15.9	15.0	28.6	15.4
	Manganese (Mn)-Dissolved (mg/L)	0.0447	0.00268	0.00137	0.00086	0.00085

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2188505-6 Water 26-OCT-18 17:10 MW17-08-03	L2188505-7 Water 26-OCT-18 17:30 MW17-08-04	L2188505-8 Water 26-OCT-18 DUP		
Grouping	Analyte						
WATER							
Physical Tests	Conductivity (uS/cm)		258	153	453		
	Hardness (as CaCO3) (mg/L)		139	74.2	239		
	pH (pH)		8.11	8.05	8.07		
	Total Suspended Solids (mg/L)		<3.0	3.1	<3.0		
	TDS (Calculated) (mg/L)		140	81.0	255		
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)		132	76.2	218		
	Alkalinity, Carbonate (as CaCO3) (mg/L)		<1.0	<1.0	<1.0		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)		<1.0	<1.0	<1.0		
	Alkalinity, Total (as CaCO3) (mg/L)		132	76.2	218		
	Ammonia, Total (as N) (mg/L)		<0.0050	0.0184	<0.0050		
	Chloride (Cl) (mg/L)		<0.50	<0.50	<0.50		
	Nitrate and Nitrite (as N) (mg/L)		0.774	0.596	0.375		
	Nitrate (as N) (mg/L)		0.774	0.594	0.375		
	Nitrite (as N) (mg/L)		<0.0010	0.0020	<0.0010		
	Sulfate (SO4) (mg/L)		5.08	2.20	37.1		
	Anion Sum (meq/L)		2.79	1.61	5.16		
	Cation Sum (meq/L)		2.97	1.63	5.13		
	Cation - Anion Balance (%)		3.0	0.5	-0.3		
Dissolved Metals	Dissolved Mercury Filtration Location		FIELD	FIELD	FIELD		
	Dissolved Metals Filtration Location		FIELD	FIELD	FIELD		
	Aluminum (Al)-Dissolved (mg/L)		0.0037	0.0037	0.0019		
	Antimony (Sb)-Dissolved (mg/L)		<0.00010	<0.00010	<0.00010		
	Arsenic (As)-Dissolved (mg/L)		0.00332	0.00489	0.00310		
	Barium (Ba)-Dissolved (mg/L)		0.0923	0.0275	0.00819		
	Beryllium (Be)-Dissolved (mg/L)		<0.000020	<0.000020	<0.000020		
	Bismuth (Bi)-Dissolved (mg/L)		<0.000050	<0.000050	<0.000050		
	Boron (B)-Dissolved (mg/L)		<0.010	<0.010	0.022		
	Cadmium (Cd)-Dissolved (mg/L)		0.0000066	0.0000402	0.0000313		
	Calcium (Ca)-Dissolved (mg/L)		35.6	22.2	47.6		
	Chromium (Cr)-Dissolved (mg/L)		<0.00010	<0.00010	<0.00010		
	Cobalt (Co)-Dissolved (mg/L)		<0.00010	<0.00010	<0.00010		
	Copper (Cu)-Dissolved (mg/L)		0.00065	0.00096	0.00055		
	Iron (Fe)-Dissolved (mg/L)		<0.010	<0.010	<0.010		
	Lead (Pb)-Dissolved (mg/L)		<0.000050	<0.000050	<0.000050		
	Lithium (Li)-Dissolved (mg/L)		<0.0010	<0.0010	0.0020		
	Magnesium (Mg)-Dissolved (mg/L)		12.1	4.54	29.1		
	Manganese (Mn)-Dissolved (mg/L)		0.00031	0.00089	0.00060		

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2188505-1 Water 26-OCT-18 13:50 MW17-10-01	L2188505-2 Water 26-OCT-18 14:10 MW17-10-02	L2188505-3 Water 26-OCT-18 14:30 MW17-10-03	L2188505-4 Water 26-OCT-18 16:15 MW17-08-01	L2188505-5 Water 26-OCT-18 16:55 MW17-08-02
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.0193	0.00753	0.00706	0.00876	0.00309
	Nickel (Ni)-Dissolved (mg/L)	0.0101	0.00284	0.00319	<0.00050	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	1.66	1.75	1.73	1.68	1.03
	Selenium (Se)-Dissolved (mg/L)	0.000724	0.00171	0.00206	0.000399	0.000514
	Silicon (Si)-Dissolved (mg/L)	5.23	4.99	4.97	4.94	4.51
	Silver (Ag)-Dissolved (mg/L)	0.000011	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	9.34	6.95	6.43	7.15	4.96
	Strontium (Sr)-Dissolved (mg/L)	1.13	0.917	0.818	6.29	1.04
	Sulfur (S)-Dissolved (mg/L)	17.5	7.88	7.29	12.1	3.58
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00246	0.00124	0.00118	0.000250	0.000164
	Vanadium (V)-Dissolved (mg/L)	0.00104	0.00059	0.00060	<0.00050	0.00084
	Zinc (Zn)-Dissolved (mg/L)	0.0222	0.0269	0.0355	0.0363	0.0127
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2188505-6 Water 26-OCT-18 17:10 MW17-08-03	L2188505-7 Water 26-OCT-18 17:30 MW17-08-04	L2188505-8 Water 26-OCT-18 DUP		
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Dissolved (mg/L)	0.000941	0.000562	0.00873		
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	0.00078	<0.00050		
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050		
	Potassium (K)-Dissolved (mg/L)	1.04	0.73	1.70		
	Selenium (Se)-Dissolved (mg/L)	0.000287	0.000158	0.000437		
	Silicon (Si)-Dissolved (mg/L)	4.20	3.61	5.07		
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010		
	Sodium (Na)-Dissolved (mg/L)	3.88	2.84	7.30		
	Strontium (Sr)-Dissolved (mg/L)	0.695	0.168	6.47		
	Sulfur (S)-Dissolved (mg/L)	1.13	<0.50	12.7		
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010		
	Tin (Sn)-Dissolved (mg/L)	<0.00010	0.00105	<0.00010		
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030		
	Uranium (U)-Dissolved (mg/L)	0.000139	0.000070	0.000264		
	Vanadium (V)-Dissolved (mg/L)	0.00071	0.00103	<0.00050		
	Zinc (Zn)-Dissolved (mg/L)	0.0128	0.0367	0.0321		
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2188505-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2188505-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2188505-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2188505-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2188505-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Nitrate (as N)	MS-B	L2188505-1, -2, -3, -4, -5, -6, -7, -8

Qualifiers for Individual Parameters Listed:

Qualifier	Description
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-WR	Water	Nitrite & Nitrate Nitrogen	EPA 300.1
Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance.			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
CL-IC-N-WR	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Weston et al.			
NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			

Reference Information

NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
SO4-IC-WR	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)
This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".			
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.			
TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.			
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-10-27 E

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 01-NOV-18
Report Date: 13-NOV-18 18:31 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2190627
Project P.O. #: 229097
Job Reference:
C of C Numbers: 2018-10-31 C
Legal Site Desc:

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2190627-1 Water 27-OCT-18 15:20 MW17-DP03				
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	2390				
	Hardness (as CaCO3) (mg/L)	1230				
	pH (pH)	7.95				
	Total Suspended Solids (mg/L)	51.3				
	TDS (Calculated) (mg/L)	2120				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	176				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Total (as CaCO3) (mg/L)	176				
	Ammonia, Total (as N) (mg/L)	2.66				
	Chloride (Cl) (mg/L)	32.9				
	Nitrate and Nitrite (as N) (mg/L)	<0.051				
	Nitrate (as N) (mg/L)	<0.050 ^{DLDS}				
	Nitrite (as N) (mg/L)	<0.010 ^{DLDS}				
	Sulfate (SO4) (mg/L)	1340				
	Anion Sum (meq/L)	32.3				
	Cation Sum (meq/L)	32.0				
	Cation - Anion Balance (%)	-0.5				
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD				
	Dissolved Metals Filtration Location	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	0.0054				
	Antimony (Sb)-Dissolved (mg/L)	<0.00050 ^{DLA}				
	Arsenic (As)-Dissolved (mg/L)	<0.00050 ^{DLA}				
	Barium (Ba)-Dissolved (mg/L)	0.00702				
	Beryllium (Be)-Dissolved (mg/L)	<0.00010 ^{DLA}				
	Bismuth (Bi)-Dissolved (mg/L)	<0.00025 ^{DLA}				
	Boron (B)-Dissolved (mg/L)	0.273				
	Cadmium (Cd)-Dissolved (mg/L)	0.00192				
	Calcium (Ca)-Dissolved (mg/L)	385				
	Chromium (Cr)-Dissolved (mg/L)	<0.00050 ^{DLA}				
	Cobalt (Co)-Dissolved (mg/L)	0.00436				
	Copper (Cu)-Dissolved (mg/L)	0.0897				
	Iron (Fe)-Dissolved (mg/L)	<0.050 ^{DLA}				
	Lead (Pb)-Dissolved (mg/L)	<0.00025 ^{DLA}				
	Lithium (Li)-Dissolved (mg/L)	0.0181				
	Magnesium (Mg)-Dissolved (mg/L)	65.0				
	Manganese (Mn)-Dissolved (mg/L)	5.50				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2190627-1 Water 27-OCT-18 15:20 MW17-DP03				
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050				
	Molybdenum (Mo)-Dissolved (mg/L)	0.0413				
	Nickel (Ni)-Dissolved (mg/L)	0.0167				
	Phosphorus (P)-Dissolved (mg/L)	<0.25 ^{DLA}				
	Potassium (K)-Dissolved (mg/L)	52.5				
	Selenium (Se)-Dissolved (mg/L)	0.00180				
	Silicon (Si)-Dissolved (mg/L)	5.30				
	Silver (Ag)-Dissolved (mg/L)	<0.000050 ^{DLA}				
	Sodium (Na)-Dissolved (mg/L)	131				
	Strontium (Sr)-Dissolved (mg/L)	17.5				
	Sulfur (S)-Dissolved (mg/L)	435				
	Thallium (Tl)-Dissolved (mg/L)	<0.000050 ^{DLA}				
	Tin (Sn)-Dissolved (mg/L)	<0.00050 ^{DLA}				
	Titanium (Ti)-Dissolved (mg/L)	<0.0015 ^{DLA}				
	Uranium (U)-Dissolved (mg/L)	0.0114				
	Vanadium (V)-Dissolved (mg/L)	<0.0025 ^{DLA}				
	Zinc (Zn)-Dissolved (mg/L)	<0.0050 ^{DLA}				
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Laboratory Control Sample	Sulfur (S)-Dissolved	MES	L2190627-1
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2190627-1
Matrix Spike	Iron (Fe)-Dissolved	MS-B	L2190627-1
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2190627-1
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2190627-1
Matrix Spike	Silicon (Si)-Dissolved	MS-B	L2190627-1
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2190627-1
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2190627-1
Matrix Spike	Nitrate (as N)	MS-B	L2190627-1
Matrix Spike	Sulfate (SO4)	MS-B	L2190627-1

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			

Reference Information

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
SO4-IC-N-VA	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)
This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".			
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.			
TSS-MAN-WR	Water	Total Suspended Solids by Gravimetric	APHA 2540 D
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids are determined by filtering a sample through a glass fibre filter and drying the filter at 104 degrees celsius.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-10-31 C

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

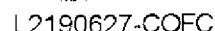
Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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Page 1 of 1

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[illegible]

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

OCTOBER 2015 ERO

Rev

Appendix D – Seepage Monitoring Program Laboratory Results

1. Seepage Site GPS Coordinates

ID	Coordinates		Spring 2018	Fall 2018
	Northing	Easting		
Mill Valley Fill Extension				
SS9	N62° 37.007'	W137° 13.296'		X
SS36	N62° 37.040'	W137° 13.313'		X
SS60	N62° 37.088'	W137° 13.432'		X
SS61	N62° 37.202'	W137° 13.266'		X
SS100	N62° 37.225'	W137° 13.305'	X	
W8A	N62° 37.089'	W137° 13.650'	X	X
W62	N62° 37.223'	W137° 13.279'	X	X
Southwest Dump				
SS13	N62° 36.539'	W137° 15.840'	X	
SS30	N62° 36.625'	W137° 15.836'		X
SS31	N62° 36.570'	W137° 15.858'	X	X
SS43	N62° 36.592'	W137° 15.857'		X
SS44	N62° 36.421'	W137° 15.818'		X
SS51	N62° 36.463'	W137° 15.793'		X
SS54	N62° 36.857'	W137° 15.607'		X
SS56	N62° 36.789'	W137° 15.719'		X
SS57	N62° 36.637'	W137° 15.830'		X
W32	N62° 36.811'	W137° 15.694'	X	
Water Storage Pond Dam				
W17	N62° 37.454'	W137° 12.551'	X	X
Ore Stockpile				
SS5	N62° 37.034'	W137° 14.133'	X	X
SS6	N62° 37.025'	W137° 14.122'	X	X
SS7	N62° 36.999'	W137° 14.108'	X	X
SS8	N62° 36.985'	W137° 14.101'	X	X
SS33	N62° 37.034'	W137° 14.147'		X
Main Waste Dump				
SS102	N62° 37.010'	W137° 15.597		X
Camp				
SS32	N62° 37.302'	W137° 14.032'	X	X
Minto North				
SS101	N62° 37.598'	W137° 15.710	X	
Ice-Rich Overburden Dump (Pelly)				
SS39	N62° 36.976'	W137° 15.886'	X	
SS48	N62° 36.953'	W137° 16.005'		X

ID	Coordinates		Spring 2018	Fall 2018
	Northing	Easting		
SS49	N62° 36.912'	W137° 16.000'		x
SS50	N62° 36.890'	W137° 15.900'		x
SS63	N62° 36.937'	W137° 16.014'		x
SS64	N62° 36.921'	W137° 16.017'		x
SS65	N62° 36.818'	W137° 15.658'		x
Ridgetop Road				
SS58	N62° 36.597'	W137° 14.048'	x	

2. Seepage Site Photos

1.1 Dry Stack Tailings Facility & Mill Valley Fill

1.1.1 SS9



Figure 2-1: SS9 Upstream (Fall 2018)



Figure 2-2: SS9 Sampling Site (Fall 2018)



Figure 2-3: SS9 Downstream (Fall 2018)



Figure 2-4: SS9 Surroundings (Fall 2018)

1.1.2 SS36



Figure 2-5: SS39 Sampling Site (Fall 2018)



Figure 2-6: SS36 Upstream (Fall 2018)



Figure 2-7: SS36 Downstream (Fall 2018)



Figure 2-8: SS36 Downstream (Fall 2018)

1.1.3 SS60



Figure 2-9: SS60 Sampling Site (Fall 2018)



Figure 2-10: SS60 Downstream (Fall 2018)



Figure 2-11: SS60 Upstream (Fall 2018)

1.1.4 SS61



Figure 2-12: SS61 Downstream (Fall 2018)



Figure 2-13: SS61 Upstream (Fall 2018)



Figure 2-14: SS61 Sampling Site (Fall 2018)

1.1.5 SS100



Figure 2-15: SS100 Upstream (Spring 2018)



Figure 2-16: SS100 Downstream (Spring 2018)



Figure 2-17: SS100 Sampling Site (Spring 2018)

1.1.6 W8A



Figure 2-18: W8A Culvert Catchment (Fall 2017)

1.2 Southwest Dump

1.2.1 SS13



Figure 2-19: SS13 Upstream (Spring 2018)



Figure 2-20: SS13 Downstream (Spring 2018)



Figure 2-21: SS13 Sampling Site (Spring 2018)

1.2.2 SS30



Figure 2-22: SS30 Sampling Site (Fall 2018)



Figure 2-23: SS30 Downstream (Fall 2018)



Figure 2-24: SS30 Upstream (Fall 2018)

1.2.3 SS31



Figure 2-25: SS31 Downstream (Spring 2018)



Figure 2-26: SS31 Upstream (Spring 2018)



Figure 2-27: SS31 Sampling Site (Spring 2018)



Figure 2-28: SS31 Sampling Site (Fall 2018)



Figure 2-29: SS31 Downstream (Fall 2018)



Figure 2-30: SS31 Upstream (Fall 2018)

1.2.4 SS43



Figure 2-31: SS43 Sampling Site (Fall 2018)



Figure 2-32: SS43 Downstream (Fall 2018)



Figure 2-33: SS43 Upstream (Fall 2018)

1.2.5 SS44



Figure 2-34: SS44 Sampling Site (Fall 2018)



Figure 2-35: SS44 Downstream (Fall 2018)



Figure 2-36: SS44 Upstream (Fall 2018)

1.2.6 SS51



Figure 2-37: SS51 Sampling Site (Fall 2018)



Figure 2-38: SS51 Sampling Site Close-up (Fall 2018)



Figure 2-39: SS51 Upstream (Fall 2018)



Figure 2-40: SS51 Downstream (Fall 2018)

1.2.7 SS54



Figure 2-41: SS54 Sampling Site (Fall 2018)

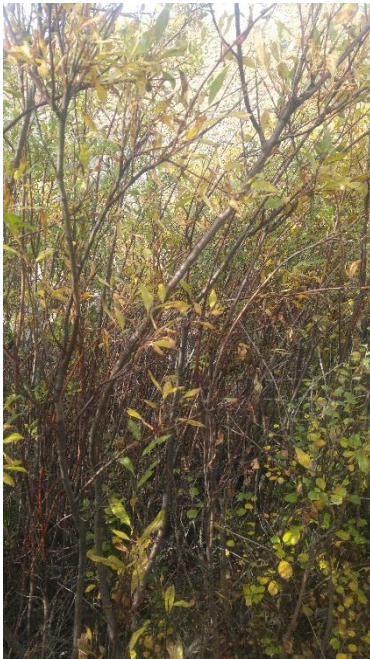


Figure 2-42: SS54 Downstream (Fall 2018)



Figure 2-43: SS54 Upstream (Fall 2018)

1.2.8 SS57



Figure 2-44: SS57 Sampling Site (Fall 2018)



Figure 2-45: SS57 Downstream (Fall 2018)



Figure 2-46: SS57 Upstream (Fall 2018)

1.2.9 SS65



Figure 2-47: SS65 Sampling Site (Fall 2018)



Figure 2-48: SS65 Downstream (Fall 2018)



Figure 2-49: SS65 Upstream (Fall 2018)

1.2.10 W32



Figure 2-50: W32 Upstream (Spring 2018)



Figure 2-51: W32 Downstream (Spring 2018)



Figure 2-52: W32 Sampling Site (Spring 2018)

1.3 Water Storage Pond Dam Seep

1.3.1 W17



Figure 2-53: W17 Sampling Site (Summer 2018)

1.4 Ore Stockpiles

1.4.1 SS5



Figure 2-54: SS5 Upstream (Spring 2018)



Figure 2-55: SS5 Sampling Site (Spring 2018)



Figure 2-56: SS5 Downstream (Spring 2018)

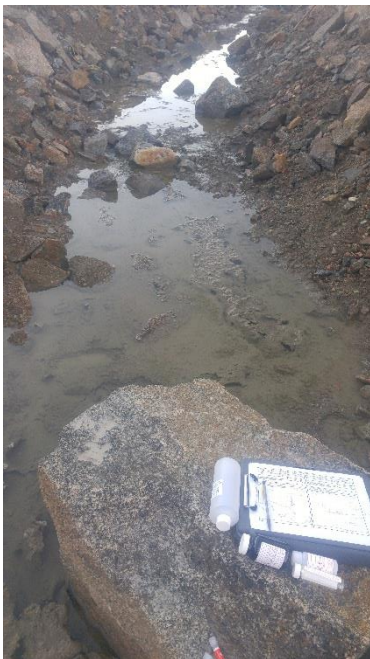


Figure 2-57: SS5 Upstream (Fall 2018)



Figure 2-58: SS5 Downstream (Fall 2018)



Figure 2-59: SS5 Bermed Sampling Site (Fall 2018)

1.4.2 SS6



Figure 2-60: SS6 Upstream (Spring 2018)



Figure 2-61: SS6 Sampling Site (Spring 2018)



Figure 2-62: SS6 Downstream (Spring 2018)



Figure 2-63: SS6 Downstream (Fall 2018)



Figure 2-64: SS6 Sampling Site (Fall 2018)

1.4.3 SS7



Figure 2-65: SS7 Downstream (Spring 2018)



Figure 2-66: SS7 Sampling Site (Spring 2018)



Figure 2-67: SS7 Upstream (Spring 2018)



Figure 2-68: SS7 Sampling Site (Fall 2018)



Figure 2-69: SS7 Downstream (Fall 2018)



Figure 2-70: SS7 Upstream (Fall 2018)

1.4.4 SS8



Figure 2-71: SS8 Upstream (Spring 2018)



Figure 2-72: SS8 Sampling Site (Spring 2018)



Figure 2-73: SS8 Downstream (Spring 2018)



Figure 2-74: SS8 Upstream (Fall 2018)



Figure 2-75: SS8 Downstream (Fall 2018)



Figure 2-76: SS8 Sampling Site (Fall 2018)

1.4.5 SS33



Figure 2-77: SS33 Upstream (Fall 2018)



Figure 2-78: SS33 Downstream (Fall 2018)



Figure 2-79: SS33 Sampling Site (Fall 2018)

1.5 Mill Area (Camp)

1.5.1 SS32



Figure 2-80: SS32 Sampling Site (Spring 2018)



Figure 2-81: SS32 Downstream (Spring 2018)



Figure 2-82: SS32 Upstream Rock Face (Spring 2018)



Figure 2-83: SS32 Downstream (Fall 2018)



Figure 2-84: SS32 Upstream Rock Face (Fall 2018)

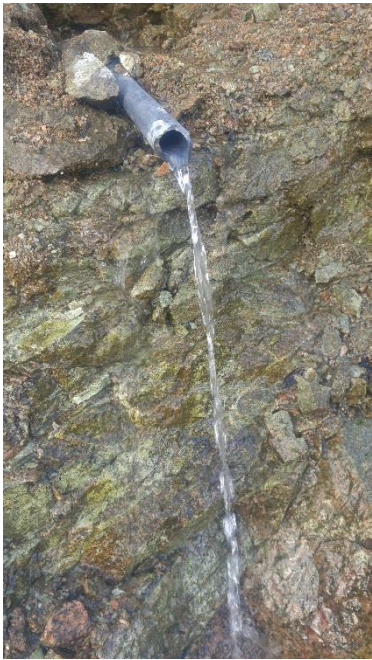


Figure 2-85: SS32 Sampling Site (Fall 2018)

1.6 Minto North Road and Main Waste Dump

1.6.1 SS101



Figure 2-86: SS101 Sampling Site (Spring 2018)



Figure 2-87: SS101 Upstream (Spring 2018)



Figure 2-88: SS101 Downstream (Spring 2018)

1.6.2 SS102



Figure 2-89: SS102 Sampling Site (Fall 2018)



Figure 2-90: SS102 Upstream (Fall 2018)

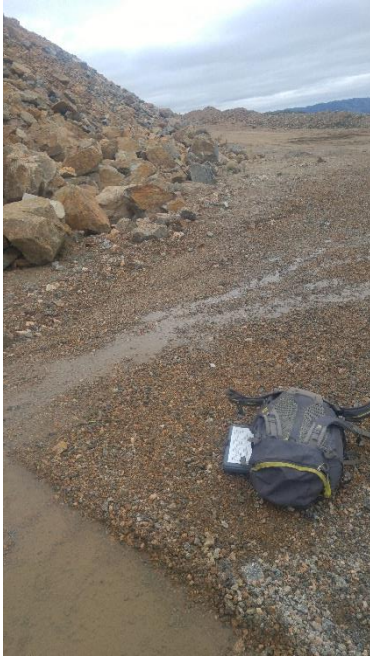


Figure 2-91: SS102 Downstream (Fall 2018)

1.7 Ice-Rich Overburden Dump

1.7.1 SS39



Figure 2-92: SS39 Stream (Spring 2018)



Figure 2-93: SS39 Downstream (Spring 2018)



Figure 2-94: SS39 Sampling Site (Spring 2018)



Figure 2-95: SS39 Upstream (Spring 2018)

1.7.2 SS48

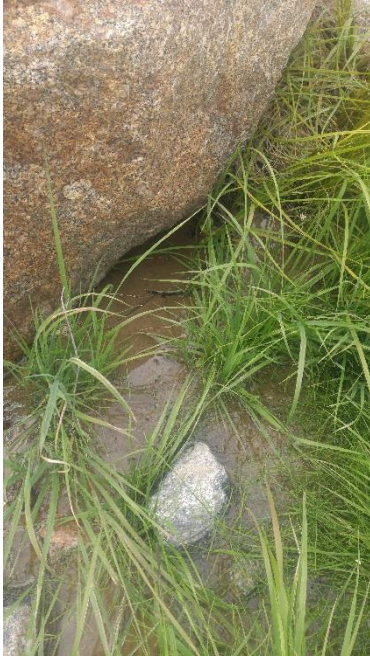


Figure 2-96: SS48 Sampling Site (Fall 2018)



Figure 2-97: SS48 Downstream (Fall 2018)



Figure 2-98: SS48 Upstream (Fall 2018)

1.7.3 SS49



Figure 2-99: SS49 Downstream (Fall 2018)



Figure 2-100: SS49 Upstream (Fall 2018)



Figure 2-101: SS49 Sampling Site (Fall 2018)

1.7.4 SS50



Figure 2-102: SS50 Upstream (Fall 2018)



Figure 2-103: SS50 Sampling Site (Fall 2018)



Figure 2-104: SS50 Downstream (Fall 2018)

1.7.5 SS63



Figure 2-105: SS63 Sampling Site (Fall 2018)

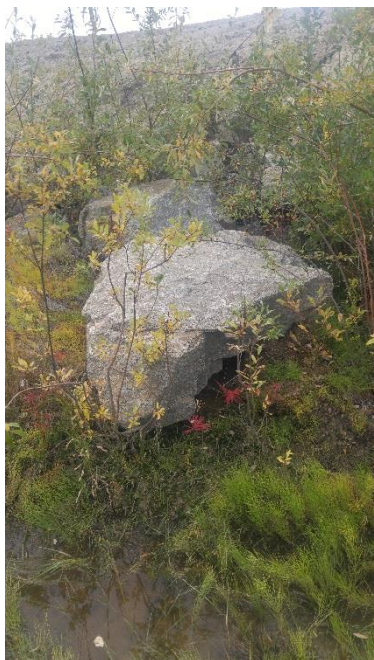


Figure 2-106: SS63 Upstream (Fall 2018)



Figure 2-107: SS63 Downstream (Fall 2018)

1.7.6 SS64



Figure 2-108: SS64 Upstream (Fall 2018)



Figure 2-109: SS64 Downstream (Fall 2018)



Figure 2-110: SS64 Sampling Site (Fall 2018)

1.8 Ridgetop Road

1.8.1 SS58



Figure 2-111: SS58 Sampling Site (Spring 2018)



Figure 2-112: SS58 Upstream (Spring 2018)



Figure 2-113: SS58 Downstream (Spring 2018)

3. Field Sheets

3.7 Spring Survey 2017 (May 18th-19th, 2018)

Seepage Water Quality Field Sheets

1. Sample Site: 5533		Date: 10/18.05.18		Time: 14:20		Seepage Site: CP/SR	
Site: Clear	P. Cloudy	Temp: +15	Pressure: HR	Light: Med	Wind: Calm	Light: Med	Wind: Calm
Clear	Fog	None	Other	Strong	Rain	Snow	Other
Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
1.4				502	8.0		
QA/QC? Y I N				Photos: Close-up ☒			
Note: 1 every 10 samples must be dumped				Upstream ☒			
New Sample? Y N If Yes, Record GPS Coordinates				Downstream ☒			
Water Colour? Turbidity, Precipitates, Description of Sample Conditions							
Clear, yellowy brown tint							
DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-10g (40 ml)	Colour of Sediment on filter: light brown residue			
☒	☒	☒	☒	# of Filters Used: 4			
Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)							
SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site features such as roads, ditches, sumps, etc.)							
Data entered (Initials): CP				Data entry reviewed (Initials):			

1. Sample Site: 555		Date: 20/05.18		Time: 14:40		Seepage Site: SR/CP	
Site: Clear	P. Cloudy	Temp: 15	Pressure: HR	Light: Med	Wind: Calm	Light: Med	Wind: Calm
Clear	Fog	None	Other	Strong	Rain	Snow	Other
Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
8.3				1348	7.5		
QA/QC? Y I N				Photos: Close-up ☒			
Note: 1 every 10 samples must be dumped				Upstream ☒			
New Sample? Y N If Yes, Record GPS Coordinates				Downstream ☒			
Water Colour? Turbidity, Precipitates, Description of Sample Conditions							
Clear water.							
DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-10g (40 ml)	Colour of Sediment on filter: no visible colour			
☒	☒	☒	☒	# of Filters Used: 1			
Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)							
SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site features such as roads, ditches, sumps, etc.)							
Data entered (Initials): CP				Data entry reviewed (Initials):			

1. Sample Site: SS100		Date: 2018.05.17	Time: 9:30	Sampler(s): CP	
Site: Clear	P. Cloudy	Temp: 13	Pressure: 13	Wind: Calm	Light: Mod
Cloud	Fog	Humidity: 13	Strong Rain	Strong N E	S W Var
Temp C	DO %	DO mg/L	SFC µS/cm	EC µS/cm	pH
0.0	—	—	—	1260	8.2
GAS/DO? Y / N				Photos: Close-up ☒	
Note: 1 every 10 samples must be dumped				Upstream ☒	
New Sample? Y / N If Yes, Record GPS Coordinates 44# 229				Downstream ☒	
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions Clear water, slight yellowing in bottle, N6945335 E386080					
DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter: Fin. yellow/brown residual	
☒	☒	☒	☒	# of Filters Used: 1	
Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)					
SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site features such as roads, ditches, sumps, etc.)					
N.T.S.					
Data entered (initials): CP			Data entry reviewed (initials): WSP		

1. Sample Site: SS32		Date: 2018.05.17	Time: 10:15	Sampler(s): CP	
Site: Clear	P. Cloudy	Temp: 13	Pressure: 13	Wind: Calm	Light: Mod
Cloud	Fog	Humidity: 13	Strong Rain	Strong N E	S W Var
Temp C	DO %	DO mg/L	SFC µS/cm	EC µS/cm	pH
1.1	—	—	—	224	7.1
GAS/DO? Y / N				Photos: Close-up ☒	
Note: 1 every 10 samples must be dumped				Upstream ☒	
New Sample? Y / N If Yes, Record GPS Coordinates				Downstream ☒	
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions Clear water					
DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter: No visible sediment or color	
☒	☒	☒	☒	# of Filters Used: 1	
Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)					
SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site features such as roads, ditches, sumps, etc.)					
N.T.S.					
Data entered (initials): CP			Data entry reviewed (initials):		

L Sample Site: SS6		Date: 2018.05.18		Time: 14:50		Sampler(s): SK/CP	
Obs: Clear	P: Cloudy	Temp: +15	Pres: MB	Light: Mod	Wind: Calm	Light: Mod	
Obs: Fog	Haze: Other		Strong: Rain	Snow: Other	Strong: N E	S W Var	
Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
10.9				1171	7.9		
QA/QC? Y 1 0				Photos: Close-up ☒			
Note: 1 every 10 samples must be damped				Upstream ☒			
New Sample? Y/N 1 0 If Yes, Record GPS Coordinates				Downstream ☒			
Water Colour? Turbidity, Precipitates/Description of Sampling Conditions							
Clear water							
DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter: light brown			
☒	☒	☒	☒	# of Filters Used: 2			
Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)							
SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site features such as roads, ditches, sumps, etc.)							
Data entered (Initials): CP				Data entry reviewed (Initials):			

L Sample Site: SS7		Date: 2018.05.18		Time: 15:00		Sampler(s): SK/CP	
Obs: Clear	P: Cloudy	Temp: +15	Pres: MB	Light: Mod	Wind: Calm	Light: Mod	
Obs: Fog	Haze: Other		Strong: Rain	Snow: Other	Strong: N E	S W Var	
Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
13.1				1025	7.4		
QA/QC? Y 1 0				Photos: Close-up ☒			
Note: 1 every 10 samples must be damped				Upstream ☒			
New Sample? Y/N 1 0 If Yes, Record GPS Coordinates				Downstream ☒			
Water Colour? Turbidity, Precipitates/Description of Sampling Conditions							
Clear water							
DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter: light brown			
☒	☒	☒	☒	# of Filters Used: 2			
Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)							
SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site features such as roads, ditches, sumps, etc.)							
Data entered (Initials): CP				Data entry reviewed (Initials):			

Seepage Water Quality Field Sheets

1. Sample Site: SS8		Date: 2018-05-18	Time: 15:10	Sample ID: SR/CP	
Sk: Clear	P: Cloudy	Temp: 15	Pres: HA	Wind: Calm	Light: Mod
W: Calm	Fog	Place: Other	Strong: Rain	Snow	Other
Temp C	DO %	DO mg/L	SPC µm/cm	EC µm/cm	pH
17.1				1381	7.8
ORP mv	Turb NTU				
QA/QC? Y	Note: 1 every 10 samples must be dumped		Photos: Close-up ☒		
New Sample? Y	If Yes, Record GPS Coordinates		Upstream ☒		
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions					
Clear water					
DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120ml	D-Hg (40ml)	Colour of Sediment on filter: Faint, light brown residue	
☒	☒	☒	☒	# of Filters Used: 1	
Notes (Site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)					
SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site features such as roads, ditches, sumps, etc.)					
Data entered (Initials): CP			Data entry reviewed (Initials):		

1. Sample Site:		Date:	Time:	Sample ID:	
Sk: Clear	P: Cloudy	Temp:	Pres: HA	Wind: Calm	Light: Mod
W: Calm	Fog	Place: Other	Strong: Rain	Snow	Other
Temp C	DO %	DO mg/L	SPC µm/cm	EC µm/cm	pH
ORP mv	Turb NTU				
QA/QC? Y	Note: 1 every 10 samples must be dumped		Photos: Close-up ☐		
New Sample? Y	If Yes, Record GPS Coordinates		Upstream ☐		
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions					
DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120ml	D-Hg (40ml)	Colour of Sediment on filter:	
				# of Filters Used:	
Notes (Site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)					
SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site features such as roads, ditches, sumps, etc.)					
Data entered (Initials):			Data entry reviewed (Initials):		

Seepage Water Quality Field Sheets

Sample Site: SS101		Date: 2018-05-19		Time: 10:15		Sample ID: SR/CP	
Sky: ☒ Clear ☐ P. Cloudy Cloud: ☐ Fog ☐ Haze ☐ Other		Temp: +15		Wind: ☒ N ☐ Light ☐ Mod Strong ☐ Rain ☐ Snow ☐ Other		Wind: ☐ Calm ☐ Light ☐ Mod Strong ☐ H ☐ E ☐ S ☐ W ☐ Var	
Temp C	DO %	DO mg/L	SPC µg/cm	EC µS/cm	pH	ORP mV	Turb NTU
15.9				44	7.7		
QA/QC? ☒ Y ☐ I ☒ N				Photos: Close-up ☐ Upstream ☐ Downstream ☐			
Note: 1 every 10 samples must be dumped							
New Sample? ☒ Y ☐ N IF Yes, Record GPS Coordinates #228							
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions: Uncertain if this is seepage or melt.							
Clear water.							
DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter: yellowish residue			
☒	☒	☒	☒	# of Filters Used: 7			
Notes (site conditions or variations from normal, i.e. ice cover, sediment, flow, etc.)							
Sketch of Sampling location (location of toe, pools of water, trace of surface water flow, site features such as roads, ditches, dumps, etc.)							
N.T.S. FP recorded in Lab.							
Data entered (Initials): SR				Data entry reviewed (Initials): CP			

Sample Site: SS39		Date: 2018-05-19		Time: 11:10		Sample ID: SR/CP	
Sky: ☒ Clear ☐ P. Cloudy Cloud: ☐ Fog ☐ Haze ☐ Other		Temp: +15		Wind: ☒ N ☐ Light ☐ Mod Strong ☐ Rain ☐ Snow ☐ Other		Wind: ☐ Calm ☐ Light ☐ Mod Strong ☐ H ☐ E ☐ S ☐ W ☐ Var	
Temp C	DO %	DO mg/L	SPC µg/cm	EC µS/cm	pH	ORP mV	Turb NTU
7.8				535	7.6		
QA/QC? ☒ Y ☐ I ☒ N				Photos: Close-up ☒ Upstream ☒ Downstream ☒			
Note: 1 every 10 samples must be dumped							
New Sample? ☒ Y ☐ N IF Yes, Record GPS Coordinates							
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions: Clear water.							
DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter: light yellow/brown residue			
☒	☒	☒	☒	# of Filters Used: 2			
Notes (site conditions or variations from normal, i.e. ice cover, sediment, flow, etc.)							
Sketch of Sampling location (location of toe, pools of water, trace of surface water flow, site features such as roads, ditches, dumps, etc.)							
N.T.S.							
Data entered (Initials): SR				Data entry reviewed (Initials): CP			

Sample Site: W32		Date: 2018.05.19	Time: 13:30	Sample ID: SK/CP			
Site: Open	Weather: P. Cloudy	Temp: 18	Pressure: 1014	Light: Mod	Wind: Calm	Light: Mod	Wind: Calm
Q/Cat: Fog	Humidity: Other	Temp: 18	Pressure: 1014	Light: Mod	Wind: Calm	Light: Mod	Wind: Calm
Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
0.1				1430	7.8		
Notes: 1 every 10 samples must be dumped				Photos: Close-up ☒			
New Sample? Y/N (N) If Yes, Record GPS Coordinates				Upstream ☒			
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions				Downstream ☒			
Clear water							
DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on Filter: light brown			
				# of Filters Used:			
Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)							
Sketch of Sampling location (location of toe, pools of water, trace of surface water flow, site features such as roads, ditches, sumps, etc.)							
Data entered (Initials): SK				Data entry reviewed (Initials): CP			

Sample Site: SS58		Date: 2018.05.19	Time: 13:45	Sample ID: SK/CP			
Site: Open	Weather: P. Cloudy	Temp: 18	Pressure: 1014	Light: Mod	Wind: Calm	Light: Mod	Wind: Calm
Q/Cat: Fog	Humidity: Other	Temp: 18	Pressure: 1014	Light: Mod	Wind: Calm	Light: Mod	Wind: Calm
Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
6.7				1163	7.3		
Notes: 1 every 10 samples must be dumped				Photos: Close-up ☒			
New Sample? Y/N (N) If Yes, Record GPS Coordinates				Upstream ☒			
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions				Downstream ☒			
DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on Filter:			
				# of Filters Used:			
Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)							
Sketch of Sampling location (location of toe, pools of water, trace of surface water flow, site features such as roads, ditches, sumps, etc.)							
Data entered (Initials): SK				Data entry reviewed (Initials): CP			

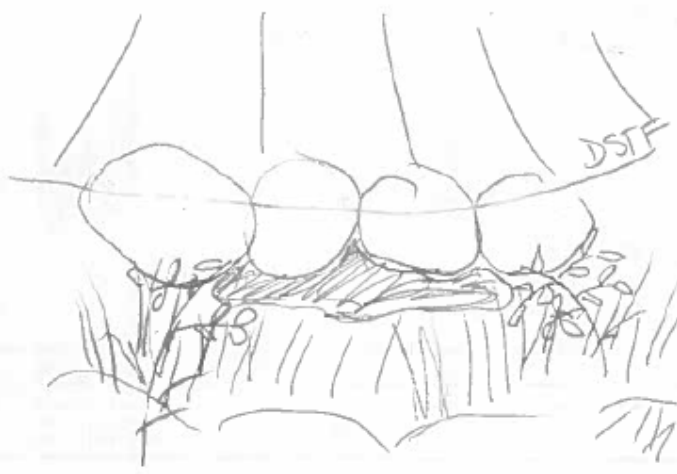
L Sample Site: SS31		Date: 2018.05.19	Time: 14:00	Sediment: SR/CP	
Site: Clear	P. Cloudy	Temp: +18	Pressure: N	Light: Mod	Wind: Calm
Q/Cast: Fog	None Other		Strong Rain	Snow Other	Strong N E S W Var
Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH
QA/QC: Y 1 (N)			Photos: Close-up ☒		
Note: 1 every 10 samples must be dumped			Upstream ☒		
New Sample? Y (N) If Yes, Record GPS Coordinates			Downstream ☒		
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions					
Clear water					
DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on Filter: light brown	
				# of Filters Used: 2	
Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)					
SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site features such as roads, ditches, sumps, etc.)					
Data entered (Initials): SR			Data entry reviewed (Initials): CP		

L Sample Site: SS13		Date: 2018.05.19	Time: 14:10	Sediment: SR/CP	
Site: Clear	P. Cloudy	Temp: +18	Pressure: N	Light: Mod	Wind: Calm
Q/Cast: Fog	None Other		Strong Rain	Snow Other	Strong N E S W Var
Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH
QA/QC: Y 1 (N)			Photos: Close-up ☒		
Note: 1 every 10 samples must be dumped			Upstream ☒		
New Sample? Y (N) If Yes, Record GPS Coordinates			Downstream ☒		
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions					
Clear water					
DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on Filter: clear	
				# of Filters Used: 2	
Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)					
SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site features such as roads, ditches, sumps, etc.)					
Data entered (Initials): SR			Data entry reviewed (Initials): CP		

3.2 Fall Seepage Survey (September 5th – 6th, 2018)

Seepage Water Quality Field Sheets

Sample Site: SS36		Date: Sept 5	Time: 10:50	Sampler(s): EB	
Sk: Clear	P: Cloudy	Temp: 8.0	Pres: NB	Light: Mod	Wind: Clear
Start: Fog	Rate: Other	Strong: Rain	Strong: N E S W Var	Light: Mod	Wind: Clear
Temp C: 6.2	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH
				161	5.4
QA/QC: Y	1	(N)	Photos: Close-up ☒		
Note: 1 every 10 samples must be dumped			Upstream ☒		
New Sample? Y/N IF Yes, Record GPS Coordinates			Downstream ☒		
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions					
Clear.					
DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Pig (40 ml)	Colour of Sediment on Filter: Clear	
☒	☒	☒	☒	# of Filters Used: 1	
Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)					
SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site features such as roads, ditches, sumps, etc.)					
NOT FLOWING VERY MUCH					
					
Data entered (Initials): EB			Data entry reviewed (Initials):		

Sample Site: SS9		Date: Sept 5	Time: 11:20	Sampler(s): EB	
Sk: Clear	P: Cloudy	Temp: 8.0	Pres: NB	Light: Mod	Wind: Clear
Start: Fog	Rate: Other	Strong: Rain	Strong: N E S W Var	Light: Mod	Wind: Clear
Temp C: 5.8	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH
				512	7.0
QA/QC: Y	1	(N)	Photos: Close-up ☒		
Note: 1 every 10 samples must be dumped			Upstream ☒		
New Sample? Y/N IF Yes, Record GPS Coordinates			Downstream ☒		
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions					
clear, filled w/ algae.					
DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Pig (40 ml)	Colour of Sediment on Filter: Green / BROWN	
☒	☒	☒	☒	# of Filters Used: 1	
Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)					
SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site features such as roads, ditches, sumps, etc.)					
NO Flow visible					
					
Data entered (Initials): EB			Data entry reviewed (Initials):		

SS16 DRY @ 11:00
SS59 DRY @ 11:01

Seepage Water Quality Field Sheets

1. Sample Site: SS60		Date: Sept 5		Time: 11:35		Sample(s): EB	
Day: Clear	P. Cloudy	Temp: 8.0	Pres: 101	Ught: Mod	Wind: Calm	Ught: Mod	
Q/est: Fog	Hail: Other	Strong: Rain	Snow: Other	Strong: N E	S W Var		
Temp C: 6.3	DO %:	DO mg/L:	SPC µs/cm:	EC µs/cm: 772	pH: 6.7	ORP mv:	Turb NTU:
QA/QC? ☒ / ☒ N				Photos: Close-up ☒			
Note: 1 every 10 samples must be dumped				Upstream ☒			
New Sample? Y / N ☒ If Yes, Record GPS Coordinates				Downstream ☒			
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions Clear							
DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter: clear			
☒	☒	☒	☒	# of Filters Used: 1			
Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)							
SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site features such as roads, ditches, sumps, etc.)							
NO VISIBLE FLOW.							
Data entered (Initials): EB				Data entry reviewed (Initials):			

1. Sample Site: SS101		Date: Sept 5		Time: 14:45		Sample(s): EB	
Day: Clear	P. Cloudy	Temp: 8.0	Pres: 101	Ught: Mod	Wind: Calm	Ught: Mod	
Q/est: Fog	Hail: Other	Strong: Rain	Snow: Other	Strong: N E	S W Var		
Temp C: 7.5	DO %:	DO mg/L:	SPC µs/cm:	EC µs/cm: 1219	pH: 7.4	ORP mv:	Turb NTU:
QA/QC? Y / ☒ N				Photos: Close-up ☒			
Note: 1 every 10 samples must be dumped				Upstream ☒			
New Sample? Y / N ☒ If Yes, Record GPS Coordinates				Downstream ☒			
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions Clear							
DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter: clear			
☒	☒	☒	☒	# of Filters Used: 1			
Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)							
SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site features such as roads, ditches, sumps, etc.)							
Data entered (Initials): EB				Data entry reviewed (Initials):			

Seepage Water Quality Field Sheets

1. Sample Site: SS48		Date: Sept 5		Time: 15:30		Sampler(s): ERB	
Obs: Clear	P. Cloudy	Temp: 8.0	Pres: 101	Wind: Calm	Light: Mod	Wind: Calm	Light: Mod
Obs: Fog	Haze Other	Strong Rain	Strong N E	S W Var			
Temp C	DO %	DO mg/L	SPC µg/cm	EC µg/cm	pH	ORP mv	Turb NTU
6.2				1210	7.7		
QA/QC: Y / N				Photos: Close-up ☒			
Note: 1 every 10 samples must be dumped				Upstream ☒			
New Sample? Y (N) If Yes, Record GPS Coordinates				Downstream ☒			
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions							
Clean.							
DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter: CLEAR			
☒	☒	☒	☒	# of Filters Used:			
Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)							
SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site features such as roads, ditches, sumps, etc.)							
NO VISIBLE FLOW ICE-RICA TOE SS48 WET GRASS PELTY YARD							
Data entered (Initials): ERB				Data entry reviewed (Initials):			

1. Sample Site: SS163		Date: Sept 5		Time: 15:50		Sampler(s): ERB	
Obs: Clear	P. Cloudy	Temp: 10.0	Pres: 101	Wind: Calm	Light: Mod	Wind: Calm	Light: Mod
Obs: Fog	Haze Other	Strong Rain	Strong N E	S W Var			
Temp C	DO %	DO mg/L	SPC µg/cm	EC µg/cm	pH	ORP mv	Turb NTU
10.3				633	7.5		
QA/QC: Y / N				Photos: Close-up ☒			
Note: 1 every 10 samples must be dumped				Upstream ☒			
New Sample? Y (N) If Yes, Record GPS Coordinates				Downstream ☒			
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions							
orange tint							
DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter: 2			
☒	☒	☒	☒	# of Filters Used: ORANGE / BROWN			
Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)							
SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site features such as roads, ditches, sumps, etc.)							
NO VISIBLE flow ICE-RICA TOE SS163 WET GRASS PELTY YARD							
Data entered (Initials): ERB				Data entry reviewed (Initials):			

Seepage Water Quality Field Sheets

1. Sample Site: SS64		Date: Sept 5		Time: 16:05		Sampler(s): EB	
Sk: Clear	P: Cloudy	Temp: 10.0	Pres: 98	Light: Mod	Wind: Calm	Light: Mod	Wind: Calm
Clear	Fog	10.0	Strong	Rain	Snow	Other	Strong N E S W Var
Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
10.4				458	8.6		
QA/QC? ☒ Y ☐ N				Photos: Close-up ☒			
Note: 1 every 10 samples must be dumped				Upstream ☒			
New Sample? ☒ Y ☐ N If Yes, Record GPS Coordinates				Downstream ☒			
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions							
Clear							
DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter: Clear			
☒	☒	☒	☒	# of Filters Used: 1			
Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)							
SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site features such as roads, ditches, sumps, etc.)							
no VISIBLE flow							
Data entered (Initials): EB				Data entry reviewed (Initials):			

1. Sample Site: SS49		Date: Sept 5		Time: 16:20		Sampler(s): EB	
Sk: Clear	P: Cloudy	Temp: 10.0	Pres: 98	Light: Mod	Wind: Calm	Light: Mod	Wind: Calm
Clear	Fog	10.0	Strong	Rain	Snow	Other	Strong N E S W Var
Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
9.5				428	8.7		
QA/QC? ☒ Y ☐ N				Photos: Close-up ☒			
Note: 1 every 10 samples must be dumped				Upstream ☒			
New Sample? ☒ Y ☐ N If Yes, Record GPS Coordinates				Downstream ☒			
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions							
Clear							
DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter: Clear			
☒	☒	☒	☒	# of Filters Used: 1			
Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)							
SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site features such as roads, ditches, sumps, etc.)							
only separated to SS64 by a berm. could be the same water travelling under the berm.							
Data entered (Initials): EB				Data entry reviewed (Initials):			

Seepage Water Quality Field Sheets

1. Sample Site: SS50		Date: Sept 5		Time: 16:35		Serial: EB3	
Obs: ☒ Clear	☐ P. Cloudy	Temp: 10.0		Pres: ☒ 04	☐ Light	☐ Mod	Wind: ☐ Calm
☒ Fog	☐ Haze	☐ Other		☐ Strong	☐ Rain	☐ Snow	☐ Other
Temp C: 6.5	DO %:	DO mg/L:	SPC µg/cm:	EC µS/cm: 526	pH: 8.2	ORP mv:	Turb NTU:
QA/QC? ☐ Y ☒ N				Photos: ☐ Close-up ☐ Upstream ☐ Downstream			
Note: 1 every 10 samples must be dumped							
New Sample? ☐ Y ☒ N If Yes, Record GPS Coordinates							
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions: Green Clear.							
DMA 120 ml: ☒	GENERAL 500 ml: ☒	TOTAL Nutrients 120 ml: ☒	D-Hg (40 ml): ☒	Colour of Sediment on filter: 2			
				# of Filters Used: GREEN			
Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.):							
SKETCH of Sampling location (location of tree, pools of water, trace of surface water flow, site features such as roads, ditches, swamps, etc.):							
NO VISIBLE FLOW							
Data entered (Initials): EP				Data entry reviewed (Initials):			

1. Sample Site: SSB2		Date: Sept 5		Time: 17:05		Serial: EB3	
Obs: ☒ Clear	☐ P. Cloudy	Temp: 10.0		Pres: ☒ 04	☐ Light	☐ Mod	Wind: ☐ Calm
☒ Fog	☐ Haze	☐ Other		☐ Strong	☐ Rain	☐ Snow	☐ Other
Temp C: 2.0	DO %:	DO mg/L:	SPC µg/cm:	EC µS/cm: 202	pH: 8.2	ORP mv:	Turb NTU:
QA/QC? ☐ Y ☒ N				Photos: ☐ Close-up ☐ Upstream ☐ Downstream			
Note: 1 every 10 samples must be dumped							
New Sample? ☐ Y ☒ N If Yes, Record GPS Coordinates							
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions: Clear.							
DMA 120 ml: ☒	GENERAL 500 ml: ☒	TOTAL Nutrients 120 ml: ☒	D-Hg (40 ml): ☒	Colour of Sediment on filter: 1			
				# of Filters Used: Clear			
Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.):							
SKETCH of Sampling location (location of tree, pools of water, trace of surface water flow, site features such as roads, ditches, swamps, etc.):							
Pipe SAMPLE collected from the pipe. Clearly flowing							
Data entered (Initials): EB3				Data entry reviewed (Initials):			

Seepage Water Quality Field Sheets

1. Sample Site: SS33		Date: 8:00	Time: Sept 6	Sampler(s): EB	
Dir: Clear	P. Cloudy	Temp: 1.0	Pres: NA	Light: Mod	Wind: Caln
Q/Cont: Fog	Haze: Other		Strong: Rain	Snow: Other	Strong: N E S W Var
Temp C: 0.1	DO %	DO mg/L	SPC µg/cm	EC µs/cm	pH
				1219	7.8
QA/QC? Y	Note: 1 every 10 samples must be dumped		Photos: Close-up ☒		
New Sample? Y/N	IF Yes, Record GPS Coordinates		Upstream ☒		
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions			Downstream ☒		
clean					
DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter: SANDY	
☒	☒	☒	☒	# of Filters Used: 1	
Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)					
SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site features such as roads, ditches, sumps, etc.)					
VISIBLE FLOW.					
Data entered (Initials): EB			Data entry reviewed (Initials):		

1. Sample Site: SS5		Date: Sept 6	Time: 8:45	Sampler(s): E13	
Dir: Clear	P. Cloudy	Temp: 1.0	Pres: NA	Light: Mod	Wind: Caln
Q/Cont: Fog	Haze: Other		Strong: Rain	Snow: Other	Strong: N E S W Var
Temp C: 0.5	DO %	DO mg/L	SPC µg/cm	EC µs/cm	pH
				1159	8.0
QA/QC? Y	Note: 1 every 10 samples must be dumped		Photos: Close-up ☒		
New Sample? Y/N	IF Yes, Record GPS Coordinates		Upstream ☒		
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions			Downstream ☒		
clean, dirty from constructed pool.					
DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter: BROWN / SANDY	
☒	☒	☒	☒	# of Filters Used: 5	
Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)					
SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site features such as roads, ditches, sumps, etc.)					
no obvious flow but the slope is wet.					
Data entered (Initials): EB			Data entry reviewed (Initials):		

Seepage Water Quality Field Sheets

1. Sample Site: SS6		Date: Sept 6	Time: 9:55	Sampled by: EB	
Obs: Clear	P. Cloudy	Temp: 3.0	Pres: 10	Light: Mod	Wind: Calm
Q/Cat: Fog	Haze Other	Strong Rain Snow Other	Strong N E S W Var		
Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH
0.6				1221	7.7
QA/QC: Y / N DUP 2			Photos: Close-up ☒		
Note: 1 every 10 samples must be dumped			Upstream ☒		
New Sample? Y / N IF Yes, Record GPS Coordinates			Downstream ☒		
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions					
Clear					
DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter: SANDY BROWN	
☒	☒	☒	☒	# of Filters Used: 1	
Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)					
SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site features such as roads, ditches, sumps, etc.) 					
Data entered (Initials): EB			Data entry reviewed (Initials):		

1. Sample Site: SS7		Date: Sept 6	Time: 10:20	Sampled by: EB	
Obs: Clear	P. Cloudy	Temp: 3.0	Pres: 10	Light: Mod	Wind: Calm
Q/Cat: Fog	Haze Other	Strong Rain Snow Other	Strong N E S W Var		
Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH
1.9				1381	8.0
QA/QC: Y / N			Photos: Close-up ☒		
Note: 1 every 10 samples must be dumped			Upstream ☒		
New Sample? Y / N IF Yes, Record GPS Coordinates			Downstream ☒		
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions					
Clear					
DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter: Clear	
☒	☒	☒	☒	# of Filters Used: 1	
Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)					
SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site features such as roads, ditches, sumps, etc.) 					
Data entered (Initials): EB			Data entry reviewed (Initials):		

Seepage Water Quality Field Sheets

1. Sample Site: SS8		Date: Sept 6		Time: 10:35		Samuel: EB	
Sec: Clear	P. Cloudy	Temp: 3.0		Pres: HL	Light: Mod	Wind: Calm	Light: Mod
Q/cst: Fog	Haze: Other			Strong: Rain	Snow: Other	Strong: N E S W Var	
Temp C: 0.7	DO %:	DO mg/L:	SPC µs/cm:	EC µs/cm: 1359	pH: 7.4	ORP mv:	Turb NTU:
QA/QC? Y / N				Photos: Close-up ☒			
Note: 1 every 10 samples must be dumped				Upstream ☐			
New Sample? Y/N If Yes, Record GPS Coordinates				Downstream ☐			
Water Colour? Turbidity? Precipitates? Description of Sample Conditions: Clear							
DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter: SANDY BROWN			
☒	☒	☒	☒	# of Filters Used: 2			
Sketch (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)							
SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site features such as roads, ditches, sumps, etc.): 							
Data entered (Initials): EB				Data entry reviewed (Initials):			

SS59 dry at 11:10
 WB8, WB9 Dry at 13:40 and 13:50

1. Sample Site: SS54		Date: Sept 6		Time: 14:00		Samuel: EB TS	
Sec: Clear	P. Cloudy	Temp: 4.8		Pres: HL	Light: Mod	Wind: Calm	Light: Mod
Q/cst: Fog	Haze: Other			Strong: Rain	Snow: Other	Strong: N E S W Var	
Temp C: 4.8	DO %:	DO mg/L:	SPC µs/cm: 1064	EC µs/cm: 78	pH:	ORP mv:	Turb NTU:
QA/QC? Y / N				Photos: Close-up ☒			
Note: 1 every 10 samples must be dumped				Upstream ☐			
New Sample? Y/N If Yes, Record GPS Coordinates				Downstream ☐			
Water Colour? Turbidity? Precipitates? Description of Sample Conditions: Clear							
DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter: Clear			
☒	☒	☒	☒	# of Filters Used: 1			
Sketch (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)							
SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site features such as roads, ditches, sumps, etc.): 							
Data entered (Initials): EB				Data entry reviewed (Initials):			

Seepage Water Quality Field Sheets

1. Sample Site: SS65		Date: 6-Sept.	Time: 14:12	Semester: EB/TS	
Obs: Clear	P: Cloudy	Temp: 15°	Cloud: NA	Light: Mod	Wind: Calm
Cloud: NA	Other: NA	Strong: NA	Rain: NA	Snow: NA	Other: NA
Temp C: 4.0	DO %: 100	DO mg/L: 11.31	SPC µg/cm: 1131	EC µS/cm: 7.6	pH: 7.6
ORP mv: 1131	Turb NTU: 7.6				
QA/QC: Y			Photos: Close-up		
Note: 1 every 10 samples must be dumped			Upstream: NA		
New Sample? Y N IF Yes, Record GPS Coordinates			Downstream: NA		
Water Colour? Turbidity, Precipitates, Description of Sampling Conditions					
CLEAR					
DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter: clear	
✓	✓	✓	✓	✓	
Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)					
SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site features such as roads, ditches, sumps, etc.)					
Data entered (Initials):			Data entry reviewed (Initials):		

SS28 Dry @ 14:15

1. Sample Site: SS56		Date: 6-Sept.	Time: 14:20	Semester: EB/TS	
Obs: Clear	P: Cloudy	Temp: 15°	Cloud: NA	Light: Mod	Wind: Calm
Cloud: NA	Other: NA	Strong: NA	Rain: NA	Snow: NA	Other: NA
Temp C: 4.5	DO %: 100	DO mg/L: 12.15	SPC µg/cm: 1215	EC µS/cm: 7.5	pH: 7.5
ORP mv: 1215	Turb NTU: 7.5				
QA/QC: Y			Photos: Close-up		
Note: 1 every 10 samples must be dumped			Upstream: NA		
New Sample? Y N IF Yes, Record GPS Coordinates			Downstream: NA		
Water Colour? Turbidity, Precipitates, Description of Sampling Conditions					
CLEAR					
DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter: CLEAR	
✓	✓	✓	✓	✓	
Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)					
SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site features such as roads, ditches, sumps, etc.)					
Data entered (Initials): EB			Data entry reviewed (Initials):		

Seepage Water Quality Field Sheets

Sample Site: SS 57		Date: 6-Sept	Time: 14:40	Sampler(s): EB/TJ			
Sec: Clear	P. Cloudy	Temp: 15°C	Pres: 0	Light: Mod	Wind: Calm	Light: Mod	
Q/Cat: Fog	Other: 0		Strong: 0	Kalm: 0	Snow: 0	Other: 0	
Temp C: 3.6	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
				1197	7.7		
QA/QC? Y I N				Photos: Close-up ☐			
Note: 1 every 10 samples must be dumped				Upstream ☐			
New Sample? Y I N If Yes, Record GPS Coordinates				Downstream ☐			
Water Colour? Turbidity, Precipitates/Description of Sampling Conditions							
CLEAR							
DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter: CLEAR			
☒	☒	☒	☒	# of Filters Used: 1			
Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)							
SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site features such as roads, ditches, sumps, etc.)							
Data entered (Initials):				Data entry reviewed (Initials):			

SS 29 Day @ 14:45
SS

Sample Site: SS 30		Date: 6-SEPT	Time: 14:50	Sampler(s): EB/TJ			
Sec: Clear	P. Cloudy	Temp:	Pres: 0	Light: Mod	Wind: Calm	Light: Mod	
Q/Cat: Fog	Other: 0		Strong: 0	Kalm: 0	Snow: 0	Other: 0	
Temp C: 1.8°	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
				1103	8.0		
QA/QC? Y I 0				Photos: Close-up ☒			
Note: 1 every 10 samples must be dumped				Upstream ☒			
New Sample? Y I 0 If Yes, Record GPS Coordinates				Downstream ☒			
Water Colour? Turbidity, Precipitates/Description of Sampling Conditions							
Yellow/Green							
DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter: BROWN			
☒	☒	☒	☒	# of Filters Used: 1			
Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)							
SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site features such as roads, ditches, sumps, etc.)							
Data entered (Initials): EB				Data entry reviewed (Initials):			

Seepage Water Quality Field Sheets

L. Sample Site: SS 43		Date: 6-SEPT		Time: 13:03		Sampler(s): EB TS	
Sk: Clear	P. Cloudy	Temp: 15°	Drizzle: NR	Light: Mod	Wind: Calm	Light: Mod	Wind: Calm
Q/cast: Fog	Other: None		Strong: NR	Rain: NR	Snow: NR	Other: NR	Strong: NR
Temp C: 7.5	DO %: 100	DO mg/L: 10.08	SPC µg/cm: 7.7	EC µS/cm: 1008	pH: 7.7	ORP mV: 1008	Turb NTU: 7.7
QA/QC: Y / N				Photos: Close-up ☒			
Note: 1 every 10 samples must be dumped				Upstream ☒			
New Sample? Y ☒ IF Yes, Record GPS Coordinates				Downstream ☒			
Water Colour? Turbidity, Precipitates (Description of Sampling Conditions): CLEAR.							
DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter: CLEAR			
☒	☒	☒	☒	# of filters Used: 1			
Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.):							
SKETCH of Sampling location (location of tree, pools of water, trace of surface water flow, site features such as roads, ditches, dumps, etc.):							
Data entered (Initials): EB				Data entry reviewed (Initials):			

L. Sample Site: SS 31		Date: 6-SEPT		Time: 13:15		Sampler(s): EB TS	
Sk: Clear	P. Cloudy	Temp: 13°	Drizzle: NR	Light: Mod	Wind: Calm	Light: Mod	Wind: Calm
Q/cast: Fog	Other: None		Strong: NR	Rain: NR	Snow: NR	Other: NR	Strong: NR
Temp C: 0.7	DO %: 110	DO mg/L: 11.06	SPC µg/cm: 8.0	EC µS/cm: 1106	pH: 8.0	ORP mV: 1106	Turb NTU: 8.0
QA/QC: Y / N				Photos: Close-up ☒			
Note: 1 every 10 samples must be dumped				Upstream ☒			
New Sample? Y ☒ IF Yes, Record GPS Coordinates				Downstream ☒			
Water Colour? Turbidity, Precipitates (Description of Sampling Conditions): CLEAR, ICE - COVERED.							
DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter: CLEAR			
☒	☒	☒	☒	# of filters Used: 1			
Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.):							
SKETCH of Sampling location (location of tree, pools of water, trace of surface water flow, site features such as roads, ditches, dumps, etc.):							
Data entered (Initials): EB				Data entry reviewed (Initials):			

Seepage Water Quality Field Sheets

L. Sample Site: SS51		Date: 6-Sept	Time: 15:30	Sampler(s): EB/TS	
Site: Clear	P. Cloudy: 140	Temp: 14.0	Wind: Light	Mod: Mod	Wind: Clear
Wind: Clear	Wind: Clear	Wind: Clear	Wind: Clear	Wind: Clear	Wind: Clear
Temp C: 1.9	DO %: 600	DO mg/L: 8.0	SPC µg/cm: 600	EC µS/cm: 8.0	pH: 7.5
QA/QC: y	Photos: Close-up		☒		
Note: 1 every 10 samples must be dumped		Upstream: ☒		Downstream: ☒	
New Sample? Y/N IF Yes, Record GPS Coordinates					
Water Colour? Turbidity, Precipitates, Description of Sampling Conditions					
CLEAR GREEN HORSETAILS					
DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on Filter: CLEAR	
☒	☒	☒	☒	# of Filters Used: 1	
Sketch site conditions or variations from normal (i.e. ice cover, sediment, flows, etc.)					
Data entered (Initials): EB			Data entry reviewed (Initials):		

L. Sample Site: SS44		Date: 6-SEPT	Time: 15:45	Sampler(s): EB/TS	
Site: Clear	P. Cloudy: 140	Temp: 14.0	Wind: Light	Mod: Mod	Wind: Clear
Wind: Clear	Wind: Clear	Wind: Clear	Wind: Clear	Wind: Clear	Wind: Clear
Temp C: 7.0	DO %: 828	DO mg/L: 7.5	SPC µg/cm: 828	EC µS/cm: 7.5	pH: 7.5
QA/QC: y	Photos: Close-up		☒		
Note: 1 every 10 samples must be dumped		Upstream: ☒		Downstream: ☒	
New Sample? Y/N IF Yes, Record GPS Coordinates					
Water Colour? Turbidity, Precipitates, Description of Sampling Conditions					
CLEAR					
DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on Filter: DK BROWN	
☒	☒	☒	☒	# of Filters Used: 1	
Sketch site conditions or variations from normal (i.e. ice cover, sediment, flows, etc.)					
Data entered (Initials): EB			Data entry reviewed (Initials):		

SS52 dry @ 15:55

Seepage Water Quality Field Sheets

1. Sample Site:		Date:		Time:		Sample Label:	
SS61		Sept 6		17:00		EB	
Skz:	Clear	P. Cloudy	Temp:	Pres:	Light	Mod	Wind:
Clear	Fog	Haze	Other	Strong	N	E	S W Var
Temp C	DO %	DO mg/L	SPC µ/cm	EC µS/cm	pH	ORP mv	Turb NTU
10.5				1118	7.8		
QA/QC: Y / N				Photos: Close-up ☒			
Note: 1 every 10 samples must be dumped				Upstream ☒			
New Sample? Y / N				Downstream ☒			
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions							
Clear							
DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter:			
✓	✓	✓	✓	1			
# of Filters Used:				CLEAR			
Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)							
SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site features such as roads, ditches, sumps, etc.)							
Data entered (Initials):				Data entry reviewed (Initials):			
				EB			

SS100 dry @ 16:55

1. Sample Site:		Date:		Time:		Sample Label:	
Skz:	Clear	P. Cloudy	Temp:	Pres:	Light	Mod	Wind:
Clear	Fog	Haze	Other	Strong	N	E	S W Var
Temp C	DO %	DO mg/L	SPC µ/cm	EC µS/cm	pH	ORP mv	Turb NTU
QA/QC: Y / N				Photos: Close-up ☐			
Note: 1 every 10 samples must be dumped				Upstream ☐			
New Sample? Y / N				Downstream ☐			
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions							
DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter:			
# of Filters Used:							
Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)							
SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site features such as roads, ditches, sumps, etc.)							
Data entered (Initials):				Data entry reviewed (Initials):			



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 04-JAN-18
Report Date: 17-JAN-18 15:03 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2041414
Project P.O. #: 228617
Job Reference:
C of C Numbers: 2018-01-03 A
Legal Site Desc:

Shane Stack
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2041414-1 Water 02-JAN-18 10:25 W3	L2041414-2 Water 02-JAN-18 11:00 W17	L2041414-3 Water 02-JAN-18 12:40 W8A	L2041414-4 Water 02-JAN-18 DUP	
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	556	535	1580	539	
	Hardness (as CaCO3) (mg/L)	283	259	830	268	
	pH (pH)	8.30	8.35	8.00	8.31	
	Total Suspended Solids (mg/L)	<3.0	<3.0	10.7	<3.0	
	TDS (Calculated) (mg/L)	334	320	1120	324	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	250	224	613	229	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	5.4	9.8	<1.0	6.2	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Total (as CaCO3) (mg/L)	255	233	613	235	
	Ammonia, Total (as N) (mg/L)	0.0090	0.0110	0.395	0.0077	
	Chloride (Cl) (mg/L)	4.47	7.33	16.8	7.38	
	Nitrate and Nitrite (as N) (mg/L)	0.224	0.0889	6.96	0.0896	
	Nitrate (as N) (mg/L)	0.224	0.0889	6.38	0.0896	
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	0.585	<0.0010	
	Sulfate (SO4) (mg/L)	59.8	62.0	348	62.2	
	Anion Sum (meq/L)	6.48	6.17	20.5	6.21	
	Cation Sum (meq/L)	6.60	5.96	19.3	6.13	
	Cation - Anion Balance (%)	0.9	-1.7	-2.9	-0.6	
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	4.55	9.52		9.49	
Total Metals	Aluminum (Al)-Total (mg/L)	0.0391	0.0289	0.0355	0.0158	
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	0.00017	0.00013	
	Arsenic (As)-Total (mg/L)	0.00022	0.00038	0.00063	0.00037	
	Barium (Ba)-Total (mg/L)	0.0611	0.0710	0.153	0.0730	
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Total (mg/L)	0.026	0.028	0.035	0.029	
	Cadmium (Cd)-Total (mg/L)	0.0000084	0.0000117	0.000414	0.0000126	
	Calcium (Ca)-Total (mg/L)	55.2	66.6	241	71.6	
	Chromium (Cr)-Total (mg/L)	0.00019	0.00014	0.00082	0.00014	
	Cobalt (Co)-Total (mg/L)	<0.00010	0.00011	0.00131	<0.00010	
	Copper (Cu)-Total (mg/L)	0.00255	0.0128	0.150	0.00929	
	Iron (Fe)-Total (mg/L)	0.072	0.093	1.45	0.074	
	Lead (Pb)-Total (mg/L)	0.000084	0.000133	0.000091	0.000062	
	Lithium (Li)-Total (mg/L)	0.0023	<0.0010	0.0029	<0.0010	
	Magnesium (Mg)-Total (mg/L)	31.4	20.8	64.0	21.1	
	Manganese (Mn)-Total (mg/L)	0.0510	0.132	3.74	0.119	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2041414-1 Water 02-JAN-18 10:25 W3	L2041414-2 Water 02-JAN-18 11:00 W17	L2041414-3 Water 02-JAN-18 12:40 W8A	L2041414-4 Water 02-JAN-18 DUP	
Grouping	Analyte						
WATER							
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Total (mg/L)	0.00485	0.00621	0.0147	0.00634		
	Nickel (Ni)-Total (mg/L)	0.00080	0.00093	0.00205	0.00090		
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	0.067	<0.050		
	Potassium (K)-Total (mg/L)	2.27	3.61	8.08	3.83		
	Selenium (Se)-Total (mg/L)	0.000357	0.000379	0.00751	0.000367		
	Silicon (Si)-Total (mg/L)	6.56	5.80	7.85	5.72		
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	0.000029	<0.000010		
	Sodium (Na)-Total (mg/L)	20.1	15.3	52.3	15.3		
	Strontium (Sr)-Total (mg/L)	0.862	0.755	3.27	0.791		
	Sulfur (S)-Total (mg/L)	21.4	21.7	140	21.8		
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010		
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010		
	Titanium (Ti)-Total (mg/L)	<0.0018 ^{DLM}	0.00156	<0.0024 ^{DLM}	<0.0012 ^{DLM}		
	Uranium (U)-Total (mg/L)	0.00294	0.00224	0.00433	0.00229		
	Vanadium (V)-Total (mg/L)	0.00055	0.00051	0.00242	<0.00050		
	Zinc (Zn)-Total (mg/L)	<0.0030	0.0102	0.237	0.0038		
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	0.00060	<0.00030		
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD		
	Dissolved Metals Filtration Location	LAB	FIELD	FIELD	FIELD		
	Aluminum (Al)-Dissolved (mg/L)	<0.0010	0.0014	0.0072	0.0016		
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	0.00010	<0.00010		
	Arsenic (As)-Dissolved (mg/L)	<0.00020 ^{DLB}	0.00037	0.00052	0.00038		
	Barium (Ba)-Dissolved (mg/L)	0.0659	0.0750	0.165	0.0775		
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020		
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050		
	Boron (B)-Dissolved (mg/L)	0.028	0.029	0.034	0.031		
	Cadmium (Cd)-Dissolved (mg/L)	0.0000065	0.0000093	0.000397	0.0000089		
	Calcium (Ca)-Dissolved (mg/L)	61.0	68.8	221	71.6		
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	0.00045	<0.00010		
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	0.00128	<0.00010		
	Copper (Cu)-Dissolved (mg/L)	0.00160	0.00721	0.0732	0.00733		
	Iron (Fe)-Dissolved (mg/L)	<0.010	0.034	0.246	0.030		
	Lead (Pb)-Dissolved (mg/L)	<0.000050 ^{DTC}	<0.000050	<0.000050	<0.000050		
	Lithium (Li)-Dissolved (mg/L)	0.0046	0.0016	0.0039	0.0019		
	Magnesium (Mg)-Dissolved (mg/L)	31.6	21.2	67.6	21.6		
	Manganese (Mn)-Dissolved (mg/L)	0.00292	0.109	3.94	0.105		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID	L2041414-1	L2041414-2	L2041414-3	L2041414-4	
		Description	Water	Water	Water	Water	
		Sampled Date	02-JAN-18	02-JAN-18	02-JAN-18	02-JAN-18	
		Sampled Time	10:25	11:00	12:40		
		Client ID	W3	W17	W8A	DUP	
Grouping	Analyte						
WATER							
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Dissolved (mg/L)	0.00486	0.00593	0.0135	0.00623		
	Nickel (Ni)-Dissolved (mg/L)	0.00062	0.00094	0.00199	0.00084		
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050		
	Potassium (K)-Dissolved (mg/L)	2.52	3.91	8.70	4.03		
	Selenium (Se)-Dissolved (mg/L)	0.000403	0.000427	0.00939	0.000381		
	Silicon (Si)-Dissolved (mg/L)	6.51	5.79	7.91	5.79		
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	0.000010	<0.000010		
	Sodium (Na)-Dissolved (mg/L)	20.4	15.8	52.8	15.5		
	Strontium (Sr)-Dissolved (mg/L)	0.914	0.799	3.27	0.809		
	Sulfur (S)-Dissolved (mg/L)	20.0	21.5	139	21.5		
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010		
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010		
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00090 ^{DLM}	<0.00030		
	Uranium (U)-Dissolved (mg/L)	0.00295	0.00213	0.00365	0.00221		
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	0.00112	<0.00050		
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	0.0030	0.229	0.0024		
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	0.00067	<0.00030		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Alkalinity, Total (as CaCO ₃)	B	L2041414-1, -2, -3, -4
Method Blank	Arsenic (As)-Dissolved	MB-LOR	L2041414-1
Laboratory Control Sample	Aluminum (Al)-Dissolved	MES	L2041414-1
Laboratory Control Sample	Magnesium (Mg)-Dissolved	MES	L2041414-1
Laboratory Control Sample	Potassium (K)-Dissolved	MES	L2041414-1
Laboratory Control Sample	Sodium (Na)-Dissolved	MES	L2041414-1
Laboratory Control Sample	Sulfur (S)-Dissolved	MES	L2041414-1
Matrix Spike	Dissolved Organic Carbon	MS-B	L2041414-1, -2, -4
Matrix Spike	Antimony (Sb)-Dissolved	MS-B	L2041414-1
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2041414-1, -2, -3, -4
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2041414-1
Matrix Spike	Boron (B)-Dissolved	MS-B	L2041414-1
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2041414-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2041414-1
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2041414-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2041414-1
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2041414-1, -2, -3, -4
Matrix Spike	Molybdenum (Mo)-Dissolved	MS-B	L2041414-1
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2041414-1
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2041414-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2041414-1
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2041414-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2041414-1
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2041414-1, -2, -3, -4
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2041414-1
Matrix Spike	Barium (Ba)-Total	MS-B	L2041414-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Total	MS-B	L2041414-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2041414-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Total	MS-B	L2041414-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Total	MS-B	L2041414-1, -2, -3, -4

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
DLB	Detection Limit Raised. Analyte detected at comparable level in Method Blank.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DTC	Dissolved concentration exceeds total. Results were confirmed by re-analysis.
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			

Reference Information

BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
SO4-IC-N-VA	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Reference Information

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
----------------------------	---------------------

VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
----	---

Chain of Custody Numbers:

2018-01-03 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

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COC Number: 2018-01-03 A

Page of

[illegible]

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an Authorized DW COC form.

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 10-JAN-18
Report Date: 22-JAN-18 15:31 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2043491
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-01-09 A
Legal Site Desc:

Shane Stack
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2043491-1 Water 08-JAN-18 10:15 W17	L2043491-2 Water 08-JAN-18 10:45 W8A	L2043491-3 Water 09-JAN-18 10:15 W3	L2043491-4 Water 09-JAN-18 10:15 F-BL	
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	523	1600	548	56.7	
	Hardness (as CaCO3) (mg/L)	269	975	284	0.53	
	pH (pH)	8.07	7.55	8.05	7.44	
	Total Suspended Solids (mg/L)	<3.0	11.4	<3.0	<3.0	
	TDS (Calculated) (mg/L)	315	1160	328	31.7	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	225	628	249	16.7	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Total (as CaCO3) (mg/L)	225	628	249	16.7	
	Ammonia, Total (as N) (mg/L)	0.0052	0.313	0.0095	0.0067 ^{RRV}	
	Chloride (Cl) (mg/L)	7.08	16.6	4.51	6.82	
	Nitrate and Nitrite (as N) (mg/L)	0.0718	6.00	0.200	0.152	
	Nitrate (as N) (mg/L)	0.0718	5.34	0.200	0.152	
	Nitrite (as N) (mg/L)	<0.0010	0.659	<0.0010	<0.0010	
	Sulfate (SO4) (mg/L)	59.9	328	58.2	1.00	
	Anion Sum (meq/L)	5.94	20.3	6.33	0.56	
	Cation Sum (meq/L)	6.17	22.4	6.58	0.57	
	Cation - Anion Balance (%)	1.9	4.9	2.0	1.5	
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	9.87		5.20	1.09	
Total Metals	Aluminum (Al)-Total (mg/L)	0.0071	0.0704	0.0250	0.0031	
	Antimony (Sb)-Total (mg/L)	<0.00010	0.00017	<0.00010	<0.00010	
	Arsenic (As)-Total (mg/L)	0.00040	0.00070	0.00021	<0.00010	
	Barium (Ba)-Total (mg/L)	0.0764	0.179	0.0682	0.000288	
	Beryllium (Be)-Total (mg/L)	<0.000020	0.000021	<0.000020	<0.000020	
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Total (mg/L)	0.030	0.041	0.027	<0.010	
	Cadmium (Cd)-Total (mg/L)	<0.0000050	0.000341	<0.0000050	<0.0000050	
	Calcium (Ca)-Total (mg/L)	66.2	243	57.6	0.280	
	Chromium (Cr)-Total (mg/L)	<0.00010	0.00094	0.00013	<0.00010	
	Cobalt (Co)-Total (mg/L)	<0.00010	0.00137	<0.00010	<0.00010	
	Copper (Cu)-Total (mg/L)	0.00756	0.165	0.00213	0.00143	
	Iron (Fe)-Total (mg/L)	0.039	1.80	0.053	0.016	
	Lead (Pb)-Total (mg/L)	<0.000050	0.000094	<0.000050	0.000154	
	Lithium (Li)-Total (mg/L)	0.0017	0.0049	0.0037	<0.0010	
	Magnesium (Mg)-Total (mg/L)	21.8	69.6	29.2	<0.10	
	Manganese (Mn)-Total (mg/L)	0.0629	4.25	0.0613	0.00109	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2043491-1 Water 08-JAN-18 10:15 W17	L2043491-2 Water 08-JAN-18 10:45 W8A	L2043491-3 Water 09-JAN-18 10:15 W3	L2043491-4 Water 09-JAN-18 10:15 F-BL	
Grouping	Analyte						
WATER							
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Total (mg/L)	0.00621	0.0145	0.00500	0.000412		
	Nickel (Ni)-Total (mg/L)	0.00085	0.00208	0.00083	<0.00050		
	Phosphorus (P)-Total (mg/L)	<0.050	0.074	<0.050	<0.050		
	Potassium (K)-Total (mg/L)	3.85	8.92	2.23	<0.10		
	Selenium (Se)-Total (mg/L)	0.000362	0.00675	0.000357	<0.000050		
	Silicon (Si)-Total (mg/L)	5.89	8.66	6.39	0.69		
	Silver (Ag)-Total (mg/L)	<0.000010	0.000033	<0.000010	<0.000010		
	Sodium (Na)-Total (mg/L)	16.7	56.9	18.7	13.2		
	Strontium (Sr)-Total (mg/L)	0.785	3.45	0.851	0.00248		
	Sulfur (S)-Total (mg/L)	21.3	134	20.3	<0.50		
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010		
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010		
	Titanium (Ti)-Total (mg/L)	0.00037	0.00360	<0.0012 ^{DLM}	<0.00030		
	Uranium (U)-Total (mg/L)	0.00234	0.00458	0.00291	0.000139		
	Vanadium (V)-Total (mg/L)	<0.00050	0.00295	<0.00050	<0.00050		
	Zinc (Zn)-Total (mg/L)	<0.0030	0.271	<0.0030	0.0255		
	Zirconium (Zr)-Total (mg/L)	<0.00030	0.00083	<0.00030	<0.00030		
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD		
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD		
	Aluminum (Al)-Dissolved (mg/L)	0.0017	0.0152	0.0012	<0.0010		
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	0.00013	<0.00010	<0.00010		
	Arsenic (As)-Dissolved (mg/L)	0.00037	0.00090	0.00032	0.00012		
	Barium (Ba)-Dissolved (mg/L)	0.0781	0.179	0.0722	0.000319		
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020		
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050		
	Boron (B)-Dissolved (mg/L)	0.026	0.035	0.025	<0.010		
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	0.000268	0.0000071	<0.0000050		
	Calcium (Ca)-Dissolved (mg/L)	71.4	272	62.5	0.213		
	Chromium (Cr)-Dissolved (mg/L)	0.00010	0.00065	<0.00010	<0.00010		
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00147	<0.00010	<0.00010		
	Copper (Cu)-Dissolved (mg/L)	0.00668	0.0627	0.00185	0.00076		
	Iron (Fe)-Dissolved (mg/L)	0.030	0.377	0.015	<0.010		
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	0.000090		
	Lithium (Li)-Dissolved (mg/L)	0.0019	0.0048	0.0040	<0.0010		
	Magnesium (Mg)-Dissolved (mg/L)	22.0	71.9	31.0	<0.10		
	Manganese (Mn)-Dissolved (mg/L)	0.0534	4.83	0.0520	0.00087		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID	L2043491-1	L2043491-2	L2043491-3	L2043491-4	
		Description	Water	Water	Water	Water	
		Sampled Date	08-JAN-18	08-JAN-18	09-JAN-18	09-JAN-18	
		Sampled Time	10:15	10:45	10:15	10:15	
		Client ID	W17	W8A	W3	F-BL	
Grouping	Analyte						
WATER							
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Dissolved (mg/L)	0.00566	0.0120	0.00435	0.000368		
	Nickel (Ni)-Dissolved (mg/L)	0.00071	0.00230	0.00077	<0.00050		
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050		
	Potassium (K)-Dissolved (mg/L)	3.65	8.86	2.30	0.11		
	Selenium (Se)-Dissolved (mg/L)	0.000341	0.00578	0.000314	<0.000050		
	Silicon (Si)-Dissolved (mg/L)	5.73	8.49	6.35	0.626		
	Silver (Ag)-Dissolved (mg/L)	<0.000010	0.000012	<0.000010	<0.000010		
	Sodium (Na)-Dissolved (mg/L)	16.1	56.0	19.6	12.9		
	Strontium (Sr)-Dissolved (mg/L)	0.823	3.60	0.865	0.00156		
	Sulfur (S)-Dissolved (mg/L)	20.7	121	19.8	<0.50		
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010		
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010		
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00060 ^{DLM}	<0.00030	<0.00030		
	Uranium (U)-Dissolved (mg/L)	0.00227	0.00447	0.00274	0.000117		
	Vanadium (V)-Dissolved (mg/L)	<0.00050	0.00151	<0.00050	<0.00050		
	Zinc (Zn)-Dissolved (mg/L)	0.0011	0.361	0.0013	0.0250		
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	0.00079	<0.00030	<0.00030		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2043491-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2043491-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2043491-1, -2, -3, -4
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2043491-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2043491-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2043491-1, -2, -3, -4
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2043491-1, -2, -3, -4
Matrix Spike	Barium (Ba)-Total	MS-B	L2043491-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Total	MS-B	L2043491-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2043491-1, -2, -3, -4
Matrix Spike	Molybdenum (Mo)-Total	MS-B	L2043491-1, -2, -3, -4
Matrix Spike	Potassium (K)-Total	MS-B	L2043491-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Total	MS-B	L2043491-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Total	MS-B	L2043491-1, -2, -3, -4
Matrix Spike	Sulfur (S)-Total	MS-B	L2043491-1, -2, -3, -4
Matrix Spike	Sulfate (SO4)	MS-B	L2043491-1, -2, -3, -4

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)

Reference Information

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
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VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
----	---

Chain of Custody Numbers:

2018-01-09 A

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lw - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

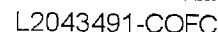
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



568 98%

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REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 EBC



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 17-JAN-18
Report Date: 02-FEB-18 11:15 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2046331
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-01-17 A
Legal Site Desc:

Shane Stack
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2046331-1 Water 13-JAN-18 08:30 UG1	L2046331-2 Water 15-JAN-18 09:30 W12	L2046331-3 Water 15-JAN-18 09:50 W14	L2046331-4 Water 15-JAN-18 10:05 W45	L2046331-5 Water 15-JAN-18 10:30 W62
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	2280	2670	3420	3160	1060
	Hardness (as CaCO3) (mg/L)	1400	1330	1700	1520	565
	pH (pH)	7.91	8.07	8.23	7.98	8.32
	Total Suspended Solids (mg/L)	323	12.6	30.8	283	8.0
	TDS (Calculated) (mg/L)	2160	2460	3250	2780	698
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	199	169	94.2	114	382
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	6.4
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	199	169	94.2	114	388
	Ammonia, Total (as N) (mg/L)	6.60	4.69	4.82	3.96	0.0107
	Chloride (Cl) (mg/L)	12	40	45	38	26.6
	Nitrate (as N) (mg/L)	14.4	13.2	23.2	14.4	4.62
	Nitrite (as N) (mg/L)	0.980	5.25	5.02	4.83	0.0058
	Sulfate (SO4) (mg/L)	1310	1540	2040	1770	189
	Anion Sum (meq/L)	32.7	37.8	47.7	41.6	12.8
	Cation Sum (meq/L)	33.3	35.1	47.8	40.8	12.6
	Cation - Anion Balance (%)	0.9	-3.7	0.1	-1.0	-0.7
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	2.76				
Total Metals	Aluminum (Al)-Total (mg/L)	7.29	0.0883		3.89	0.0306
	Antimony (Sb)-Total (mg/L)	0.00050	0.00039		0.00054	0.00018
	Arsenic (As)-Total (mg/L)	0.00210	0.00044		0.00098	0.00047
	Barium (Ba)-Total (mg/L)	0.163	0.0896		0.209	0.103
	Beryllium (Be)-Total (mg/L)	0.000196	<0.000040 ^{DLA}		0.000095	<0.000020
	Bismuth (Bi)-Total (mg/L)	0.00021	<0.00010 ^{DLA}		0.00011	<0.000050
	Boron (B)-Total (mg/L)	0.526	0.297		0.336	0.022
	Cadmium (Cd)-Total (mg/L)	0.000390	<0.00017 ^{DLM}		<0.00030 ^{DLM}	0.0000296
	Calcium (Ca)-Total (mg/L)	469	426		494	159
	Chromium (Cr)-Total (mg/L)	0.00265	<0.00020 ^{DLA}		0.00241	0.00026
	Cobalt (Co)-Total (mg/L)	0.00462	0.00232		0.00641	0.00012
	Copper (Cu)-Total (mg/L)	1.28	0.0635		0.746	0.0600
	Iron (Fe)-Total (mg/L)	12.7	0.128		8.10	0.069
	Lead (Pb)-Total (mg/L)	0.00524	<0.00010 ^{DLA}		0.0111	<0.000050
	Lithium (Li)-Total (mg/L)	0.0140	0.0203		0.0268	0.0021
	Magnesium (Mg)-Total (mg/L)	48.9	76.7		89.3	43.8
	Manganese (Mn)-Total (mg/L)	0.509	1.56		2.32	0.0372
	Mercury (Hg)-Total (mg/L)	0.0000109	<0.0000050	<0.0000050	<0.0000050	<0.0000050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

02-FEB-18 11:15 (MT)

Version: FINAL

Sample ID Description Sampled Date Sampled Time Client ID		L2046331-6 Water 16-JAN-18 10:00 W3	L2046331-7 Water 16-JAN-18 10:35 W17	L2046331-8 Water 16-JAN-18 11:20 W8A	L2046331-9 Water 16-JAN-18 14:00 W16 (1)	L2046331-10 Water 16-JAN-18 14:00 W16 (2)
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	560	527	1600	541	523
	Hardness (as CaCO3) (mg/L)	279	272	897	266	258
	pH (pH)	8.26	8.22	7.99	8.15	8.28
	Total Suspended Solids (mg/L)	4.4	15.8	12.4	10.0	37.2
	TDS (Calculated) (mg/L)	330	319	1160	331	310
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	254	226	647	212	223
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	254	226	647	212	223
	Ammonia, Total (as N) (mg/L)	0.0276	0.0080	0.295	0.0660	0.0062
	Chloride (Cl) (mg/L)	4.74	7.24	17.9	7.72	7.19
	Nitrate (as N) (mg/L)	0.187	0.0813	5.83	1.71	0.0695
	Nitrite (as N) (mg/L)	<0.0010	0.0011	0.591	0.0066	<0.0010
	Sulfate (SO4) (mg/L)	59.5	60.8	346	75.8	60.7
	Anion Sum (meq/L)	6.45	5.99	21.1	6.16	5.92
	Cation Sum (meq/L)	6.48	6.35	20.7	6.12	5.91
	Cation - Anion Balance (%)	0.2	2.9	-1.1	-0.4	0.0
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	5.25	9.41		12.9	9.29
Total Metals	Aluminum (Al)-Total (mg/L)	0.0214	0.0594	0.0489	0.140	0.0667
	Antimony (Sb)-Total (mg/L)	<0.00010	0.00023	0.00030	0.00013	0.00022
	Arsenic (As)-Total (mg/L)	0.00023	0.00040	0.00065	0.00042	0.00042
	Barium (Ba)-Total (mg/L)	0.0687	0.0797	0.172	0.0875	0.0823
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.024	0.026	0.034	0.028	0.026
	Cadmium (Cd)-Total (mg/L)	0.0000064	0.0000314	0.000337	0.0000139	0.0000332
	Calcium (Ca)-Total (mg/L)	59.2	69.0	241	72.4	68.5
	Chromium (Cr)-Total (mg/L)	0.00013	0.00023	0.00094	0.00034	0.00030
	Cobalt (Co)-Total (mg/L)	<0.00010	0.00020	0.00135	0.00014	0.00021
	Copper (Cu)-Total (mg/L)	0.00255	0.0184	0.152	0.0542	0.0166
	Iron (Fe)-Total (mg/L)	0.046	0.417	1.91	0.301	0.862
	Lead (Pb)-Total (mg/L)	<0.000050	0.000872	0.000129	0.000089	0.000873
	Lithium (Li)-Total (mg/L)	0.0028	0.0011	0.0036	<0.0010	0.0012
	Magnesium (Mg)-Total (mg/L)	31.0	22.3	70.5	21.2	22.3
	Manganese (Mn)-Total (mg/L)	0.0969	0.329	4.47	0.166	0.329
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2046331-1 Water 13-JAN-18 08:30 UG1	L2046331-2 Water 15-JAN-18 09:30 W12	L2046331-3 Water 15-JAN-18 09:50 W14	L2046331-4 Water 15-JAN-18 10:05 W45	L2046331-5 Water 15-JAN-18 10:30 W62
Grouping	Analyte					
WATER						
Total Metals	Molybdenum (Mo)-Total (mg/L)	0.0241	0.0984		0.130	0.00685
	Nickel (Ni)-Total (mg/L)	0.0042	0.0041 ^{DLA}		0.0119	0.00112
	Phosphorus (P)-Total (mg/L)	0.21	<0.10		0.26	<0.050
	Potassium (K)-Total (mg/L)	13.2	57.3		78.7	5.12
	Selenium (Se)-Total (mg/L)	0.00141	0.0120		0.0134	0.00204
	Silicon (Si)-Total (mg/L)	19.6	4.15 ^{DLA}		10.8	7.80
	Silver (Ag)-Total (mg/L)	0.000742	<0.000020 ^{DLA}		0.000150	<0.000010
	Sodium (Na)-Total (mg/L)	108	168		200	27.2
	Strontium (Sr)-Total (mg/L)	8.43	7.49		7.70	1.63
	Sulfur (S)-Total (mg/L)	449	531		661	63.7
	Thallium (Tl)-Total (mg/L)	0.000102	<0.000020 ^{DLA}		0.000055	<0.000010
	Tin (Sn)-Total (mg/L)	0.00034	<0.00020 ^{DLA}		0.00042	<0.00010 ^{DLM}
	Titanium (Ti)-Total (mg/L)	0.507	<0.0036 ^{DLM}		0.275	<0.0024
	Uranium (U)-Total (mg/L)	0.00876	0.00863 ^{DLA}		0.0101	0.00494
	Vanadium (V)-Total (mg/L)	0.0272	<0.0010		0.0170	0.00067
	Zinc (Zn)-Total (mg/L)	0.105	0.0132		0.149	0.135
	Zirconium (Zr)-Total (mg/L)	0.00037	<0.00030		0.00050	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD		FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0085	0.0054	0.0309	0.0092	0.0024
	Antimony (Sb)-Dissolved (mg/L)	0.00045	0.00032	0.00041	0.00049	0.00011
	Arsenic (As)-Dissolved (mg/L)	0.00119	0.00041	0.00034	0.00038	0.00041
	Barium (Ba)-Dissolved (mg/L)	0.0432	0.0919	0.239	0.116	0.108
	Beryllium (Be)-Dissolved (mg/L)	<0.000040 ^{DLA}	<0.000040 ^{DLA}	<0.000040 ^{DLA}	<0.000040 ^{DLA}	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.00010 ^{DLA}	<0.00010 ^{DLA}	<0.00010 ^{DLA}	<0.00010 ^{DLA}	<0.000050
	Boron (B)-Dissolved (mg/L)	0.553	0.292	0.315	0.310	0.019
	Cadmium (Cd)-Dissolved (mg/L)	0.000197	<0.00020 ^{DLA}	<0.000050 ^{DLA}	<0.00020 ^{DLM}	0.0000306
	Calcium (Ca)-Dissolved (mg/L)	480	412	532	467	154
	Chromium (Cr)-Dissolved (mg/L)	<0.00020 ^{DLA}	<0.00020 ^{DLA}	<0.00020 ^{DLA}	<0.00020 ^{DLA}	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	0.00090	0.00220	0.00035	0.00394	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.0146	0.0342	0.00223	0.00594	0.0530
	Iron (Fe)-Dissolved (mg/L)	<0.020 ^{DLA}	<0.020 ^{DLA}	<0.020 ^{DLA}	<0.020 ^{DLA}	0.016
	Lead (Pb)-Dissolved (mg/L)	<0.00010 ^{DLA}	<0.00010 ^{DLA}	<0.00010 ^{DLA}	0.00012	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0132	0.0221	0.0359	0.0269	0.0021
	Magnesium (Mg)-Dissolved (mg/L)	47.9	74.0	90.4	84.8	44.1
	Manganese (Mn)-Dissolved (mg/L)	0.195	1.50	1.39	2.11	0.0360
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050		<0.0000050	<0.0000050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2046331-6 Water 16-JAN-18 10:00 W3	L2046331-7 Water 16-JAN-18 10:35 W17	L2046331-8 Water 16-JAN-18 11:20 W8A	L2046331-9 Water 16-JAN-18 14:00 W16 (1)	L2046331-10 Water 16-JAN-18 14:00 W16 (2)
Grouping	Analyte						
WATER							
Total Metals	Molybdenum (Mo)-Total (mg/L)	0.00508	0.00630	0.0131	0.00352	0.00642	
	Nickel (Ni)-Total (mg/L)	0.00093	0.00119	0.00222	0.00082	0.00125	
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	0.073	<0.050	<0.050	
	Potassium (K)-Total (mg/L)	2.22	3.78	8.72	3.22	3.76	
	Selenium (Se)-Total (mg/L)	0.000275	0.000385	0.00584	0.000706	0.000337	
	Silicon (Si)-Total (mg/L)	6.25	5.62	8.20	4.87	5.69	
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	0.000031	0.000015	<0.000010	
	Sodium (Na)-Total (mg/L)	19.7	16.3	55.2	16.3	15.9	
	Strontium (Sr)-Total (mg/L)	0.863	0.800	3.50	0.742	0.816	
	Sulfur (S)-Total (mg/L)	19.4	20.3	118	25.9	20.5	
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Total (mg/L)	0.00080	<0.0036 ^{DLM}	0.00295	0.00757	0.00359	
	Uranium (U)-Total (mg/L)	0.00295	0.00244	0.00463	0.00163	0.00244	
	Vanadium (V)-Total (mg/L)	<0.00050	0.00065	0.00296	0.00075	0.00064	
	Zinc (Zn)-Total (mg/L)	<0.0030	0.0156	0.303	0.0136	0.0145	
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	0.00080	<0.00030	<0.00030	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0015	0.0023	0.0103	0.0031	0.0020	
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	0.00016	0.00018	<0.00010	0.00015	
	Arsenic (As)-Dissolved (mg/L)	0.00023	0.00041	0.00059	0.00036	0.00035	
	Barium (Ba)-Dissolved (mg/L)	0.0723	0.0894	0.169	0.0868	0.0788	
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	0.023	0.024	0.033	0.027	0.025	
	Cadmium (Cd)-Dissolved (mg/L)	0.0000094	0.0000322	0.000295	0.0000143	0.0000260	
	Calcium (Ca)-Dissolved (mg/L)	60.2	66.7	242	71.1	67.2	
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	0.00067	<0.00010	<0.00010	
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00010	0.00131	<0.00010	<0.00010	
	Copper (Cu)-Dissolved (mg/L)	0.00212	0.00941	0.0783	0.0207	0.00765	
	Iron (Fe)-Dissolved (mg/L)	0.014	0.045	0.332	0.063	0.073	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.0033	<0.0010	0.0041	0.0011	0.0010	
	Magnesium (Mg)-Dissolved (mg/L)	31.3	25.6	71.2	21.5	21.9	
	Manganese (Mn)-Dissolved (mg/L)	0.0968	0.0772	4.60	0.152	0.0719	
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2046331-1 Water 13-JAN-18 08:30 UG1	L2046331-2 Water 15-JAN-18 09:30 W12	L2046331-3 Water 15-JAN-18 09:50 W14	L2046331-4 Water 15-JAN-18 10:05 W45	L2046331-5 Water 15-JAN-18 10:30 W62
Grouping	Analyte					
WATER						
Dissolved Metals	Molybdenum (Mo)-Dissolved (mg/L)	0.0245	0.0975	0.158	0.134	0.00595
	Nickel (Ni)-Dissolved (mg/L)	0.0028	0.0038	0.0019	0.0095	0.00114
	Phosphorus (P)-Dissolved (mg/L)	<0.10 ^{DLA}	<0.10 ^{DLA}	<0.10 ^{DLA}	<0.10 ^{DLA}	<0.050
	Potassium (K)-Dissolved (mg/L)	10.6	55.1	119	76.0	5.27
	Selenium (Se)-Dissolved (mg/L)	0.00133	0.0116	0.0162	0.0130	0.00250
	Silicon (Si)-Dissolved (mg/L)	7.29	3.93	2.37	3.20	7.92
	Silver (Ag)-Dissolved (mg/L)	<0.000020 ^{DLA}	<0.000020 ^{DLA}	<0.000020 ^{DLA}	<0.000020 ^{DLA}	<0.000010
	Sodium (Na)-Dissolved (mg/L)	106	154	238	188	26.1
	Strontium (Sr)-Dissolved (mg/L)	8.27	7.39	7.27	7.19	1.53
	Sulfur (S)-Dissolved (mg/L)	470	491	742	623	60.2
	Thallium (Tl)-Dissolved (mg/L)	<0.000020 ^{DLA}	<0.000020 ^{DLA}	<0.000020 ^{DLA}	<0.000020 ^{DLA}	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00020 ^{DLA}	<0.00020 ^{DLA}	<0.00020 ^{DLA}	<0.00020 ^{DLA}	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00060 ^{DLM}	<0.00060 ^{DLM}	<0.00060 ^{DLM}	<0.00060 ^{DLM}	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00844	0.00795	0.0106	0.00938	0.00445
	Vanadium (V)-Dissolved (mg/L)	<0.0010 ^{DLA}	<0.0010 ^{DLA}	<0.0010 ^{DLA}	<0.0010 ^{DLA}	0.00055
	Zinc (Zn)-Dissolved (mg/L)	0.0325	0.0073	<0.0020 ^{DLA}	0.0851	0.128
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2046331-6 Water 16-JAN-18 10:00 W3	L2046331-7 Water 16-JAN-18 10:35 W17	L2046331-8 Water 16-JAN-18 11:20 W8A	L2046331-9 Water 16-JAN-18 14:00 W16 (1)	L2046331-10 Water 16-JAN-18 14:00 W16 (2)
Grouping	Analyte					
WATER						
Dissolved Metals	Molybdenum (Mo)-Dissolved (mg/L)	0.00479	0.00584	0.0117	0.00341	0.00591
	Nickel (Ni)-Dissolved (mg/L)	0.00084	0.00110	0.00204	0.00078	0.00091
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	2.46	4.35	8.98	3.37	3.66
	Selenium (Se)-Dissolved (mg/L)	0.000383 ^{RRV}	0.000389	0.00607	0.000748	0.000333
	Silicon (Si)-Dissolved (mg/L)	6.46	5.70	8.28	4.71	5.60
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	0.000012	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	19.2	18.2	52.5	16.2	15.2
	Strontium (Sr)-Dissolved (mg/L)	0.857	0.794	3.33	0.721	0.800
	Sulfur (S)-Dissolved (mg/L)	20.3	19.7	110	24.5	19.6
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00090 ^{DLM}	0.00031	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00271	0.00220	0.00419	0.00148	0.00216
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	0.00134	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0011	0.0080	0.305	0.0045	0.0050
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	0.00080	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Dissolved Organic Carbon	MS-B	L2046331-1, -10, -6, -7, -9
Matrix Spike	Dissolved Organic Carbon	MS-B	L2046331-1, -10, -6, -7, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Reference Information

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
SO4-IC-N-VA	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)
This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".			
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.			
TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.			
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-01-17 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.





Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 24-JAN-18
Report Date: 31-JAN-18 16:24 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2048964
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-01-24 A
Legal Site Desc:

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2048964-1 Water 23-JAN-18 09:15 W3	L2048964-2 Water 23-JAN-18 10:15 W17	L2048964-3 Water 23-JAN-18 11:40 W8A	L2048964-4 Water 23-JAN-18 DUP	
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	562	540	1620	528	
	Hardness (as CaCO ₃) (mg/L)	271	261	942	266	
	pH (pH)	8.03	8.06	7.85	8.23	
	Total Suspended Solids (mg/L)	4.0	30.4	18.0	10.2	
	Total Dissolved Solids (mg/L)	341	337	1240	358	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO ₃) (mg/L)	246	221	691	227	
	Alkalinity, Carbonate (as CaCO ₃) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Hydroxide (as CaCO ₃) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Total (as CaCO ₃) (mg/L)	246	221	691	227	
	Ammonia, Total (as N) (mg/L)	0.0167	0.0101	0.285	0.0058	
	Chloride (Cl) (mg/L)	8.76	7.18	17.7	7.21	
	Nitrate and Nitrite (as N) (mg/L)	0.294	0.0610	4.17	0.0585	
	Nitrate (as N) (mg/L)	0.291	0.0610	3.67	0.0585	
	Nitrite (as N) (mg/L)	0.0024	<0.0010	0.500	<0.0010	
	Sulfate (SO ₄) (mg/L)	58.7	60.2	313	60.1	
	Anion Sum (meq/L)	6.41	5.87	21.1	6.00	
	Cation Sum (meq/L)	6.34	5.99	21.8	6.08	
	Cation - Anion Balance (%)	-0.5	1.0	1.6	0.7	
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	4.40 ^M	8.88		7.79	
Total Metals	Aluminum (Al)-Total (mg/L)	0.0180	0.177	0.0630	0.0313	
	Antimony (Sb)-Total (mg/L)	<0.00010	0.00012	0.00017	<0.00010	
	Arsenic (As)-Total (mg/L)	0.00028	0.00044	0.00084	0.00035	
	Barium (Ba)-Total (mg/L)	0.0699	0.101	0.201	0.0767	
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	0.000020	<0.000020	
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Total (mg/L)	0.029	0.029	0.038	0.030	
	Cadmium (Cd)-Total (mg/L)	0.0000098	0.0000575	0.000238	0.0000122	
	Calcium (Ca)-Total (mg/L)	67.2	69.5	250	72.1	
	Chromium (Cr)-Total (mg/L)	<0.00020 ^{DLB}	<0.00040 ^{DLB}	0.00115	<0.00020 ^{DLB}	
	Cobalt (Co)-Total (mg/L)	0.00010	0.00035	0.00169	0.00010	
	Copper (Cu)-Total (mg/L)	0.00228	0.0473	0.137	0.0125	
	Iron (Fe)-Total (mg/L)	0.055	0.252	2.80	0.044	
	Lead (Pb)-Total (mg/L)	<0.000050	0.000101	0.000166	<0.000050	
	Lithium (Li)-Total (mg/L)	0.0039	0.0012	0.0045	0.0016	
	Magnesium (Mg)-Total (mg/L)	34.6	23.4	80.2	23.3	
	Manganese (Mn)-Total (mg/L)	0.128	1.22	5.96	0.183	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID	L2048964-1	L2048964-2	L2048964-3	L2048964-4	
		Description	Water	Water	Water	Water	
		Sampled Date	23-JAN-18	23-JAN-18	23-JAN-18	23-JAN-18	
		Sampled Time	09:15	10:15	11:40		
		Client ID	W3	W17	W8A	DUP	
Grouping	Analyte						
WATER							
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	0.0000065	0.0000080	<0.0000050		
	Molybdenum (Mo)-Total (mg/L)	0.00542	0.00726	0.0107	0.00660		
	Nickel (Ni)-Total (mg/L)	0.00087	0.00177	0.00217	0.00085		
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	0.103	<0.050		
	Potassium (K)-Total (mg/L)	2.32	3.79	8.76	3.78		
	Selenium (Se)-Total (mg/L)	0.000296	0.000309	0.00343	0.000313		
	Silicon (Si)-Total (mg/L)	7.17	6.50	9.92	5.99		
	Silver (Ag)-Total (mg/L)	<0.000010	0.000017	0.000037	<0.000010		
	Sodium (Na)-Total (mg/L)	20.2	17.0	58.5	16.1		
	Strontium (Sr)-Total (mg/L)	0.918	0.828	3.61	0.815		
	Sulfur (S)-Total (mg/L)	22.2	21.9	102	22.0		
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010		
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010		
	Titanium (Ti)-Total (mg/L)	0.00091	0.00713	0.00357	<0.012 ^{DLM}		
	Uranium (U)-Total (mg/L)	0.00313	0.00237	0.00471	0.00238		
	Vanadium (V)-Total (mg/L)	0.00054	0.00130	0.00438	0.00050		
	Zinc (Zn)-Total (mg/L)	<0.0030	0.0080	0.173	<0.0030		
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	0.00099	<0.00030		
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD		
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD		
	Aluminum (Al)-Dissolved (mg/L)	0.0011	0.0015	0.0100	0.0014		
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	0.00014	<0.00010		
	Arsenic (As)-Dissolved (mg/L)	0.00021	0.00035	0.00072	0.00034		
	Barium (Ba)-Dissolved (mg/L)	0.0726	0.0811	0.217	0.0840		
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	0.000020	<0.000020		
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050		
	Boron (B)-Dissolved (mg/L)	0.025	0.028	0.038	0.028		
	Cadmium (Cd)-Dissolved (mg/L)	0.0000081	<0.0000050	0.000210	0.0000052		
	Calcium (Ca)-Dissolved (mg/L)	57.9	68.9	253	70.0		
	Chromium (Cr)-Dissolved (mg/L)	0.00016	0.00014	0.00083	<0.00010		
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	0.00179	<0.00010		
	Copper (Cu)-Dissolved (mg/L)	0.00170	0.00691	0.0559	0.00638		
	Iron (Fe)-Dissolved (mg/L)	0.032	<0.010	0.710	<0.010		
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050		
	Lithium (Li)-Dissolved (mg/L)	0.0032	0.0012	0.0042	0.0011		
	Magnesium (Mg)-Dissolved (mg/L)	30.8	21.5	75.5	22.1		
	Manganese (Mn)-Dissolved (mg/L)	0.122	0.0102	5.89	0.0244		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2048964-1 Water 23-JAN-18 09:15 W3	L2048964-2 Water 23-JAN-18 10:15 W17	L2048964-3 Water 23-JAN-18 11:40 W8A	L2048964-4 Water 23-JAN-18 DUP	
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Dissolved (mg/L)	0.00422	0.00549	0.00897	0.00552	
	Nickel (Ni)-Dissolved (mg/L)	0.00082	0.00075	0.00227	0.00075	
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	0.056	<0.050	
	Potassium (K)-Dissolved (mg/L)	2.43	3.82	9.05	3.82	
	Selenium (Se)-Dissolved (mg/L)	0.000324	0.000405	0.00419	0.000388	
	Silicon (Si)-Dissolved (mg/L)	6.20	5.70	9.38	5.74	
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	0.000014	<0.000010	
	Sodium (Na)-Dissolved (mg/L)	19.5	15.7	56.5	15.5	
	Strontium (Sr)-Dissolved (mg/L)	0.829	0.823	3.60	0.855	
	Sulfur (S)-Dissolved (mg/L)	19.6	20.1	94.3	19.7	
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.0012 ^{DLM}	<0.00030	
	Uranium (U)-Dissolved (mg/L)	0.00275	0.00228	0.00490	0.00222	
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	0.00220	<0.00050	
	Zinc (Zn)-Dissolved (mg/L)	0.0014	0.0022	0.173	0.0012	
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	0.00106	<0.00030	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Magnesium (Mg)-Total	B	L2048964-1, -2, -3, -4
Method Blank	Chromium (Cr)-Total	MB-LOR	L2048964-1, -2, -3, -4
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2048964-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2048964-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2048964-1, -2, -3, -4
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2048964-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2048964-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2048964-1, -2, -3, -4
Matrix Spike	Barium (Ba)-Total	MS-B	L2048964-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Total	MS-B	L2048964-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2048964-1, -2, -3, -4
Matrix Spike	Manganese (Mn)-Total	MS-B	L2048964-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Total	MS-B	L2048964-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Total	MS-B	L2048964-1, -2, -3, -4
Matrix Spike	Sulfur (S)-Total	MS-B	L2048964-1, -2, -3, -4

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
DLB	Detection Limit Raised. Analyte detected at comparable level in Method Blank.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
M	A peak has been manually integrated.
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Reference Information

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 µm), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-VA Water Total Dissolved Solids by Gravimetric APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
----------------------------	---------------------

VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
----	---

Reference Information

Chain of Custody Numbers:

2018-01-24 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2048964-COFC

COC Number: 2018-01-24 A

Page 1 of 1

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REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

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~~JAN 25 2011~~

OCTOBER 2015 ERO



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 31-JAN-18
Report Date: 09-FEB-18 15:37 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2051510
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-01-31 A
Legal Site Desc:

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ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2051510-1 Water 29-JAN-18 11:10 W8A	L2051510-2 Water 30-JAN-18 11:00 W3	L2051510-3 Water 30-JAN-18 DUP		
Grouping	Analyte						
WATER							
Physical Tests	Conductivity (uS/cm)		1640	563	569		
	Hardness (as CaCO3) (mg/L)		959	265	264		
	pH (pH)		7.77	8.16	8.19		
	Total Suspended Solids (mg/L)		22.6	<3.0	<3.0		
	TDS (Calculated) (mg/L)		1150	320	323		
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)		699	245	251		
	Alkalinity, Carbonate (as CaCO3) (mg/L)		<1.0	<1.0	<1.0		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)		<1.0	<1.0	<1.0		
	Alkalinity, Total (as CaCO3) (mg/L)		699	245	251		
	Ammonia, Total (as N) (mg/L)		0.387	0.0144	0.0133		
	Chloride (Cl) (mg/L)		18.1	4.56	4.56		
	Nitrate and Nitrite (as N) (mg/L)		4.17	0.192	0.190		
	Nitrate (as N) (mg/L)		3.68	0.192	0.190		
	Nitrite (as N) (mg/L)		0.494	<0.0010	<0.0010		
	Sulfate (SO4) (mg/L)		291	59.5	59.6		
	Anion Sum (meq/L)		20.8	6.28	6.40		
	Cation Sum (meq/L)		21.9	6.11	6.10		
	Cation - Anion Balance (%)		2.6	-1.4	-2.4		
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)			4.82	5.02		
Total Metals	Aluminum (Al)-Total (mg/L)		0.0514	0.0080	0.0156		
	Antimony (Sb)-Total (mg/L)		0.00019	<0.00010	<0.00010		
	Arsenic (As)-Total (mg/L)		0.00076	0.00025	0.00028		
	Barium (Ba)-Total (mg/L)		0.187	0.0708	0.0716		
	Beryllium (Be)-Total (mg/L)		<0.000020	<0.000020	<0.000020		
	Bismuth (Bi)-Total (mg/L)		<0.000050	<0.000050	<0.000050		
	Boron (B)-Total (mg/L)		0.034	0.022	0.022		
	Cadmium (Cd)-Total (mg/L)		0.000249	0.0000056	0.0000071		
	Calcium (Ca)-Total (mg/L)		249	57.7	56.2		
	Chromium (Cr)-Total (mg/L)		0.00116	<0.00010	<0.00010		
	Cobalt (Co)-Total (mg/L)		0.00164	<0.00010	<0.00010		
	Copper (Cu)-Total (mg/L)		0.131	0.00163	0.00190		
	Iron (Fe)-Total (mg/L)		3.02	0.039	0.051		
	Lead (Pb)-Total (mg/L)		0.000096	<0.000050	<0.000050		
	Lithium (Li)-Total (mg/L)		0.0048	0.0037	0.0035		
	Magnesium (Mg)-Total (mg/L)		72.5	30.5	31.3		
	Manganese (Mn)-Total (mg/L)		5.07	0.123	0.130		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2051510-1 Water 29-JAN-18 11:10 W8A	L2051510-2 Water 30-JAN-18 11:00 W3	L2051510-3 Water 30-JAN-18 DUP		
Grouping	Analyte						
WATER							
Total Metals	Mercury (Hg)-Total (mg/L)	0.0000063	<0.0000050	<0.0000050			
	Molybdenum (Mo)-Total (mg/L)	0.0121	0.00480	0.00506			
	Nickel (Ni)-Total (mg/L)	0.00302	0.00082	0.00089			
	Phosphorus (P)-Total (mg/L)	0.084	<0.050	<0.050			
	Potassium (K)-Total (mg/L)	8.75	2.34	2.44			
	Selenium (Se)-Total (mg/L)	0.00427	0.000316	0.000307			
	Silicon (Si)-Total (mg/L)	9.20	6.45	6.33			
	Silver (Ag)-Total (mg/L)	0.000031	<0.000010	<0.000010			
	Sodium (Na)-Total (mg/L)	54.8	18.8	19.4			
	Strontium (Sr)-Total (mg/L)	3.55	0.833	0.857			
	Sulfur (S)-Total (mg/L)	110	21.2	20.8			
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010			
	Tin (Sn)-Total (mg/L)	0.00010	<0.00010	<0.00010			
	Titanium (Ti)-Total (mg/L)	0.00521	<0.00030	<0.00090 ^{DLM}			
	Uranium (U)-Total (mg/L)	0.00501	0.00316	0.00317			
	Vanadium (V)-Total (mg/L)	0.00386	0.00060	0.00065			
	Zinc (Zn)-Total (mg/L)	0.472	<0.0030	<0.0030			
	Zirconium (Zr)-Total (mg/L)	0.00092	<0.00030	<0.00030			
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD			
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD			
	Aluminum (Al)-Dissolved (mg/L)	0.0063	0.0018	0.0017			
	Antimony (Sb)-Dissolved (mg/L)	<0.00020 ^{DLA}	<0.00010	<0.00010			
	Arsenic (As)-Dissolved (mg/L)	0.00066	0.00023	0.00021			
	Barium (Ba)-Dissolved (mg/L)	0.184	0.0673	0.0700			
	Beryllium (Be)-Dissolved (mg/L)	<0.000040 ^{DLA}	<0.000020	<0.000020			
	Bismuth (Bi)-Dissolved (mg/L)	<0.00010 ^{DLA}	<0.000050	<0.000050			
	Boron (B)-Dissolved (mg/L)	0.037	0.023	0.023			
	Cadmium (Cd)-Dissolved (mg/L)	0.000157	0.0000104	0.0000103			
	Calcium (Ca)-Dissolved (mg/L)	273	61.0	60.2			
	Chromium (Cr)-Dissolved (mg/L)	0.00061	<0.00010	<0.00010			
	Cobalt (Co)-Dissolved (mg/L)	0.00166	<0.00010	<0.00010			
	Copper (Cu)-Dissolved (mg/L)	0.0405	0.00152	0.00153			
	Iron (Fe)-Dissolved (mg/L)	0.378	0.026	0.024			
	Lead (Pb)-Dissolved (mg/L)	<0.00010 ^{DLA}	<0.000050	<0.000050			
	Lithium (Li)-Dissolved (mg/L)	0.0043	0.0033	0.0033			
	Magnesium (Mg)-Dissolved (mg/L)	67.5	27.4	27.5			
	Manganese (Mn)-Dissolved (mg/L)	5.31	0.114	0.115			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2051510-1 Water 29-JAN-18 11:10 W8A	L2051510-2 Water 30-JAN-18 11:00 W3	L2051510-3 Water 30-JAN-18 DUP		
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Dissolved (mg/L)	0.0114	0.00484	0.00451		
	Nickel (Ni)-Dissolved (mg/L)	0.0027	0.00074	0.00076		
	Phosphorus (P)-Dissolved (mg/L)	<0.10 ^{DLA}	<0.050	<0.050		
	Potassium (K)-Dissolved (mg/L)	8.13	2.07	2.12		
	Selenium (Se)-Dissolved (mg/L)	0.00330	0.000371	0.000268		
	Silicon (Si)-Dissolved (mg/L)	8.39	5.85	5.97		
	Silver (Ag)-Dissolved (mg/L)	0.000022	<0.000010	<0.000010		
	Sodium (Na)-Dissolved (mg/L)	53.4	17.3	17.8		
	Strontium (Sr)-Dissolved (mg/L)	3.74	0.865	0.875		
	Sulfur (S)-Dissolved (mg/L)	95.0	19.9	19.9		
	Thallium (Tl)-Dissolved (mg/L)	<0.000020 ^{DLA}	<0.000010	<0.000010		
	Tin (Sn)-Dissolved (mg/L)	<0.00020 ^{DLA}	<0.00010	<0.00010		
	Titanium (Ti)-Dissolved (mg/L)	0.00068	<0.00030	<0.00030		
	Uranium (U)-Dissolved (mg/L)	0.00504	0.00288	0.00285		
	Vanadium (V)-Dissolved (mg/L)	0.0017	<0.00050	<0.00050		
	Zinc (Zn)-Dissolved (mg/L)	0.323	<0.0010	<0.0010		
	Zirconium (Zr)-Dissolved (mg/L)	0.00110	<0.00030	<0.00030		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2051510-1, -2, -3
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2051510-1, -2, -3
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2051510-1, -2, -3
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2051510-1, -2, -3
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2051510-1, -2, -3
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2051510-1, -2, -3
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2051510-1, -2, -3
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2051510-1, -2, -3
Matrix Spike	Barium (Ba)-Total	MS-B	L2051510-1, -2, -3
Matrix Spike	Calcium (Ca)-Total	MS-B	L2051510-1, -2, -3
Matrix Spike	Copper (Cu)-Total	MS-B	L2051510-1, -2, -3
Matrix Spike	Iron (Fe)-Total	MS-B	L2051510-1, -2, -3
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2051510-1, -2, -3
Matrix Spike	Manganese (Mn)-Total	MS-B	L2051510-1, -2, -3
Matrix Spike	Potassium (K)-Total	MS-B	L2051510-1, -2, -3
Matrix Spike	Sodium (Na)-Total	MS-B	L2051510-1, -2, -3
Matrix Spike	Strontium (Sr)-Total	MS-B	L2051510-1, -2, -3
Matrix Spike	Sulfur (S)-Total	MS-B	L2051510-1, -2, -3
Matrix Spike	Uranium (U)-Total	MS-B	L2051510-1, -2, -3
Matrix Spike	Zinc (Zn)-Total	MS-B	L2051510-1, -2, -3

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Reference Information

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 µm), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
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VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
----	---

Reference Information

Chain of Custody Numbers:

2018-01-31 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lw - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2051510-COFC

COC Number: 2018-01-31 A

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REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2016 FRONT



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 02-FEB-18
Report Date: 13-FEB-18 17:14 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2052415
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-02-01 A
Legal Site Desc:

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID				
		L2052415-1 Water 31-JAN-18 10:30 W17				
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	516				
	Hardness (as CaCO3) (mg/L)	287				
	pH (pH)	8.32				
	Total Suspended Solids (mg/L)	<3.0				
	TDS (Calculated) (mg/L)	326				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	223				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	4.8				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Total (as CaCO3) (mg/L)	227				
	Ammonia, Total (as N) (mg/L)	0.0068				
	Chloride (Cl) (mg/L)	7.42				
	Nitrate and Nitrite (as N) (mg/L)	0.0557				
	Nitrate (as N) (mg/L)	0.0557				
	Nitrite (as N) (mg/L)	<0.0010				
	Sulfate (SO4) (mg/L)	61.6				
	Anion Sum (meq/L)	6.04				
	Cation Sum (meq/L)	6.54				
	Cation - Anion Balance (%)	4.0				
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	8.72				
Total Metals	Aluminum (Al)-Total (mg/L)	0.0031				
	Antimony (Sb)-Total (mg/L)	<0.00010				
	Arsenic (As)-Total (mg/L)	0.00043				
	Barium (Ba)-Total (mg/L)	0.0739				
	Beryllium (Be)-Total (mg/L)	<0.000020				
	Bismuth (Bi)-Total (mg/L)	<0.000050				
	Boron (B)-Total (mg/L)	0.026				
	Cadmium (Cd)-Total (mg/L)	<0.0000050				
	Calcium (Ca)-Total (mg/L)	76.2				
	Chromium (Cr)-Total (mg/L)	0.00013				
	Cobalt (Co)-Total (mg/L)	<0.00010				
	Copper (Cu)-Total (mg/L)	0.00660				
	Iron (Fe)-Total (mg/L)	0.029				
	Lead (Pb)-Total (mg/L)	<0.000050				
	Lithium (Li)-Total (mg/L)	0.0014				
	Magnesium (Mg)-Total (mg/L)	21.9				
	Manganese (Mn)-Total (mg/L)	0.0431				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID				
		L2052415-1 Water 31-JAN-18 10:30 W17				
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050				
	Molybdenum (Mo)-Total (mg/L)	0.00674				
	Nickel (Ni)-Total (mg/L)	0.00078				
	Phosphorus (P)-Total (mg/L)	<0.050				
	Potassium (K)-Total (mg/L)	3.64				
	Selenium (Se)-Total (mg/L)	0.000341				
	Silicon (Si)-Total (mg/L)	5.82				
	Silver (Ag)-Total (mg/L)	<0.000010				
	Sodium (Na)-Total (mg/L)	15.7				
	Strontium (Sr)-Total (mg/L)	0.824				
	Sulfur (S)-Total (mg/L)	22.0				
	Thallium (Tl)-Total (mg/L)	<0.000010				
	Tin (Sn)-Total (mg/L)	<0.00010				
	Titanium (Ti)-Total (mg/L)	<0.00030				
	Uranium (U)-Total (mg/L)	0.00252				
	Vanadium (V)-Total (mg/L)	0.00053				
	Zinc (Zn)-Total (mg/L)	<0.0030				
	Zirconium (Zr)-Total (mg/L)	<0.00030				
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD				
	Dissolved Metals Filtration Location	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	0.0017				
	Antimony (Sb)-Dissolved (mg/L)	<0.00010				
	Arsenic (As)-Dissolved (mg/L)	0.00035				
	Barium (Ba)-Dissolved (mg/L)	0.0779				
	Beryllium (Be)-Dissolved (mg/L)	<0.000020				
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050				
	Boron (B)-Dissolved (mg/L)	0.027				
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050				
	Calcium (Ca)-Dissolved (mg/L)	77.2				
	Chromium (Cr)-Dissolved (mg/L)	<0.00010				
	Cobalt (Co)-Dissolved (mg/L)	<0.00010				
	Copper (Cu)-Dissolved (mg/L)	0.00664				
	Iron (Fe)-Dissolved (mg/L)	0.024				
	Lead (Pb)-Dissolved (mg/L)	<0.000050				
	Lithium (Li)-Dissolved (mg/L)	0.0016				
	Magnesium (Mg)-Dissolved (mg/L)	22.9				
	Manganese (Mn)-Dissolved (mg/L)	0.0445				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2052415-1 Water 31-JAN-18 10:30 W17				
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050				
	Molybdenum (Mo)-Dissolved (mg/L)	0.00583				
	Nickel (Ni)-Dissolved (mg/L)	0.00077				
	Phosphorus (P)-Dissolved (mg/L)	<0.050				
	Potassium (K)-Dissolved (mg/L)	4.05				
	Selenium (Se)-Dissolved (mg/L)	0.000422				
	Silicon (Si)-Dissolved (mg/L)	5.90				
	Silver (Ag)-Dissolved (mg/L)	<0.000010				
	Sodium (Na)-Dissolved (mg/L)	16.2				
	Strontium (Sr)-Dissolved (mg/L)	0.865				
	Sulfur (S)-Dissolved (mg/L)	22.4				
	Thallium (Tl)-Dissolved (mg/L)	<0.000010				
	Tin (Sn)-Dissolved (mg/L)	<0.00010				
	Titanium (Ti)-Dissolved (mg/L)	<0.00030				
	Uranium (U)-Dissolved (mg/L)	0.00249				
	Vanadium (V)-Dissolved (mg/L)	<0.00050				
	Zinc (Zn)-Dissolved (mg/L)	<0.0010				
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Dissolved Organic Carbon	MS-B	L2052415-1
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2052415-1
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2052415-1
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2052415-1
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2052415-1
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2052415-1
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2052415-1
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2052415-1
Matrix Spike	Barium (Ba)-Total	MS-B	L2052415-1
Matrix Spike	Calcium (Ca)-Total	MS-B	L2052415-1
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2052415-1
Matrix Spike	Manganese (Mn)-Total	MS-B	L2052415-1
Matrix Spike	Sodium (Na)-Total	MS-B	L2052415-1
Matrix Spike	Strontium (Sr)-Total	MS-B	L2052415-1
Matrix Spike	Sulfur (S)-Total	MS-B	L2052415-1
Matrix Spike	Sulfate (SO4)	MS-B	L2052415-1

Qualifiers for Individual Parameters Listed:

Qualifier	Description
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)

Reference Information

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
----------------------------	---------------------

VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
----	---

Chain of Custody Numbers:

2018-02-01 A

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

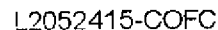
Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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COC Number: 2018-02-01 A

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REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FROM



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 07-FEB-18
Report Date: 16-FEB-18 16:13 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2054124
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-02-07 A
Legal Site Desc:

Shane Stack
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2054124-1 Water 06-FEB-18 11:20 W3	L2054124-2 Water 06-FEB-18 11:30 W17	L2054124-3 Water 06-FEB-18 16:35 W51		
Grouping	Analyte						
WATER							
Physical Tests	Conductivity (uS/cm)		568	563	1360		
	Hardness (as CaCO3) (mg/L)		264	269	677		
	pH (pH)		8.03	8.13	8.10		
	Total Suspended Solids (mg/L)		4.3	<3.0	7.3		
	TDS (Calculated) (mg/L)		321	323	936		
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)		243	233	407		
	Alkalinity, Carbonate (as CaCO3) (mg/L)		<1.0	<1.0	<1.0		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)		<1.0	<1.0	<1.0		
	Alkalinity, Total (as CaCO3) (mg/L)		243	233	407		
	Ammonia, Total (as N) (mg/L)		0.0225	0.0076	3.47		
	Chloride (Cl) (mg/L)		4.04	7.48	<2.5	DLDS	
	Nitrate and Nitrite (as N) (mg/L)		0.235	0.0524	19.4		
	Nitrate (as N) (mg/L)		0.235	0.0524	19.0		
	Nitrite (as N) (mg/L)		<0.0010	<0.0010	0.430		
	Sulfate (SO4) (mg/L)		60.1	62.0	323		
	Anion Sum (meq/L)		6.25	6.16	16.2		
	Cation Sum (meq/L)		6.21	6.15	16.0		
	Cation - Anion Balance (%)		-0.3	-0.1	-0.9		
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)		4.06	9.48			
Total Metals	Aluminum (Al)-Total (mg/L)		0.0157	0.0074	0.147		
	Antimony (Sb)-Total (mg/L)		<0.00010	<0.00010	0.00026		
	Arsenic (As)-Total (mg/L)		0.00024	0.00040	0.00035		
	Barium (Ba)-Total (mg/L)		0.0612	0.0743	0.0524		
	Beryllium (Be)-Total (mg/L)		<0.000020	<0.000020	<0.000020		
	Bismuth (Bi)-Total (mg/L)		<0.000050	<0.000050	<0.000050		
	Boron (B)-Total (mg/L)		0.022	0.023	0.270		
	Cadmium (Cd)-Total (mg/L)		0.0000074	0.0000055	0.000188		
	Calcium (Ca)-Total (mg/L)		50.9	67.4	142		
	Chromium (Cr)-Total (mg/L)		<0.00010	0.00013	0.00014		
	Cobalt (Co)-Total (mg/L)		<0.00010	<0.00010	0.00079		
	Copper (Cu)-Total (mg/L)		0.00133	0.00749	0.194		
	Iron (Fe)-Total (mg/L)		0.054	0.031	0.280		
	Lead (Pb)-Total (mg/L)		<0.000050	0.000063	0.000092		
	Lithium (Li)-Total (mg/L)		0.0032	<0.0010	0.0152		
	Magnesium (Mg)-Total (mg/L)		31.0	23.0	79.4		
	Manganese (Mn)-Total (mg/L)		0.160	0.0849	0.256		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2054124-1 Water 06-FEB-18 11:20 W3	L2054124-2 Water 06-FEB-18 11:30 W17	L2054124-3 Water 06-FEB-18 16:35 W51		
Grouping	Analyte						
WATER							
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	0.0000093			
	Molybdenum (Mo)-Total (mg/L)	0.00510	0.00624	0.0327			
	Nickel (Ni)-Total (mg/L)	0.00061	0.00083	0.00069			
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050			
	Potassium (K)-Total (mg/L)	2.00	3.75	7.97			
	Selenium (Se)-Total (mg/L)	0.000375	0.000382	0.00456			
	Silicon (Si)-Total (mg/L)	6.29	5.88	8.57			
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	0.000034			
	Sodium (Na)-Total (mg/L)	20.6	17.3	52.1			
	Strontium (Sr)-Total (mg/L)	0.837	0.800	2.68			
	Sulfur (S)-Total (mg/L)	20.7	22.1	118			
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010			
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010			
	Titanium (Ti)-Total (mg/L)	0.00055	<0.00030	<0.0045 ^{DLM}			
	Uranium (U)-Total (mg/L)	0.00279	0.00250	0.00689			
	Vanadium (V)-Total (mg/L)	0.00065	<0.00050	0.00121			
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	0.0047			
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030			
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD			
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD			
	Aluminum (Al)-Dissolved (mg/L)	0.0014	0.0017	0.0012			
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	0.00027			
	Arsenic (As)-Dissolved (mg/L)	0.00022	0.00034	0.00028			
	Barium (Ba)-Dissolved (mg/L)	0.0799	0.0924	0.0620			
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020			
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050			
	Boron (B)-Dissolved (mg/L)	0.024	0.027	0.310			
	Cadmium (Cd)-Dissolved (mg/L)	0.0000096	<0.0000050	0.000174			
	Calcium (Ca)-Dissolved (mg/L)	59.2	74.0	156			
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00010	0.00013			
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	0.00064			
	Copper (Cu)-Dissolved (mg/L)	<0.0018 ^{DLB}	0.00672	0.139			
	Iron (Fe)-Dissolved (mg/L)	0.032	0.022	<0.010			
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050			
	Lithium (Li)-Dissolved (mg/L)	0.0039	0.0015	0.0148			
	Magnesium (Mg)-Dissolved (mg/L)	28.2	20.3	69.8			
	Manganese (Mn)-Dissolved (mg/L)	0.165	0.0662	0.239			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2054124-1 Water 06-FEB-18 11:20 W3	L2054124-2 Water 06-FEB-18 11:30 W17	L2054124-3 Water 06-FEB-18 16:35 W51		
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Dissolved (mg/L)	0.00398	0.00521	0.0295		
	Nickel (Ni)-Dissolved (mg/L)	0.00056	0.00080	0.00058		
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050		
	Potassium (K)-Dissolved (mg/L)	2.24	3.72	7.49		
	Selenium (Se)-Dissolved (mg/L)	0.000367	0.000412	0.00440		
	Silicon (Si)-Dissolved (mg/L)	6.47	5.95	8.34		
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	0.000033		
	Sodium (Na)-Dissolved (mg/L)	20.1	15.7	45.4		
	Strontium (Sr)-Dissolved (mg/L)	0.829	0.795	2.66		
	Sulfur (S)-Dissolved (mg/L)	19.4	20.1	108		
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010		
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010		
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030		
	Uranium (U)-Dissolved (mg/L)	0.00279	0.00244	0.00700		
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050		
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	0.0041		
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Potassium (K)-Dissolved	B	L2054124-1, -2, -3
Method Blank	Copper (Cu)-Dissolved	MB-LOR	L2054124-1, -2, -3
Method Blank	Chromium (Cr)-Total	MB-LOR	L2054124-1, -2, -3
Laboratory Control Sample	Boron (B)-Total	MES	L2054124-1, -2, -3
Matrix Spike	Dissolved Organic Carbon	MS-B	L2054124-1, -2
Matrix Spike	Barium (Ba)-Total	MS-B	L2054124-1, -2, -3
Matrix Spike	Calcium (Ca)-Total	MS-B	L2054124-1, -2, -3
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2054124-1, -2, -3
Matrix Spike	Selenium (Se)-Total	MS-B	L2054124-1, -2, -3
Matrix Spike	Sodium (Na)-Total	MS-B	L2054124-1, -2, -3
Matrix Spike	Strontium (Sr)-Total	MS-B	L2054124-1, -2, -3
Matrix Spike	Sulfur (S)-Total	MS-B	L2054124-1, -2, -3

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
DLB	Detection Limit Raised. Analyte detected at comparable level in Method Blank.
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			

Reference Information

HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
SO4-IC-N-VA	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)
This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".			
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.			
TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.			
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
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VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
----	---

Chain of Custody Numbers:

2018-02-07 A

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lw - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2054124-COFC

COC Number: 2018-02-07 A

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REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 6903



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 07-FEB-18
Report Date: 16-FEB-18 16:29 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2054145
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2017-02-06 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

16-FEB-18 16:29 (MT)

Version: FINAL

Sample ID Description Sampled Date Sampled Time Client ID		L2054145-1 Water 04-FEB-18 16:45 UG1	L2054145-2 Water 05-FEB-18 10:45 W12	L2054145-3 Water 05-FEB-18 10:55 W14	L2054145-4 Water 06-FEB-18 09:10 W8A	L2054145-5 Water 05-FEB-18 DUP
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	2550	2800	3370	1700	2790
	Hardness (as CaCO3) (mg/L)	1460	1370	1670	950	1420
	pH (pH)	7.90	7.87	8.17	7.77	7.84
	Total Suspended Solids (mg/L)	528	8.9	62.1	27.5	10.5
	TDS (Calculated) (mg/L)	2310	2400	2960	1160	2420
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	186	183	138	734	189
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	186	183	138	734	189
	Ammonia, Total (as N) (mg/L)	7.87	4.46	3.69	0.351	4.53
	Chloride (Cl) (mg/L)	<10 ^{DLDS}	36	54	18.0	37
	Nitrate and Nitrite (as N) (mg/L)	18.1	16.5	21.6	2.96	16.5
	Nitrate (as N) (mg/L)	17.3	9.96	15.4	2.54	9.97
	Nitrite (as N) (mg/L)	0.827	6.49	6.15	0.428	6.50
	Sulfate (SO4) (mg/L)	1450	1480	1840	282	1470
	Anion Sum (meq/L)	35.2	36.6	44.1	21.3	36.7
	Cation Sum (meq/L)	34.0	35.3	44.2	21.6	36.3
	Cation - Anion Balance (%)	-1.7	-1.8	0.1	0.9	-0.5
Total Metals	Aluminum (Al)-Total (mg/L)	2.21	0.0742	0.298	0.0604	0.0789
	Antimony (Sb)-Total (mg/L)	0.00042	0.00031	0.00041	0.00020	0.00033
	Arsenic (As)-Total (mg/L)	0.00122	0.00048	0.00050	0.00092	0.00051
	Barium (Ba)-Total (mg/L)	0.0680	0.0868	0.192	0.199	0.0904 ^{DLA}
	Beryllium (Be)-Total (mg/L)	0.000059 ^{DLA}	<0.000040 ^{DLA}	<0.000040 ^{DLA}	<0.000020	<0.000040 ^{DLA}
	Bismuth (Bi)-Total (mg/L)	<0.00010 ^{DLA}	<0.00010 ^{DLA}	<0.00010 ^{DLA}	<0.000050	<0.00010 ^{DLA}
	Boron (B)-Total (mg/L)	0.528	0.248	0.241	0.032	0.247
	Cadmium (Cd)-Total (mg/L)	0.000374	0.000171	<0.000075 ^{DLM}	0.000249	0.000174
	Calcium (Ca)-Total (mg/L)	488	406 ^{DLA}	464	240	406 ^{DLA}
	Chromium (Cr)-Total (mg/L)	0.00080	<0.00020	0.00028	0.00118	<0.00020
	Cobalt (Co)-Total (mg/L)	0.00185	0.00251	0.00154	0.00176	0.00243
	Copper (Cu)-Total (mg/L)	0.411	0.0828	0.213	0.144	0.0832
	Iron (Fe)-Total (mg/L)	3.57	0.141	0.371	3.41	0.150
	Lead (Pb)-Total (mg/L)	0.00167	<0.00010 ^{DLA}	0.00017	0.000101	<0.00010 ^{DLA}
	Lithium (Li)-Total (mg/L)	0.0105	0.0204	0.0304	0.0043	0.0179
	Magnesium (Mg)-Total (mg/L)	46.4	75.7	97.4	73.6	76.2
	Manganese (Mn)-Total (mg/L)	0.275	1.61	1.16	5.75	1.61
	Mercury (Hg)-Total (mg/L)	<0.000025 ^{DLM}	<0.0000050	<0.0000050	0.0000068	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.0237	0.0970	0.122	0.0113	0.101

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

16-FEB-18 16:29 (MT)

Version: FINAL

Sample ID Description Sampled Date Sampled Time Client ID		L2054145-1 Water 04-FEB-18 16:45 UG1	L2054145-2 Water 05-FEB-18 10:45 W12	L2054145-3 Water 05-FEB-18 10:55 W14	L2054145-4 Water 06-FEB-18 09:10 W8A	L2054145-5 Water 05-FEB-18 DUP
Grouping	Analyte					
WATER						
Total Metals	Nickel (Ni)-Total (mg/L)	0.0029	0.0034	0.0039	0.00251	0.0038
	Phosphorus (P)-Total (mg/L)	<0.10 ^{DLA}	<0.10 ^{DLA}	<0.10 ^{DLA}	0.089	<0.10 ^{DLA}
	Potassium (K)-Total (mg/L)	11.1	55.0	83.0	8.68	55.2
	Selenium (Se)-Total (mg/L)	0.00174	0.0116	0.0144	0.00385	0.0114
	Silicon (Si)-Total (mg/L)	10.3	3.95	3.14	8.87	3.85
	Silver (Ag)-Total (mg/L)	0.000201	<0.000020 ^{DLA}	<0.000020 ^{DLA}	0.000043	<0.000020 ^{DLA}
	Sodium (Na)-Total (mg/L)	108	172	232	59.4	168
	Strontium (Sr)-Total (mg/L)	8.30	7.31	7.33	3.52	7.65
	Sulfur (S)-Total (mg/L)	511	532	690	100	529
	Thallium (Tl)-Total (mg/L)	0.000035	<0.000020 ^{DLA}	<0.000020 ^{DLA}	<0.000010	<0.000020 ^{DLA}
	Tin (Sn)-Total (mg/L)	<0.00020 ^{DLA}	<0.00020 ^{DLA}	<0.00020 ^{DLA}	<0.00010	<0.00020 ^{DLA}
	Titanium (Ti)-Total (mg/L)	0.143	<0.0033 ^{DLM}	<0.0078 ^{DLM}	0.00411	0.00348
	Uranium (U)-Total (mg/L)	0.00962	0.00928	0.0136	0.00489	0.00922
	Vanadium (V)-Total (mg/L)	0.0078	<0.0010 ^{DLA}	0.0010 ^{DLA}	0.00459	<0.0010 ^{DLA}
	Zinc (Zn)-Total (mg/L)	0.0461	0.0061	<0.0060	0.311	0.0072
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	0.00103	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0087	0.0044	0.0187	0.0065	0.0041
	Antimony (Sb)-Dissolved (mg/L)	0.00044	0.00032	0.00042	0.00014	0.00034
	Arsenic (As)-Dissolved (mg/L)	0.00083	0.00039	0.00032	0.00064	0.00040
	Barium (Ba)-Dissolved (mg/L)	0.0403	0.106	0.270 ^{DTMF}	0.227	0.106
	Beryllium (Be)-Dissolved (mg/L)	<0.000040 ^{DLA}	<0.000040 ^{DLA}	<0.000040 ^{DLA}	<0.000020	<0.000040 ^{DLA}
	Bismuth (Bi)-Dissolved (mg/L)	<0.00010 ^{DLA}	<0.00010	<0.00010	<0.000050	<0.00010
	Boron (B)-Dissolved (mg/L)	0.602	0.287	0.272	0.036	0.278
	Cadmium (Cd)-Dissolved (mg/L)	0.000265	<0.00015 ^{DLM}	<0.000045 ^{DLM}	0.000208	0.000137
	Calcium (Ca)-Dissolved (mg/L)	521	442	534	273	457
	Chromium (Cr)-Dissolved (mg/L)	<0.00020 ^{DLA}	<0.00020 ^{DLA}	<0.00020 ^{DLA}	0.00071	<0.00020 ^{DLA}
	Cobalt (Co)-Dissolved (mg/L)	0.00066	0.00224	0.00138	0.00159	0.00229
	Copper (Cu)-Dissolved (mg/L)	0.00770	0.0382	0.00850	0.0472	0.0374
	Iron (Fe)-Dissolved (mg/L)	<0.020 ^{DLA}	<0.020 ^{DLA}	<0.020 ^{DLA}	0.636	<0.020 ^{DLA}
	Lead (Pb)-Dissolved (mg/L)	<0.00010 ^{DLA}	<0.00010 ^{DLA}	<0.00010 ^{DLA}	<0.000050	<0.00010 ^{DLA}
	Lithium (Li)-Dissolved (mg/L)	0.0111	0.0211	0.0334	0.0042	0.0214
	Magnesium (Mg)-Dissolved (mg/L)	39.2	65.1	82.2	65.2	66.9
	Manganese (Mn)-Dissolved (mg/L)	0.178	1.47	1.05	5.27	1.47
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.0232	0.0927	0.122	0.00937	0.0969

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2054145-1 Water 04-FEB-18 16:45 UG1	L2054145-2 Water 05-FEB-18 10:45 W12	L2054145-3 Water 05-FEB-18 10:55 W14	L2054145-4 Water 06-FEB-18 09:10 W8A	L2054145-5 Water 05-FEB-18 DUP
Grouping	Analyte					
WATER						
Dissolved Metals	Nickel (Ni)-Dissolved (mg/L)	0.0024	0.0034	0.0039	0.00237	0.0034
	Phosphorus (P)-Dissolved (mg/L)	<0.10 ^{DLA}	<0.10 ^{DLA}	<0.10 ^{DLA}	<0.050	<0.10 ^{DLA}
	Potassium (K)-Dissolved (mg/L)	10.1	50.6	77.2	7.99	50.3
	Selenium (Se)-Dissolved (mg/L)	0.00146	0.0104	0.0136	0.00353	0.0101
	Silicon (Si)-Dissolved (mg/L)	6.66	3.83	2.54	8.84	3.78
	Silver (Ag)-Dissolved (mg/L)	<0.000020 ^{DLA}	<0.000020 ^{DLA}	<0.000020 ^{DLA}	0.000013	<0.000020 ^{DLA}
	Sodium (Na)-Dissolved (mg/L)	91.9	143	195	50.3	145
	Strontium (Sr)-Dissolved (mg/L)	7.88	6.93	7.13	3.26	7.35
	Sulfur (S)-Dissolved (mg/L)	483	500	648	92.6	497
	Thallium (Tl)-Dissolved (mg/L)	<0.000020 ^{DLA}	<0.000020 ^{DLA}	<0.000020 ^{DLA}	<0.000010	<0.000020 ^{DLA}
	Tin (Sn)-Dissolved (mg/L)	<0.00020 ^{DLA}	<0.00020 ^{DLA}	<0.00020 ^{DLA}	<0.00010	<0.00020 ^{DLA}
	Titanium (Ti)-Dissolved (mg/L)	<0.00060 ^{DLA}	<0.00060 ^{DLA}	<0.00060 ^{DLA}	0.00104	<0.00060 ^{DLA}
	Uranium (U)-Dissolved (mg/L)	0.00969	0.00942	0.0136	0.00473	0.00912
	Vanadium (V)-Dissolved (mg/L)	<0.0010 ^{DLA}	<0.0010 ^{DLA}	<0.0010 ^{DLA}	0.00186	<0.0010 ^{DLA}
	Zinc (Zn)-Dissolved (mg/L)	0.0234	0.0055	<0.0020 ^{DLA}	0.267	0.0054
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	0.00095	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Potassium (K)-Dissolved	B	L2054145-1, -2, -3, -4, -5
Method Blank	Copper (Cu)-Dissolved	MB-LOR	L2054145-1, -2, -3, -4, -5
Method Blank	Chromium (Cr)-Total	MB-LOR	L2054145-1, -2, -3, -4, -5
Laboratory Control Sample	Boron (B)-Total	MES	L2054145-1, -2, -3, -4, -5
Matrix Spike	Barium (Ba)-Total	MS-B	L2054145-1, -2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Total	MS-B	L2054145-1, -2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2054145-1, -2, -3, -4, -5
Matrix Spike	Selenium (Se)-Total	MS-B	L2054145-1, -2, -3, -4, -5
Matrix Spike	Sodium (Na)-Total	MS-B	L2054145-1, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Total	MS-B	L2054145-1, -2, -3, -4, -5
Matrix Spike	Sulfur (S)-Total	MS-B	L2054145-1, -2, -3, -4, -5

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
DLA	Detection Limit adjusted for required dilution
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DTMF	Dissolved concentration exceeds total for field-filtered metals sample. Metallic contaminants may have been introduced to dissolved sample during field filtration.
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			

Reference Information

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
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VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
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Chain of Custody Numbers:

2017-02-06 A

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Report To						Contact and company name below will appear on the final report							
Company:						Minto Explorations Ltd.							
Contact:						Minto Environment - Coordinator							
Phone:						1-604-759-4659							
						Company address below will appear on the final report							
Street:						2100-510 West Georgia St.							
City/Province:						Vancouver, British Columbia							
Postal Code:						V6B 0M3							
Invoice To						Same as Report To ☐ YES ☒ NO							
						Copy of Invoice with Report ☐ YES ☒ NO							
Company:						Minto Explorations Ltd.							
Contact:						Ruth Cayetano							
Project Information						Oil and Gas Required Fields (client use)							
ALS Account # / Quote #:						AFE/Cost Center: PO#							
Job #:						Major/Minor Code: Routing Code:							
PO / AFE:						229096							
LSD:						Location:							
ALS Lab Work Order # (lab use only)						ALS Contact: Shane Stack Sampler: SR							
ALS Sample # (lab use only)						Sample Identification and/or Coordinates (This description will appear on the report)							
						Date (dd-mm-yy) Time (hh:mm) Sample Type							
UG1						4-Feb-18 16:45 Water							
W12						5-Feb-18 10:45 Water							
W14						5-Feb-18 10:55 Water							
W8A						6-Feb-18 9:10 Water							
DUP						5-Feb-18 Water							
Drinking Water (DW) Samples ¹ (client use)						Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)							
Are samples taken from a Regulated DW System? ☐ YES ☒ NO													
Are samples for human drinking water use? ☐ YES ☒ NO													
SHIPMENT RELEASE (client use)						INITIAL SHIPMENT RECEPTION (lab use only)							
Released by: Shaun Roberts Date: 2018-02-06 Time: 13:00						Received by: [Signature] Date: Feb 7/18 Time: 14:56							
						FINAL SHIPMENT RECEPTION (lab use only)							
						Received by: Date: Time:							

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 ÉBENT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 14-FEB-18
Report Date: 26-FEB-18 13:59 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2056741
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-02-14 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

26-FEB-18 13:59 (MT)

Version: FINAL

Sample ID Description Sampled Date Sampled Time Client ID		L2056741-1 Water 12-FEB-18 16:40 W62	L2056741-2 Water 13-FEB-18 08:20 W3	L2056741-3 Water 13-FEB-18 08:40 W17	L2056741-4 Water 13-FEB-18 09:30 W8A	L2056741-5 Water 13-FEB-18 14:05 W4
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	1040	617	561	1750	315
	Hardness (as CaCO3) (mg/L)	540	286	268	894	148
	pH (pH)	7.89	7.90	7.83	7.61	7.98
	Total Suspended Solids (mg/L)	6.0	<3.0	16.7	40.7	<3.0
	TDS (Calculated) (mg/L)	648	353	320	1150	165
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	353	268	217	751	150
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	353	268	217	751	150
	Ammonia, Total (as N) (mg/L)	0.0057	<0.0050	0.0554	0.347	<0.0050
	Chloride (Cl) (mg/L)	25.9	4.64	7.54	18.7	0.85
	Nitrate and Nitrite (as N) (mg/L)	4.27	0.121	0.0841	2.87	0.189
	Nitrate (as N) (mg/L)	4.27	0.121	0.0841	2.40	0.189
	Nitrite (as N) (mg/L)	0.0091	<0.0010	<0.0010	0.473	<0.0010
	Sulfate (SO4) (mg/L)	169	67.5	65.4	283	14.4
	Anion Sum (meq/L)	11.6	6.90	5.92	21.6	3.33
	Cation Sum (meq/L)	12.1	6.79	6.24	20.9	3.20
	Cation - Anion Balance (%)	2.0	-0.8	2.6	-1.8	-1.9
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)		6.78	10.0		2.15
Total Metals	Aluminum (Al)-Total (mg/L)	0.0186	0.0210	0.0210	0.0480	0.0075
	Antimony (Sb)-Total (mg/L)	0.00012	0.00011	0.00016	0.00027	<0.00010
	Arsenic (As)-Total (mg/L)	0.00036	0.00024	0.00067	0.00069	0.00034
	Barium (Ba)-Total (mg/L)	0.106	0.0764	0.112	0.184	0.105
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.021	0.025	0.030	0.038	<0.010
	Cadmium (Cd)-Total (mg/L)	0.0000196	0.0000145	0.0000444	0.000362	<0.0000050
	Calcium (Ca)-Total (mg/L)	151	66.9	79.9	271	46.3
	Chromium (Cr)-Total (mg/L)	0.00022	0.00011	0.00019	0.00104	0.00013
	Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	0.00044	0.00151	<0.00010
	Copper (Cu)-Total (mg/L)	0.0400	0.00778	0.0124	0.167	0.00087
	Iron (Fe)-Total (mg/L)	0.043	0.036	0.579	2.09	0.029
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	0.000858	0.000164	<0.000050
	Lithium (Li)-Total (mg/L)	0.0021	0.0044	0.0011	0.0043	0.0012
	Magnesium (Mg)-Total (mg/L)	40.6	33.4	20.7	69.5	9.21
	Manganese (Mn)-Total (mg/L)	0.0138	0.114	1.01	5.37	0.00284

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2056741-6 Water 13-FEB-18 15:02 W5	L2056741-7 Water 13-FEB-18 17:00 W16	L2056741-8 Water 13-FEB-18 DUP		
Grouping	Analyte						
WATER							
Physical Tests	Conductivity (uS/cm)		182	580	626		
	Hardness (as CaCO3) (mg/L)		85.1	281	296		
	pH (pH)		7.96	7.93	7.99		
	Total Suspended Solids (mg/L)		27.3	<3.0	<3.0		
	TDS (Calculated) (mg/L)		94.3	339	355		
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)		78.8	212	266		
	Alkalinity, Carbonate (as CaCO3) (mg/L)		<1.0	<1.0	<1.0		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)		<1.0	<1.0	<1.0		
	Alkalinity, Total (as CaCO3) (mg/L)		78.8	212	266		
	Ammonia, Total (as N) (mg/L)		0.0066	0.0577	0.0109		
	Chloride (Cl) (mg/L)		<0.50	8.01	4.62		
	Nitrate and Nitrite (as N) (mg/L)		0.0761	1.68	0.122		
	Nitrate (as N) (mg/L)		0.0761	1.67	0.121		
	Nitrite (as N) (mg/L)		<0.0010	0.0056	0.0016		
	Sulfate (SO4) (mg/L)		13.0	76.4	67.4		
	Anion Sum (meq/L)		1.85	6.17	6.86		
	Cation Sum (meq/L)		1.83	6.47	6.96		
	Cation - Anion Balance (%)		-0.6	2.4	0.7		
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)		2.52	13.4	6.98		
Total Metals	Aluminum (Al)-Total (mg/L)		0.0910	0.0178	0.0118		
	Antimony (Sb)-Total (mg/L)		0.00039	<0.00010	<0.00010		
	Arsenic (As)-Total (mg/L)		0.00046	0.00042	0.00024		
	Barium (Ba)-Total (mg/L)		0.0461	0.0956	0.0737		
	Beryllium (Be)-Total (mg/L)		<0.000020	<0.000020	<0.000020		
	Bismuth (Bi)-Total (mg/L)		<0.000050	<0.000050	<0.000050		
	Boron (B)-Total (mg/L)		<0.010	0.031	0.024		
	Cadmium (Cd)-Total (mg/L)		0.0000268	0.0000132	0.0000150		
	Calcium (Ca)-Total (mg/L)		27.2	82.8	66.2		
	Chromium (Cr)-Total (mg/L)		0.00059	0.00019	<0.00010		
	Cobalt (Co)-Total (mg/L)		<0.00010	<0.00010	<0.00010		
	Copper (Cu)-Total (mg/L)		0.0106	0.0317	0.00592		
	Iron (Fe)-Total (mg/L)		0.147	0.105	0.027		
	Lead (Pb)-Total (mg/L)		0.000104	0.000122	<0.000050		
	Lithium (Li)-Total (mg/L)		0.0011	0.0014	0.0043		
	Magnesium (Mg)-Total (mg/L)		6.01	22.1	33.7		
	Manganese (Mn)-Total (mg/L)		0.00786	0.0758	0.113		

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2056741-1 Water 12-FEB-18 16:40 W62	L2056741-2 Water 13-FEB-18 08:20 W3	L2056741-3 Water 13-FEB-18 08:40 W17	L2056741-4 Water 13-FEB-18 09:30 W8A	L2056741-5 Water 13-FEB-18 14:05 W4
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	0.0000064	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.00583	0.00392	0.00622	0.0127	0.000594
	Nickel (Ni)-Total (mg/L)	0.00087	0.00062	0.00188	0.00238	<0.00050
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	0.077	<0.050
	Potassium (K)-Total (mg/L)	4.70	2.87	3.33	9.52	1.04
	Selenium (Se)-Total (mg/L)	0.00148	0.000432	0.000212	0.00396	0.000134
	Silicon (Si)-Total (mg/L)	7.90	7.33	5.69	9.05	6.22
	Silver (Ag)-Total (mg/L)	0.000011	<0.000010	<0.000010	0.000033	<0.000010
	Sodium (Na)-Total (mg/L)	25.7	22.0	16.0	54.7	4.56
	Strontium (Sr)-Total (mg/L)	1.49	0.928	0.717	3.78	0.279
	Sulfur (S)-Total (mg/L)	61.6	24.2	24.0	107	5.08
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	0.00106	<0.00080 ^{DLM}	0.00134	<0.0035 ^{DLM}	0.00031
	Uranium (U)-Total (mg/L)	0.00589	0.00280	0.00288	0.00479	0.000535
	Vanadium (V)-Total (mg/L)	0.00072	<0.00050	0.00060	0.00317	<0.00050
	Zinc (Zn)-Total (mg/L)	0.180	0.0156	0.0105	0.268	<0.0030
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	0.00092	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0017	0.0024	0.0023	0.0067	<0.0010
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	0.00011	0.00016	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00036	0.00023	0.00062	0.00059	0.00034
	Barium (Ba)-Dissolved (mg/L)	0.104	0.0723	0.109	0.175	0.102
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.021	0.022	0.029	0.035	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	0.0000204	0.0000120	0.0000440	0.000375	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	151	61.1	74.1	246	44.1
	Chromium (Cr)-Dissolved (mg/L)	0.00016	<0.00010	0.00011	0.00079	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	0.00043	0.00149	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.0379	0.00554	0.00780	0.0899	0.00034
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	0.389	0.395	0.020
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	0.000307	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0026	0.0040	0.0014	0.0043	<0.0010
	Magnesium (Mg)-Dissolved (mg/L)	39.7	32.4	20.0	67.7	9.23
Manganese (Mn)-Dissolved (mg/L)	0.0127	0.112	0.927	4.98	0.00277	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2056741-6 Water 13-FEB-18 15:02 W5	L2056741-7 Water 13-FEB-18 17:00 W16	L2056741-8 Water 13-FEB-18 DUP		
Grouping	Analyte						
WATER							
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050			
	Molybdenum (Mo)-Total (mg/L)	0.00149	0.00377	0.00377			
	Nickel (Ni)-Total (mg/L)	<0.00050	0.00080	0.00058			
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050			
	Potassium (K)-Total (mg/L)	0.97	3.53	2.81			
	Selenium (Se)-Total (mg/L)	0.000171	0.000702	0.000386			
	Silicon (Si)-Total (mg/L)	3.16	5.16	7.30			
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010			
	Sodium (Na)-Total (mg/L)	2.25	16.7	21.4			
	Strontium (Sr)-Total (mg/L)	0.141	0.794	0.879			
	Sulfur (S)-Total (mg/L)	4.36	28.0	23.9			
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010			
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010			
	Titanium (Ti)-Total (mg/L)	<0.0040 ^{DLM}	<0.00095 ^{DLM}	<0.00045 ^{DLM}			
	Uranium (U)-Total (mg/L)	0.00112	0.00181	0.00266			
	Vanadium (V)-Total (mg/L)	0.00050	<0.00050	<0.00050			
	Zinc (Zn)-Total (mg/L)	0.0107	0.0040	0.0166			
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030			
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD			
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD			
	Aluminum (Al)-Dissolved (mg/L)	0.0046	0.0022	0.0033			
	Antimony (Sb)-Dissolved (mg/L)	0.00025	<0.00010	<0.00010			
	Arsenic (As)-Dissolved (mg/L)	0.00041	0.00038	0.00024			
	Barium (Ba)-Dissolved (mg/L)	0.0427	0.0893	0.0730			
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020			
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050			
	Boron (B)-Dissolved (mg/L)	<0.010	0.029	0.024			
	Cadmium (Cd)-Dissolved (mg/L)	0.0000211	0.0000085	0.0000110			
	Calcium (Ca)-Dissolved (mg/L)	24.7	77.4	64.4			
	Chromium (Cr)-Dissolved (mg/L)	0.00026	<0.00010	<0.00010			
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010			
	Copper (Cu)-Dissolved (mg/L)	0.00348	0.0196	0.00541			
	Iron (Fe)-Dissolved (mg/L)	<0.010	0.065	<0.010			
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050			
	Lithium (Li)-Dissolved (mg/L)	<0.0010	0.0013	0.0049			
	Magnesium (Mg)-Dissolved (mg/L)	5.68	21.4	32.8			
	Manganese (Mn)-Dissolved (mg/L)	0.00242	0.0671	0.111			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2056741-1 Water 12-FEB-18 16:40 W62	L2056741-2 Water 13-FEB-18 08:20 W3	L2056741-3 Water 13-FEB-18 08:40 W17	L2056741-4 Water 13-FEB-18 09:30 W8A	L2056741-5 Water 13-FEB-18 14:05 W4
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00506	0.00342	0.00543	0.0113	0.000581
	Nickel (Ni)-Dissolved (mg/L)	0.00088	0.00062	0.00185	0.00235	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	0.057	<0.050
	Potassium (K)-Dissolved (mg/L)	4.69	3.02	3.57	8.91	1.11
	Selenium (Se)-Dissolved (mg/L)	0.00162	0.000413	0.000232	0.00465	0.000122
	Silicon (Si)-Dissolved (mg/L)	7.54	7.20	5.44	8.75	5.94
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	0.000014	<0.000010
	Sodium (Na)-Dissolved (mg/L)	27.0	22.8	17.1	58.1	4.87
	Strontium (Sr)-Dissolved (mg/L)	1.36	0.854	0.649	3.43	0.273
	Sulfur (S)-Dissolved (mg/L)	58.0	24.0	22.5	105	4.87
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	0.00105	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00549	0.00260	0.00267	0.00461	0.000541
	Vanadium (V)-Dissolved (mg/L)	0.00064	<0.00050	<0.00050	0.00173	0.00052
	Zinc (Zn)-Dissolved (mg/L)	0.176	0.0151	0.0077	0.258	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	0.00100	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2056741-6 Water 13-FEB-18 15:02 W5	L2056741-7 Water 13-FEB-18 17:00 W16	L2056741-8 Water 13-FEB-18 DUP		
Grouping	Analyte						
WATER							
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050			
	Molybdenum (Mo)-Dissolved (mg/L)	0.00130	0.00320	0.00328			
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	0.00071	0.00057			
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050			
	Potassium (K)-Dissolved (mg/L)	1.01	3.72	2.97			
	Selenium (Se)-Dissolved (mg/L)	0.000211	0.000710	0.000438			
	Silicon (Si)-Dissolved (mg/L)	2.94	4.90	7.06			
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010			
	Sodium (Na)-Dissolved (mg/L)	2.31	17.2	22.2			
	Strontium (Sr)-Dissolved (mg/L)	0.125	0.714	0.829			
	Sulfur (S)-Dissolved (mg/L)	4.51	26.6	23.0			
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010			
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010			
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030			
	Uranium (U)-Dissolved (mg/L)	0.00104	0.00165	0.00261			
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050			
	Zinc (Zn)-Dissolved (mg/L)	0.0097	0.0016	0.0152			
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Dissolved Organic Carbon	MS-B	L2056741-2, -3, -5, -6, -7, -8
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2056741-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2056741-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2056741-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2056741-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2056741-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2056741-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2056741-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Barium (Ba)-Total	MS-B	L2056741-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Calcium (Ca)-Total	MS-B	L2056741-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2056741-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Manganese (Mn)-Total	MS-B	L2056741-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Sodium (Na)-Total	MS-B	L2056741-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Strontium (Sr)-Total	MS-B	L2056741-1, -2, -3, -4, -5, -6, -7, -8

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			

Reference Information

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = \frac{[\text{Cation Sum} - \text{Anion Sum}]}{[\text{Cation Sum} + \text{Anion Sum}]}$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-MAN-WR Water Total Suspended Solids by Gravimetric APHA 2540 D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids are determined by filtering a sample through a glass fibre filter and drying the filter at 104 degrees celsius.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-02-14 A

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2056741-COFC

COC Number: 2018-02-14 A

Page 1 of 1

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Report To		Report Format / Distribution		Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply			
Contact and company name below will appear on the final report		Select Report Format: ☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)		Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply			
Company:	Minto Explorations Ltd.	Quality Control (QC) Report with Report ☒ YES ☐ NO		PRIORITY (Business Days)	EMERGENCY		
Contact:	Minto Environment - Coordinator	☒ Compare Results to Criteria on Report - provide details below if box checked		4 day [P4] ☐	1 Business day [E1] ☐		
Phone:	1-604-759-4659	Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX		3 day [P3] ☐	Same Day, Weekend or Statutory holiday [E0] ☐		
Company address below will appear on the final report		Email 1 or Fax minto_environment@mintomine.com		Date and Time Required for all E&P TATs:			
Street:	2100-510 West Georgia St.	Email 2		For tests that can not be performed according to the service level selected, you will be contacted.			
City/Province:	Vancouver, British Columbia	Email 3		Analysis Request			
Postal Code:	V6B 0M3	Invoice Distribution		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below			
Invoice To	Same as Report To ☐ YES ☒ NO	Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX		P F/P P F/P P F/P			
	Copy of Invoice with Report ☐ YES ☒ NO	Email 1 or Fax ap@mintomine.com		pH / Conductivity / Alkalinity / Anions			
Company:	Minto Explorations Ltd.	Email 2		Total Suspended Solids (TSS)			
Contact:	Ruth Cayetano	Oil and Gas Required Fields (client use)		Total Dissolved Solids (TDS)			
Project Information		AFE/Cost Center: PO#		Total Metals (TM), Hardness			
ALS Account # / Quote #:		Major/Minor Code: Routing Code:		Dissolved Metals (DM) (filtered and preserved)			
Job #:		Requisitioner:		Total Mercury, Hardness			
PO / AFE: 229096 (WUL)		Location:		Dissolved Mercury [1] (Filtered + preserved)			
LSD:		ALS Contact: Shane Stack		Total Nutrients (Ammonia)			
ALS Lab Work Order # (lab use only)		Sampler: CR/CH		Dissolved Organic Carbon (DOC)			
Sample Identification and/or Coordinates (This description will appear on the report)		Date (dd-mm-yy)		Time (hh:mm)		Sample Type	
W62		12-Feb-18		16:40		Water	
W3		13-Feb-18		8:20		Water	
W17		13-Feb-18		8:40		Water	
W8A		13-Feb-18		9:30		Water	
W4		13-Feb-18		14:05		Water	
W5		13-Feb-18		15:02		Water	
W16		13-Feb-18		17:00		Water	
DUP		13-Feb-18				Water	
Drinking Water (DW) Samples ¹ (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)		SAMPLE CONDITION AS RECEIVED (lab use only)			
Are samples taken from a Regulated DW System? ☐ YES ☒ NO				Frozen ☐ SIF Observations Yes ☐ No ☐			
Are samples for human drinking water use? ☐ YES ☒ NO				Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐			
				Cooling Initiated ☐			
				INITIAL COOLER TEMPERATURES °C			
				FINAL COOLER TEMPERATURES °C			
				1°C			
				4			
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)		FINAL SHIPMENT RECEPTION (lab use only)			
Released by: Chris Harry		Date: 2018-02-14 7:45		Received by: JC			
		Time: 15:37		Date: FEB 15 2018			
		Time: 12:30					

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

WHITE - LABORATORY COPY

YELLOW - CLIENT COPY

OCTOBER 2015 FRONT



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 21-FEB-18
Report Date: 01-MAR-18 19:01 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2059189
Project P.O. #: 229096 (WUL)
Job Reference:
C of C Numbers: 2018-02-21 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

01-MAR-18 19:01 (MT)

Version: FINAL

Sample ID Description Sampled Date Sampled Time Client ID		L2059189-1 WATER 20-FEB-18 14:00 W8A	L2059189-2 WATER 20-FEB-18 10:55 W17	L2059189-3 WATER 20-FEB-18 15:10 W3	L2059189-4 WATER 20-FEB-18 DUP	L2059189-5 WATER 20-FEB-18 10:55 F-BL
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	1650	525	560	568	<2.0
	Hardness (as CaCO3) (mg/L)	1020	294	311	313	<0.50
	pH (pH)	7.39	8.09	8.11	8.10	5.41
	Total Suspended Solids (mg/L)	10.7	6.4	<3.0	<3.0	<3.0
	TDS (Calculated) (mg/L)	1180	326	348	347	<1.0
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	776	219	259	257	<1.0
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	776	219	259	257	<1.0
	Ammonia, Total (as N) (mg/L)	0.309	0.0503	0.0138	0.0120	<0.0050
	Chloride (Cl) (mg/L)	18.8	7.34	4.70	4.68	<0.50
	Nitrate (as N) (mg/L)	1.26	0.0536	0.112	0.113	<0.0050
	Nitrite (as N) (mg/L)	0.568	0.0024	0.0010	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	250	62.5	61.8	61.4	<0.30
	Anion Sum (meq/L)	21.4	5.88	6.61	6.56	<0.10
	Cation Sum (meq/L)	23.5	6.73	7.18	7.24	<0.10
	Cation - Anion Balance (%)	4.8	6.7	4.1	4.9	0.0
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)		8.52	5.82	5.77	<0.50
Total Metals	Aluminum (Al)-Total (mg/L)	0.104	0.0775	0.0376	0.0261	<0.0030
	Antimony (Sb)-Total (mg/L)	0.00031	0.00014	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00080	0.00062	0.00025	0.00025	<0.00010
	Barium (Ba)-Total (mg/L)	0.221	0.125	0.0766	0.0755	<0.000050
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.037	0.028	0.023	0.022	<0.010
	Cadmium (Cd)-Total (mg/L)	0.000248	0.0000414	0.0000117	0.0000116	<0.0000050
	Calcium (Ca)-Total (mg/L)	228	63.6	54.9	52.0	<0.050
	Chromium (Cr)-Total (mg/L)	0.00118	0.00020	0.00012	0.00010	<0.00010
	Cobalt (Co)-Total (mg/L)	0.00173	0.00042	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Total (mg/L)	0.160	0.0217	0.00534	0.00565	<0.00050
	Iron (Fe)-Total (mg/L)	2.31	0.735	0.073	0.056	<0.010
	Lead (Pb)-Total (mg/L)	0.000250	0.00149	0.000242	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	0.0041	<0.0010	0.0034	0.0032	<0.0010
	Magnesium (Mg)-Total (mg/L)	71.5	19.5	31.4	31.0	<0.10
	Manganese (Mn)-Total (mg/L)	5.95	1.10	0.129	0.129	<0.00010
	Mercury (Hg)-Total (mg/L)	0.0000070	<0.0000050	<0.0000050	<0.0000050	<0.0000050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

01-MAR-18 19:01 (MT)

Version: FINAL

Sample ID Description Sampled Date Sampled Time Client ID		L2059189-1 WATER 20-FEB-18 14:00 W8A	L2059189-2 WATER 20-FEB-18 10:55 W17	L2059189-3 WATER 20-FEB-18 15:10 W3	L2059189-4 WATER 20-FEB-18 DUP	L2059189-5 WATER 20-FEB-18 10:55 F-BL
Grouping	Analyte					
WATER						
Total Metals	Molybdenum (Mo)-Total (mg/L)	0.00991	0.00459	0.00375	0.00381	<0.000050
	Nickel (Ni)-Total (mg/L)	0.00207	0.00187	0.00112	0.00076	<0.00050
	Phosphorus (P)-Total (mg/L)	0.104	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	9.32	3.25	2.70	2.64	<0.10
	Selenium (Se)-Total (mg/L)	0.00277	0.000169	0.000293	0.000283	<0.000050
	Silicon (Si)-Total (mg/L)	9.64	5.35	6.58	6.52	<0.10
	Silver (Ag)-Total (mg/L)	<0.000050 ^{DLB}	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	55.6	15.6	19.9	19.4	<0.050
	Strontium (Sr)-Total (mg/L)	3.46	0.634	0.817	0.818	<0.00020
	Sulfur (S)-Total (mg/L)	94.2	21.6	21.5	21.4	<0.50
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	0.00598	0.00381	<0.0030 ^{DLM}	0.00063	<0.00030
	Uranium (U)-Total (mg/L)	0.00512	0.00247	0.00263	0.00255	<0.000010
	Vanadium (V)-Total (mg/L)	0.00402	0.00077	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Total (mg/L)	0.201	0.0273	0.0034	0.0032	<0.0030
	Zirconium (Zr)-Total (mg/L)	0.00113	<0.00030	<0.00030	<0.00030	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0060	0.0013	0.0012	<0.0010	<0.0010
	Antimony (Sb)-Dissolved (mg/L)	0.00015	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00071	0.00055	0.00022	0.00023	<0.00010
	Barium (Ba)-Dissolved (mg/L)	0.196	0.103	0.0703	0.0715	<0.000050
	Beryllium (Be)-Dissolved (mg/L)	0.000023	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.037	0.027	0.023	0.024	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	0.000241	0.0000229	0.0000087	0.0000098	<0.0000050 ^{RRV}
	Calcium (Ca)-Dissolved (mg/L)	291	82.1	68.0	67.7	0.070
	Chromium (Cr)-Dissolved (mg/L)	0.00070	<0.00010	<0.00010	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	0.00161	0.00030	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.0656	0.00612	0.00399	0.00408	0.00052 ^{RRV}
	Iron (Fe)-Dissolved (mg/L)	0.380	0.254	0.013	0.013	<0.010
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0050	0.0013	0.0038	0.0038	<0.0010
	Magnesium (Mg)-Dissolved (mg/L)	72.6	21.7	34.3	35.0	<0.10
	Manganese (Mn)-Dissolved (mg/L)	5.68	0.760	0.112	0.113	0.00021 ^{RRV}
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2059189-1 WATER 20-FEB-18 14:00 W8A	L2059189-2 WATER 20-FEB-18 10:55 W17	L2059189-3 WATER 20-FEB-18 15:10 W3	L2059189-4 WATER 20-FEB-18 DUP	L2059189-5 WATER 20-FEB-18 10:55 F-BL
Grouping	Analyte					
WATER						
Dissolved Metals	Molybdenum (Mo)-Dissolved (mg/L)	0.00996	0.00434	0.00365	0.00361	<0.000050
	Nickel (Ni)-Dissolved (mg/L)	0.00182	0.00155	0.00068	0.00065	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	0.073	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	8.84	2.98	2.48	2.49	<0.10
	Selenium (Se)-Dissolved (mg/L)	0.00241	0.000233	0.000351	0.000337	<0.000050
	Silicon (Si)-Dissolved (mg/L)	9.36	5.29	6.57	6.76	<0.050
	Silver (Ag)-Dissolved (mg/L)	0.000018	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	58.8	16.6	20.6	20.9	<0.050
	Strontium (Sr)-Dissolved (mg/L)	4.04	0.743	0.964	0.959	0.00116 ^{DTC}
	Sulfur (S)-Dissolved (mg/L)	89.7	22.1	22.3	22.0	<0.50
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00102	<0.00030	<0.00030	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00526	0.00235	0.00256	0.00252	<0.000010
	Vanadium (V)-Dissolved (mg/L)	0.00215	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0947	0.0147	0.0021	0.0027	0.0013 ^{RRV}
	Zirconium (Zr)-Dissolved (mg/L)	0.00121	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Silver (Ag)-Total	MB-LOR	L2059189-1, -2, -3, -4, -5
Matrix Spike	Dissolved Organic Carbon	MS-B	L2059189-2, -3, -4, -5
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2059189-1, -2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2059189-1, -2, -3, -4, -5
Matrix Spike	Copper (Cu)-Dissolved	MS-B	L2059189-1, -2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2059189-1, -2, -3, -4, -5
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2059189-1, -2, -3, -4, -5
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2059189-1, -2, -3, -4, -5
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2059189-1, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2059189-1, -2, -3, -4, -5
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2059189-1, -2, -3, -4, -5
Matrix Spike	Uranium (U)-Dissolved	MS-B	L2059189-1, -2, -3, -4, -5
Matrix Spike	Copper (Cu)-Total	MS-B	L2059189-1, -2, -3, -4, -5
Matrix Spike	Sodium (Na)-Total	MS-B	L2059189-1, -2, -3, -4, -5

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLB	Detection Limit Raised. Analyte detected at comparable level in Method Blank.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DTC	Dissolved concentration exceeds total. Results were confirmed by re-analysis.
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			

Reference Information

HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
SO4-IC-N-VA	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)
This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".			
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.			
TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.			
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
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VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
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Chain of Custody Numbers:

2018-02-21 A

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lw - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2059189-COFC

COC Number: 2018-02-21 A

Page 1 of 1

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Report To Contact and company name below will appear on the final report		Report Format / Distribution			Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply																					
Company:	Minto Explorations Ltd.	Select Report Format: ☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)			Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply																					
Contact:	Minto Environment - Coordinator	Quality Control (QC) Report with Report ☒ YES ☐ NO			PRIORITY (Business Days)	4 day [P4] ☐				EMERGENCY	1 Business day [E1] ☐															
Phone:	1-604-759-4659	☒ Compare Results to Criteria on Report - provide details below if box checked				3 day [P3] ☐					Same Day, Weekend or Statutory holiday [E0] ☐															
Company address below will appear on the final report		Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX				2 day [P2] ☐																				
Street:	2100-510 West Georgia St.	Email 1 or Fax minto_environment@mintomine.com			Date and Time Required for all E&P TATs:																					
City/Province:	Vancouver, British Columbia	Email 2			For tests that can not be performed according to the service level selected, you will be contacted.																					
Postal Code:	V6B 0M3	Email 3			Analysis Request																					
Invoice To		Invoice Distribution			Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below																					
Same as Report To ☐ YES ☒ NO		Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX																								
Copy of Invoice with Report ☐ YES ☒ NO		Email 1 or Fax ap@mintomine.com																								
Company:		Email 2																								
Contact:		Ruth Cayetano																								
Project Information		Oil and Gas Required Fields (client use)																								
ALS Account # / Quote #:		AFE/Cost Center:			PO#																					
Job #:		Major/Minor Code:			Routing Code:																					
PO / AFE: 229096 (WUL)		Requisitioner:																								
LSD:		Location:																								
ALS Lab Work Order # (lab use only)		ALS Contact: Shane Stack			Sampler: EB/CR																					
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)		Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Number of Containers																				
	W8A		20-Feb-18	14:00	Water	R	R	R	R	R	R	R	R	R	R	R	6									
	W17		20-Feb-18	10:55	Water	R	R	R	R	R	R	R	R	R	R	R	7									
	W3		20-Feb-18	15:00	Water	R	R	R	R	R	R	R	R	R	R	R	7									
	DUP		20-Feb-18		Water	R	R	R	R	R	R	R	R	R	R	R	7									
	F-BL		20-Feb-18	10:55	Water	R	R	R	R	R	R	R	R	R	R	R	7									
Drinking Water (DW) Samples¹ (client use)			Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)			SAMPLE CONDITION AS RECEIVED (lab use only)																				
Are samples taken from a Regulated DW System? ☐ YES ☒ NO						Frozen ☐ SIF Observations Yes ☐ No ☐																				
Are samples for human drinking water use? ☐ YES ☒ NO						Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐																				
						Cooling Initiated ☐																				
						INITIAL COOLER TEMPERATURES °C																				
						2°C 2°C 5°C 3 4																				
						FINAL COOLER TEMPERATURES °C																				
SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)																				
Released by: Emilie Bouchard			Date: February 21st, 2017			Time:			Received by:			Date: Feb 21/18			Time: 15:00			Received by: JC			Date: 2/22/18			Time: 12:25pm		

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2016 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 28-FEB-18
Report Date: 09-MAR-18 17:27 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2062126
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-02-28 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

09-MAR-18 17:27 (MT)

Version: FINAL

Sample ID Description Sampled Date Sampled Time Client ID		L2062126-1 Water 26-FEB-18 15:15 W17	L2062126-2 Water 26-FEB-18 15:40 W45	L2062126-3 Water 26-FEB-18 16:45 W8A	L2062126-4 Water 27-FEB-18 08:45 W3	L2062126-5 Water 26-FEB-18 DUP
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	520	3080	1630	566	3060
	Hardness (as CaCO3) (mg/L)	259	1540	914	275	1520
	pH (pH)	8.00	8.08	7.64	8.05	8.09
	Total Suspended Solids (mg/L)	<3.0	173	27.6	<3.0	169
	TDS (Calculated) (mg/L)	304	2800	1120	331	2750
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	209	160	732	253	159
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	209	160	732	253	159
	Ammonia, Total (as N) (mg/L)	0.0472	6.64	0.305	0.0122	6.52
	Chloride (Cl) (mg/L)	7.40	37	20.1	4.96	36
	Nitrate and Nitrite (as N) (mg/L)	0.0398	24.3	1.64	0.124	23.8
	Nitrate (as N) (mg/L)	0.0385	19.5	0.975	0.123	19.1
	Nitrite (as N) (mg/L)	0.0013	4.76	0.667	0.0012	4.65
	Sulfate (SO4) (mg/L)	62.3	1760	263	63.4	1730
	Anion Sum (meq/L)	5.68	42.7	20.8	6.52	41.8
	Cation Sum (meq/L)	5.89	40.4	21.0	6.35	39.9
	Cation - Anion Balance (%)	1.8	-2.8	0.6	-1.3	-2.3
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	8.43			5.75	
Total Metals	Aluminum (Al)-Total (mg/L)	<0.0060 ^{DLB}	0.412	0.0521	0.0082	5.31
	Antimony (Sb)-Total (mg/L)	<0.00020 ^{DLB}	0.00046	0.00017	<0.00010	0.00044
	Arsenic (As)-Total (mg/L)	0.00050	0.00059	0.00083	0.00027	0.00123
	Barium (Ba)-Total (mg/L)	0.0941	0.115	0.206	0.0706	0.226
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000040 ^{DLA}	<0.000020	<0.000020	0.000163
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.00010 ^{DLA}	<0.000050	<0.000050	0.00013
	Boron (B)-Total (mg/L)	0.027	0.360	0.035	0.022	0.371
	Cadmium (Cd)-Total (mg/L)	0.0000179	0.000106	0.000220	0.0000085	0.000201
	Calcium (Ca)-Total (mg/L)	68.6	463	251	58.4	463
	Chromium (Cr)-Total (mg/L)	0.00015	0.00026	0.00110	<0.00010	0.00229
	Cobalt (Co)-Total (mg/L)	0.00019	0.00249	0.00153	<0.00010	0.00539
	Copper (Cu)-Total (mg/L)	0.00771	0.109	0.112	0.00539	0.735
	Iron (Fe)-Total (mg/L)	0.210	0.844	1.84	0.022	11.6
	Lead (Pb)-Total (mg/L)	0.000056	0.00034	0.000091	<0.000050	0.00212
	Lithium (Li)-Total (mg/L)	0.0014	0.0299	0.0047	0.0040	0.0326
	Magnesium (Mg)-Total (mg/L)	19.3	87.6	70.3	30.6	91.2
	Manganese (Mn)-Total (mg/L)	0.497	2.27	5.87	0.0716	2.59

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2062126-1 Water 26-FEB-18 15:15 W17	L2062126-2 Water 26-FEB-18 15:40 W45	L2062126-3 Water 26-FEB-18 16:45 W8A	L2062126-4 Water 27-FEB-18 08:45 W3	L2062126-5 Water 26-FEB-18 DUP
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.000025 ^{DLM}	0.0000088	<0.0000050	<0.000025 ^{DLM}
	Molybdenum (Mo)-Total (mg/L)	0.00413	0.109	0.00900	0.00351	0.112
	Nickel (Ni)-Total (mg/L)	0.00137	0.0044	0.00171	0.00054	0.0056
	Phosphorus (P)-Total (mg/L)	<0.050	<0.10 ^{DLA}	0.097	<0.050	0.23
	Potassium (K)-Total (mg/L)	3.10	62.3	8.25	2.46	65.1
	Selenium (Se)-Total (mg/L)	0.000182	0.00840	0.00246	0.000278	0.00884
	Silicon (Si)-Total (mg/L)	5.17	4.33	9.40	6.38	13.4
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000020 ^{DLA}	0.000043	<0.000010	0.000171
	Sodium (Na)-Total (mg/L)	14.0	166	51.6	17.9	168
	Strontium (Sr)-Total (mg/L)	0.606	7.04	3.35	0.803	7.16
	Sulfur (S)-Total (mg/L)	20.7	634	84.7	20.9	635
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000020 ^{DLA}	<0.000010	<0.000010	0.000064
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00020 ^{DLA}	<0.00010	<0.00010	0.00043
	Titanium (Ti)-Total (mg/L)	0.00051	0.0217	0.00312	<0.00060 ^{DLM}	0.337
	Uranium (U)-Total (mg/L)	0.00227	0.00956	0.00515	0.00243	0.00969
	Vanadium (V)-Total (mg/L)	0.00053	0.0019	0.00385	<0.00050	0.0223
	Zinc (Zn)-Total (mg/L)	0.0134	0.0081	0.145	0.0066	0.0448
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	0.00122	<0.00030	0.00068
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0021	0.0094	0.0076	0.0016	0.0079
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	0.00041	0.00013	<0.00010	0.00037
	Arsenic (As)-Dissolved (mg/L)	0.00042	0.00043	0.00059	0.00021	0.00043
	Barium (Ba)-Dissolved (mg/L)	0.0994	0.119	0.203	0.0725	0.114
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000040 ^{DLA}	<0.000020	<0.000020	<0.000040 ^{DLA}
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.00010 ^{DLA}	<0.000050	<0.000050	<0.00010 ^{DLA}
	Boron (B)-Dissolved (mg/L)	0.027	0.390	0.037	0.022	0.390
	Cadmium (Cd)-Dissolved (mg/L)	<0.000025 ^{DLM}	0.000079	0.000202	0.0000128	0.000091
	Calcium (Ca)-Dissolved (mg/L)	70.8	465	246	57.6	462
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00020 ^{DLA}	0.00070	<0.00010	<0.00020 ^{DLA}
	Cobalt (Co)-Dissolved (mg/L)	0.00021	0.00221	0.00144	<0.00010	0.00220
	Copper (Cu)-Dissolved (mg/L)	0.00705	0.0120	0.0576	0.00482	0.0124
	Iron (Fe)-Dissolved (mg/L)	0.148	<0.020 ^{DLA}	0.326	0.013	<0.020 ^{DLA}
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.00010 ^{DLA}	<0.000050	<0.000050	0.00011
	Lithium (Li)-Dissolved (mg/L)	0.0012	0.0291	0.0045	0.0038	0.0293
	Magnesium (Mg)-Dissolved (mg/L)	19.8	91.1	73.1	31.9	89.5
	Manganese (Mn)-Dissolved (mg/L)	0.516	2.41	5.97	0.0772	2.33

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2062126-1 Water 26-FEB-18 15:15 W17	L2062126-2 Water 26-FEB-18 15:40 W45	L2062126-3 Water 26-FEB-18 16:45 W8A	L2062126-4 Water 27-FEB-18 08:45 W3	L2062126-5 Water 26-FEB-18 DUP
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	0.0000059	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00367	0.106	0.00779	0.00301	0.106
	Nickel (Ni)-Dissolved (mg/L)	0.00136	0.0043 ^{DLA}	0.00178	0.00054	0.0042 ^{DLA}
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.10 ^{DLA}	<0.050	<0.050	<0.10 ^{DLA}
	Potassium (K)-Dissolved (mg/L)	3.23	63.6	8.61	2.53	64.6
	Selenium (Se)-Dissolved (mg/L)	0.000158	0.00848	0.00240	0.000346	0.00846
	Silicon (Si)-Dissolved (mg/L)	5.14	3.58 ^{DLA}	9.15	6.42	3.57 ^{DLA}
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000020 ^{DLA}	0.000015	<0.000010	<0.000020 ^{DLA}
	Sodium (Na)-Dissolved (mg/L)	14.1	172	52.3	18.0	169
	Strontium (Sr)-Dissolved (mg/L)	0.629	7.06	3.41	0.802	7.19
	Sulfur (S)-Dissolved (mg/L)	20.5	638	83.1	20.4	658 ^{DLA}
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000020 ^{DLA}	<0.000010	<0.000010	<0.000020 ^{DLA}
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00020 ^{DLA}	<0.00010	<0.00010	<0.00020 ^{DLA}
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00060 ^{DLA}	<0.0012 ^{DLM}	<0.00030	<0.00060 ^{DLA}
	Uranium (U)-Dissolved (mg/L)	0.00213	0.00947 ^{DLA}	0.00457	0.00219	0.00916 ^{DLA}
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.0010 ^{DLA}	0.00201 ^{DTC}	<0.00050	<0.0010 ^{DLA}
	Zinc (Zn)-Dissolved (mg/L)	0.0152	0.0044	0.227	0.0080	0.0042
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	0.00050	0.00107	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Aluminum (Al)-Dissolved	MB-LOR	L2062126-1, -3
Method Blank	Zirconium (Zr)-Dissolved	MB-LOR	L2062126-1, -3
Method Blank	Aluminum (Al)-Total	MB-LOR	L2062126-1, -2, -5
Method Blank	Antimony (Sb)-Total	MB-LOR	L2062126-1, -2, -5
Method Blank	Silver (Ag)-Total	MB-LOR	L2062126-1, -2, -5
Method Blank	Zirconium (Zr)-Total	MB-LOR	L2062126-1, -2, -5
Laboratory Control Sample	Strontium (Sr)-Total	MES	L2062126-3, -4, -5
Matrix Spike	Dissolved Organic Carbon	MS-B	L2062126-1, -4
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2062126-1, -2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2062126-1, -2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2062126-1, -2, -3, -4, -5
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2062126-1, -2, -3, -4, -5
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2062126-1, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2062126-1, -2, -3, -4, -5
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2062126-1, -2, -3, -4, -5
Matrix Spike	Barium (Ba)-Total	MS-B	L2062126-3, -4, -5
Matrix Spike	Calcium (Ca)-Total	MS-B	L2062126-3, -4, -5
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2062126-3, -4, -5
Matrix Spike	Selenium (Se)-Total	MS-B	L2062126-3, -4, -5
Matrix Spike	Sodium (Na)-Total	MS-B	L2062126-1, -2, -3, -4, -5
Matrix Spike	Sodium (Na)-Total	MS-B	L2062126-3, -4, -5
Matrix Spike	Strontium (Sr)-Total	MS-B	L2062126-3, -4, -5
Matrix Spike	Sulfur (S)-Total	MS-B	L2062126-3, -4, -5
Matrix Spike	Uranium (U)-Total	MS-B	L2062126-3, -4, -5

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLB	Detection Limit Raised. Analyte detected at comparable level in Method Blank.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DTC	Dissolved concentration exceeds total. Results were confirmed by re-analysis.
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			

Reference Information

CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Weston et al.			
NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
SO4-IC-N-VA	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)
This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".			
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.			
TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

Reference Information

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-02-28 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2062126-COFC

COC Number: 2018-02-28 A

Page of

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Report To			Report Format / Distribution			Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply														
Contact and company name below will appear on the final report			Select Report Format: ☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)			Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply														
Company: Minto Explorations Ltd.			Quality Control (QC) Report with Report ☒ YES ☐ NO			PRIORITY (Business days) 4 day [P4] ☐ 3 day [P3] ☐ 2 day [P2] ☐				EMERGENCY 1 Business day [E1] ☐ Same Day, Weekend or Statutory holiday [E0] ☐										
Contact: Minto Environment - Coordinator			☒ Compare Results to Criteria on Report - provide details below if box checked																	
Phone: 1-604-759-4659			Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX																	
Company address below will appear on the final report			Email 1 or Fax minto_environment@mintomine.com																	
Street: 2100-510 West Georgia St.			Email 2																	
City/Province: Vancouver, British Columbia			Email 3																	
Postal Code: V6B 0M3																				
Invoice To			Invoice Distribution			Analysis Request														
Same as Report To ☐ YES ☒ NO			Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX			Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below														
Copy of Invoice with Report ☐ YES ☒ NO			Email 1 or Fax ap@mintomine.com																	
Company: Minto Explorations Ltd.			Email 2																	
Contact: Ruth Cayetano																				
Project Information			Oil and Gas Required Fields (client use)																	
ALS Account # / Quote #:			AFE/Cost Center:																	
Job #:			Major/Minor Code:																	
PO / AFE: 229096 (WUL)			Requisitioner:																	
LSD:			Location:																	
ALS Lab Work Order # (lab use only)			ALS Contact: Shane Stack			Sampler: SR														
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)		Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	pH / Conductivity / Alkalinity / Anions	Total Suspended Solids (TSS)	Total Dissolved Solids (TDS)	Total Metals (TMM), Hardness	Dissolved Metals (DM) (filtered and preserved)	Total Mercury, Hardness	Dissolved Mercury [I] (Filtered + preserved)	Total Nutrients (Ammonia)	Dissolved Organic Carbon (DOC)	Number of Containers					
	W17		26-Feb-18	15:15	Water	R	R	R	R	R	R	R	R			7				
	W45		26-Feb-18	15:40	Water	R	R	R	R	R	R	R	R			6				
	W8A		26-Feb-18	16:45	Water	R	R	R	R	R	R	R	R			6				
	W3		27-Feb-18	8:45	Water	R	R	R	R	R	R	R	R			7				
	DUP		26-Feb-18		Water	R	R	R	R	R	R	R	R			6				
Drinking Water (DW) Samples¹ (client use)			Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic QC only)			SAMPLE CONDITION AS RECEIVED (lab use only)														
Are samples taken from a Regulated DW System? ☐ YES ☒ NO						Frozen ☐ SIF Observations Yes ☐ No ☐														
Are samples for human drinking water use? ☐ YES ☒ NO						Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐														
						Cooling Initiated ☐														
						INITIAL COOLER TEMPERATURES °C														
						FINAL COOLER TEMPERATURES °C														
						-1°C														
						3 4														
SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)														
Released by: Shaun Roberts		Date: 2018-02-28	Time: 11:00	Received by:	Date: Feb 28/18	Time: 14:36	Received by: JC	Date: MAR - 1 2018	Time: 14:25											

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2016 FROM

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 07-MAR-18
Report Date: 20-MAR-18 15:24 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2064858
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-03-07 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

20-MAR-18 15:24 (MT)

Version: FINAL

Sample ID Description Sampled Date Sampled Time Client ID		L2064858-1 Water 04-MAR-18 16:20 UG1	L2064858-2 Water 06-MAR-18 11:00 W8A	L2064858-3 Water 06-MAR-18 13:40 W17	L2064858-4 Water 06-MAR-18 14:45 W3	L2064858-5 Water 06-MAR-18 14:45 F-BL
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	2830	1710	544	580	<2.0
	Hardness (as CaCO3) (mg/L)	1470	878	238	254	<0.50
	pH (pH)	7.94	7.69	8.03	8.08	5.39
	Total Suspended Solids (mg/L)	37.5	45.3	<3.0	<3.0	<3.0
	TDS (Calculated) (mg/L)	2530	1120	308	326	<1.0
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	165	779	225	254	<1.0
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	165	779	225	254	<1.0
	Ammonia, Total (as N) (mg/L)	9.76	0.280	0.0425	0.0102	<0.0050
	Chloride (Cl) (mg/L)	12	19.5	7.52	4.98	<0.50
	Nitrate and Nitrite (as N) (mg/L)	20.0	1.04	0.0536	0.0959	<0.0051
	Nitrate (as N) (mg/L)	18.9	0.615	0.0519	0.0943	<0.0050
	Nitrite (as N) (mg/L)	1.04	0.428	0.0017	0.0016	<0.0010
	Sulfate (SO4) (mg/L)	1640	249	62.7	62.1	<0.30
	Anion Sum (meq/L)	39.2	21.4	6.03	6.55	<0.10
	Cation Sum (meq/L)	35.1	20.5	5.51	5.97	<0.10
	Cation - Anion Balance (%)	-5.6	-2.1	-4.5	-4.6	0.0
	Organic / Inorganic Carbon			9.31	6.07	<0.50
	Dissolved Organic Carbon (mg/L)					
Total Metals	Aluminum (Al)-Total (mg/L)	1.42	0.0630	0.0085	0.0218	<0.0030
	Antimony (Sb)-Total (mg/L)	0.00049	0.00021	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00133	0.00077	0.00055	0.00023	<0.00010
	Barium (Ba)-Total (mg/L)	0.0664	0.208	0.106	0.0758	<0.000050
	Beryllium (Be)-Total (mg/L)	0.000062	0.000024	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.00010 ^{DLA}	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.699	0.042	0.028	0.027	<0.010
	Cadmium (Cd)-Total (mg/L)	0.000226	0.000264	0.0000248	0.0000151	<0.0000050
	Calcium (Ca)-Total (mg/L)	565	252	70.3	57.5	<0.050
	Chromium (Cr)-Total (mg/L)	0.00343	0.00138	0.00025	<0.00010	<0.00010
	Cobalt (Co)-Total (mg/L)	0.00105	0.00178	0.00027	<0.00010	<0.00010
	Copper (Cu)-Total (mg/L)	0.665	0.136	0.00984	0.00770	0.00062 ^{RRV}
	Iron (Fe)-Total (mg/L)	2.33	2.86	0.277	0.051	<0.010
	Lead (Pb)-Total (mg/L)	0.00126	0.000112	0.000096	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	0.0337	0.0050	0.0012	0.0039	<0.0010
	Magnesium (Mg)-Total (mg/L)	43.4	76.0	21.6	33.2	<0.10
	Manganese (Mn)-Total (mg/L)	0.206	6.04	0.683	0.0768	<0.00010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2064858-1 Water 04-MAR-18 16:20 UG1	L2064858-2 Water 06-MAR-18 11:00 W8A	L2064858-3 Water 06-MAR-18 13:40 W17	L2064858-4 Water 06-MAR-18 14:45 W3	L2064858-5 Water 06-MAR-18 14:45 F-BL
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	0.0000052	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.0294	0.00999	0.00446	0.00344	<0.000050
	Nickel (Ni)-Total (mg/L)	0.0040	0.00224	0.00160	0.00060	<0.00050
	Phosphorus (P)-Total (mg/L)	<0.10 ^{DLA}	0.098	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	13.4	8.11	3.27	2.69	<0.10
	Selenium (Se)-Total (mg/L)	0.00091	0.00238	0.000152	0.000276	<0.000050
	Silicon (Si)-Total (mg/L)	11.5	9.78	5.53	6.82	<0.10
	Silver (Ag)-Total (mg/L)	0.000259	<0.000040 ^{DLB}	<0.000010	<0.000020 ^{DLB}	<0.000010
	Sodium (Na)-Total (mg/L)	120	60.7	17.2	20.3	<0.050
	Strontium (Sr)-Total (mg/L)	7.74	3.61	0.637	0.812	<0.00020
	Sulfur (S)-Total (mg/L)	592	90.2	22.4	22.1	<0.50
	Thallium (Tl)-Total (mg/L)	0.000028	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00020 ^{DLA}	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	0.0752	0.00347	<0.00030	<0.0012 ^{DLM}	<0.00030
	Uranium (U)-Total (mg/L)	0.00786	0.00530	0.00250	0.00242	<0.000010
	Vanadium (V)-Total (mg/L)	0.0051	0.00375	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Total (mg/L)	0.0173	0.353	0.0171	0.0079	<0.0030
	Zirconium (Zr)-Total (mg/L)	<0.00030	0.00112	<0.00030	<0.00030	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0147	0.0073	0.0022	0.0014	<0.0010
	Antimony (Sb)-Dissolved (mg/L)	0.00041	0.00014	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00106	0.00065	0.00048	0.00021	<0.00010
	Barium (Ba)-Dissolved (mg/L)	0.0382	0.172	0.0974	0.0701	<0.000050
	Beryllium (Be)-Dissolved (mg/L)	<0.000040 ^{DLA}	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.00010 ^{DLA}	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.573	0.036	0.025	0.024	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	0.000111	0.000217	0.0000200	0.0000102	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	526	239	65.0	55.4	<0.050
	Chromium (Cr)-Dissolved (mg/L)	0.00261	0.00072	<0.00010	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	0.00040	0.00170	0.00022	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.0150	0.0510	0.00686	0.00444	0.00046 ^{RRV}
	Iron (Fe)-Dissolved (mg/L)	<0.020 ^{DLA}	0.322	0.181	0.018	<0.010
	Lead (Pb)-Dissolved (mg/L)	<0.00010 ^{DLA}	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0306	0.0048	0.0014	0.0040	<0.0010
	Magnesium (Mg)-Dissolved (mg/L)	37.3	68.4	18.3	28.1	<0.10
	Manganese (Mn)-Dissolved (mg/L)	0.141	5.53	0.617	0.0704	0.00035 ^{RRV}

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2064858-1 Water 04-MAR-18 16:20 UG1	L2064858-2 Water 06-MAR-18 11:00 W8A	L2064858-3 Water 06-MAR-18 13:40 W17	L2064858-4 Water 06-MAR-18 14:45 W3	L2064858-5 Water 06-MAR-18 14:45 F-BL
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	0.0000051	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.0266	0.00911	0.00404	0.00305	<0.000050
	Nickel (Ni)-Dissolved (mg/L)	0.0033	0.00235	0.00143	0.00053	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.10 ^{DLA}	0.057	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	12.1	8.25	2.97	2.50	<0.10
	Selenium (Se)-Dissolved (mg/L)	0.00080	0.00262	0.000163	0.000300	<0.000050
	Silicon (Si)-Dissolved (mg/L)	8.61	9.16	5.17	6.36	<0.050
	Silver (Ag)-Dissolved (mg/L)	<0.000020 ^{DLA}	0.000016	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	110	58.2	15.0	19.1	<0.050
	Strontium (Sr)-Dissolved (mg/L)	7.34	3.38	0.629	0.796	0.00029 ^{RRV}
	Sulfur (S)-Dissolved (mg/L)	597	89.3	21.2	21.2	<0.50
	Thallium (Tl)-Dissolved (mg/L)	<0.000020 ^{DLA}	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00020 ^{DLA}	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00060 ^{DLA}	0.00094	<0.00030	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00690	0.00461	0.00215	0.00213	<0.000010
	Vanadium (V)-Dissolved (mg/L)	<0.0010 ^{DLA}	0.00154	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0038	0.422	0.0159	0.0073	0.0025 ^{RRV}
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	0.00102	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Molybdenum (Mo)-Total	B	L2064858-1, -2, -3, -4, -5
Method Blank	Molybdenum (Mo)-Total	MB-LOR	L2064858-1, -2, -3, -4, -5
Method Blank	Potassium (K)-Total	MB-LOR	L2064858-1, -2, -3, -4, -5
Method Blank	Silver (Ag)-Total	MB-LOR	L2064858-1, -2, -3, -4, -5
Matrix Spike	Dissolved Organic Carbon	MS-B	L2064858-3, -4, -5
Matrix Spike	Barium (Ba)-Total	MS-B	L2064858-1, -2, -3, -4, -5
Matrix Spike	Barium (Ba)-Total	MS-B	L2064858-5
Matrix Spike	Calcium (Ca)-Total	MS-B	L2064858-1, -2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Total	MS-B	L2064858-5
Matrix Spike	Iron (Fe)-Total	MS-B	L2064858-1, -2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2064858-1, -2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2064858-5
Matrix Spike	Manganese (Mn)-Total	MS-B	L2064858-1, -2, -3, -4, -5
Matrix Spike	Potassium (K)-Total	MS-B	L2064858-1, -2, -3, -4, -5
Matrix Spike	Selenium (Se)-Total	MS-B	L2064858-5
Matrix Spike	Sodium (Na)-Total	MS-B	L2064858-1, -2, -3, -4, -5
Matrix Spike	Sodium (Na)-Total	MS-B	L2064858-5
Matrix Spike	Strontium (Sr)-Total	MS-B	L2064858-1, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Total	MS-B	L2064858-5
Matrix Spike	Sulfur (S)-Total	MS-B	L2064858-1, -2, -3, -4, -5
Matrix Spike	Sulfur (S)-Total	MS-B	L2064858-5

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
DLA	Detection Limit adjusted for required dilution
DLB	Detection Limit Raised. Analyte detected at comparable level in Method Blank.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
BR-L-IC-N-VA	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			

Reference Information

CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
F-IC-N-VA	Water	Fluoride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
SO4-IC-N-VA	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)

Reference Information

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
----------------------------	---------------------

VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
----	---

Chain of Custody Numbers:

2018-03-07 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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Report To Contact and company name below will appear on the final report		Report Format / Distribution		Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply																			
Company:	Minto Explorations Ltd.	Select Report Format: ☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)		Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply																			
Contact:	Minto Environment - Coordinator	Quality Control (QC) Report with Report ☒ YES ☐ NO		PRIORITY (Business Days)	4 day [P4] ☐				1 Business day [E1] ☐				EMERGENCY										
Phone:	1-604-759-4659	☒ Compare Results to Criteria on Report - provide details below if box checked			3 day [P3] ☐				Same Day, Weekend or Statutory holiday [E0] ☐														
Company address below will appear on the final report		Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX			2 day [P2] ☐																		
Street:	2100-510 West Georgia St.	Email 1 or Fax minto_environment@mintomine.com		Date and Time Required for all E&P TATs: 30-10-2018 09:00 AM																			
City/Province:	Vancouver, British Columbia	Email 2		For tests that can not be performed according to the service level selected, you will be contacted.																			
Postal Code:	V6B 0M3	Email 3		Analysis Request																			
Invoice To	Same as Report To ☐ YES ☒ NO	Invoice Distribution		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below																			
	Copy of Invoice with Report ☐ YES ☒ NO	Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX																					
Company:	Minto Explorations Ltd.	Email 1 or Fax ap@mintomine.com		pH / Conductivity / Alkalinity / Anions	Total Suspended Solids (TSS)	Total Dissolved Solids (TDS)	Total Metals (TM), Hardness	Dissolved Metals (DM) (filtered and preserved)	Total Mercury, Hardness	Dissolved Mercury [1] (Filtered + preserved)	Total Nutrients (Ammonia)	Dissolved Organic Carbon (DOC)	Number of Containers										
Contact:	Ruth Cayetano	Email 2																					
Project Information		Oil and Gas Required Fields (client use)																					
ALS Account # / Quote #:		AFE/Cost Center: PO#																					
Job #:		Major/Minor Code: Routing Code:																					
PO / AFE: 229096 (WUL)		Requisitioner:																					
LSD:		Location:																					
ALS Lab Work Order # (lab use only)		ALS Contact: Shane Stack		Sampler: SR																			
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type																			
	UG1	4-Mar-18	16:20	Water	R	R	R	R	R	R	R	R	6										
	W8A	6-Mar-18	11:00	Water	R	R	R	R	R	R	R	R	6										
	W17	6-Mar-18	13:40	Water	R	R	R	R	R	R	R	R	7										
	W3	6-Mar-18	14:45	Water	R	R	R	R	R	R	R	R	7										
	F-BL	6-Mar-18	14:45	Water	R	R	R	R	R	R	R	R	7										
Drinking Water (DW) Samples¹ (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)		SAMPLE CONDITION AS RECEIVED (lab use only)																			
Are samples taken from a Regulated DW System? ☐ YES ☒ NO				Frozen ☐ SIF Observations Yes ☐ No ☐																			
Are samples for human drinking water use? ☐ YES ☒ NO				Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐																			
				Cooling Initiated ☐																			
				INITIAL COOLER TEMPERATURES °C: 3°C FINAL COOLER TEMPERATURES °C: 4 5 7																			
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)		FINAL SHIPMENT RECEPTION (lab use only)																			
Released by: Shaun Roberts	Date: 2018-03-07	Time: 10:30	Received by: 	Date: Mar 7 / 18	Time: 14:20	Received by: SC	Date: MAR - 8 2018	Time: 12pm															

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY

YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 14-MAR-18
Report Date: 28-MAR-18 13:27 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2067825
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-03-14 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

28-MAR-18 13:27 (MT)

Version: FINAL

Sample ID Description Sampled Date Sampled Time Client ID		L2067825-1 Water 12-MAR-18 11:20 W62	L2067825-2 Water 09-MAR-18 16:25 W51	L2067825-3 Water 13-MAR-18 08:40 W3	L2067825-4 Water 13-MAR-18 09:00 W17	L2067825-5 Water 13-MAR-18 09:55 W8A
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	1080	1400	574	540	1560
	Hardness (as CaCO3) (mg/L)	527	650	265	254	915
	pH (pH)	8.32	7.88	8.17	8.13	7.72
	Total Suspended Solids (mg/L)	<3.0	505	<3.0	4.5	22.9
	TDS (Calculated) (mg/L)	678	948	326	311	1110
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	394	444	257	222	757
	Alkalinity, Carbonate (as CaCO3) (mg/L)	7.8	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	402	444	257	222	757
	Ammonia, Total (as N) (mg/L)	0.0086	12.2	0.0089	0.0488	0.333
	Chloride (Cl) (mg/L)	26.3	<2.5 ^{DLDS}	4.83	7.29	19.4
	Nitrate (as N) (mg/L)	3.88	34.8	0.129	0.0620	0.235
	Nitrite (as N) (mg/L)	<0.0050 ^{DLDS}	1.15	<0.0010	0.0011	0.467
	Sulfate (SO4) (mg/L)	178	243	58.9	61.8	240
	Anion Sum (meq/L)	12.8	16.5	6.53	5.96	20.8
	Cation Sum (meq/L)	11.8	16.3	6.17	5.86	21.2
	Cation - Anion Balance (%)	-4.0	-0.8	-2.8	-0.9	1.0
	Organic / Inorganic Carbon			5.12	8.62	
Total Metals	Aluminum (Al)-Total (mg/L)	0.0183	6.72	0.0244	0.129	0.313
	Antimony (Sb)-Total (mg/L)	<0.00030 ^{DLB}	<0.00060 ^{DLB}	<0.00020 ^{DLB}	<0.00030 ^{DLB}	<0.00040 ^{DLB}
	Arsenic (As)-Total (mg/L)	0.00049	0.00358	0.00028	0.00064	0.00085
	Barium (Ba)-Total (mg/L)	0.114	0.299	0.0741	0.121	0.224
	Beryllium (Be)-Total (mg/L)	<0.000020	0.000521	<0.000020	<0.000020	0.000032
	Bismuth (Bi)-Total (mg/L)	<0.000050	0.000261	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.022	0.580	0.032	0.030	0.040
	Cadmium (Cd)-Total (mg/L)	0.0000197	0.0000976	0.0000098	0.0000485	0.000302
	Calcium (Ca)-Total (mg/L)	157	132	57.0	71.3	257
	Chromium (Cr)-Total (mg/L)	0.00019	0.00150	<0.00010	0.00027	0.00149
	Cobalt (Co)-Total (mg/L)	0.00012	0.00388	<0.00010	0.00045	0.00170
	Copper (Cu)-Total (mg/L)	0.0641	0.738	0.00950	0.0290	0.213
	Iron (Fe)-Total (mg/L)	0.055	14.3	0.069	0.888	4.40
	Lead (Pb)-Total (mg/L)	<0.000050	0.00612	0.000061	0.00177	0.000353
	Lithium (Li)-Total (mg/L)	0.0026	0.0240	0.0038	<0.0010	0.0048
	Magnesium (Mg)-Total (mg/L)	40.7	82.9	28.1	18.7	68.6
	Manganese (Mn)-Total (mg/L)	0.0413	0.517	0.0832	1.12	5.49
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.000025 ^{DLM}	<0.0000050	<0.0000050	0.0000066

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2067825-6 Water 13-MAR-18 10:25 W12	L2067825-7 Water 13-MAR-18 13:50 W45	L2067825-8 Water 13-MAR-18 14:10 W14	L2067825-9 Water 13-MAR-18 14:50 W16	L2067825-10 Water 13-MAR-18 DUP1
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	2740	3060	2800	510	555
	Hardness (as CaCO3) (mg/L)	1330	1490		231	276
	pH (pH)	8.07	8.10	8.21	8.16	8.32
	Total Suspended Solids (mg/L)	4.9	69.1		44.7	<3.0
	TDS (Calculated) (mg/L)	2320	2690		305	326
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	198	159	154	160	244
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	5.8
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	198	159	154	160	250
	Ammonia, Total (as N) (mg/L)	4.56	5.83	2.97	0.101	0.0118
	Chloride (Cl) (mg/L)	37	40	52	9.94	4.88
	Nitrate (as N) (mg/L)	6.22	17.8	11.1	1.52	0.130
	Nitrite (as N) (mg/L)	8.12	5.95	8.42	0.0216	<0.0010
	Sulfate (SO4) (mg/L)	1410	1670	1440	92.0	58.9
	Anion Sum (meq/L)	35.3	40.8		5.52	6.40
	Cation Sum (meq/L)	35.1	39.7		5.37	6.42
	Cation - Anion Balance (%)	-0.3	-1.4		-1.3	0.2
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)		110		14.6	5.14
Total Metals	Aluminum (Al)-Total (mg/L)	0.0222	1.09		2.65	0.0067
	Antimony (Sb)-Total (mg/L)	<0.00040 ^{DLB}	<0.00060 ^{DLB}		<0.00070 ^{DLB}	<0.00010
	Arsenic (As)-Total (mg/L)	0.00049	0.00066		0.00091	0.00028
	Barium (Ba)-Total (mg/L)	0.0941	0.152		0.135	0.0739
	Beryllium (Be)-Total (mg/L)	<0.000040 ^{DLA}	0.000042 ^{DLA}		0.000086	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.00010 ^{DLA}	<0.00010 ^{DLA}		0.000080	<0.000050
	Boron (B)-Total (mg/L)	0.282	0.361		0.030	0.026
	Cadmium (Cd)-Total (mg/L)	0.000157	<0.000090 ^{DLM}		0.000263	0.0000136
	Calcium (Ca)-Total (mg/L)	406	445		65.3	58.7
	Chromium (Cr)-Total (mg/L)	<0.00020 ^{DLA}	0.00067		0.00143	<0.00010
	Cobalt (Co)-Total (mg/L)	0.00230	0.00148		0.00138	<0.00010
	Copper (Cu)-Total (mg/L)	0.0554	0.0860		0.655	0.00408
	Iron (Fe)-Total (mg/L)	0.040	2.38		4.36	0.031
	Lead (Pb)-Total (mg/L)	<0.00010 ^{DLA}	0.00080		0.00135	<0.000050
	Lithium (Li)-Total (mg/L)	0.0206	0.0363		0.0025	0.0041
	Magnesium (Mg)-Total (mg/L)	73.3	93.9		17.3	28.2
	Manganese (Mn)-Total (mg/L)	1.53	1.14		0.178	0.0803
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.000025 ^{DLM}		<0.000025 ^{DLM}	<0.0000050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2067825-11 Water 13-MAR-18 DUP2	L2067825-12 Water 13-MAR-18 T-BL		
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	3090	<2.0			
	Hardness (as CaCO3) (mg/L)	1490	<0.50 ^{HTC}			
	pH (pH)	8.10	5.54			
	Total Suspended Solids (mg/L)	89.5				
	TDS (Calculated) (mg/L)	2690				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	154	<1.0			
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0			
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0			
	Alkalinity, Total (as CaCO3) (mg/L)	154	<1.0			
	Ammonia, Total (as N) (mg/L)	5.76	<0.0050			
	Chloride (Cl) (mg/L)	40	<0.50			
	Nitrate (as N) (mg/L)	17.7	<0.0050			
	Nitrite (as N) (mg/L)	5.87	<0.0010			
	Sulfate (SO4) (mg/L)	1660	<0.30			
	Anion Sum (meq/L)	40.5				
	Cation Sum (meq/L)	39.8				
	Cation - Anion Balance (%)	-0.9				
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	112				
Total Metals	Aluminum (Al)-Total (mg/L)	0.689	<0.0030			
	Antimony (Sb)-Total (mg/L)	<0.0010 ^{DLB}	<0.00010			
	Arsenic (As)-Total (mg/L)	0.00062	<0.00010			
	Barium (Ba)-Total (mg/L)	0.146	<0.000050			
	Beryllium (Be)-Total (mg/L)	<0.000040 ^{DLA}	<0.000020			
	Bismuth (Bi)-Total (mg/L)	<0.00010 ^{DLA}	<0.000050			
	Boron (B)-Total (mg/L)	0.371	<0.010			
	Cadmium (Cd)-Total (mg/L)	<0.000060 ^{DLM}	<0.0000050			
	Calcium (Ca)-Total (mg/L)	452	<0.050			
	Chromium (Cr)-Total (mg/L)	0.00043	<0.00010			
	Cobalt (Co)-Total (mg/L)	0.00126	<0.00010			
	Copper (Cu)-Total (mg/L)	0.0494	<0.00050			
	Iron (Fe)-Total (mg/L)	1.35	<0.010			
	Lead (Pb)-Total (mg/L)	0.00040	<0.000050			
	Lithium (Li)-Total (mg/L)	0.0395	<0.0010			
	Magnesium (Mg)-Total (mg/L)	95.2	<0.10			
	Manganese (Mn)-Total (mg/L)	1.15	<0.00010			
	Mercury (Hg)-Total (mg/L)	<0.000025 ^{DLM}	<0.0000050			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2067825-1 Water 12-MAR-18 11:20 W62	L2067825-2 Water 09-MAR-18 16:25 W51	L2067825-3 Water 13-MAR-18 08:40 W3	L2067825-4 Water 13-MAR-18 09:00 W17	L2067825-5 Water 13-MAR-18 09:55 W8A
Grouping	Analyte					
WATER						
Total Metals	Molybdenum (Mo)-Total (mg/L)	0.00655	0.00448	0.00390	0.00511	0.00891
	Nickel (Ni)-Total (mg/L)	0.00107	0.00187	0.00060	0.00200	0.00225
	Phosphorus (P)-Total (mg/L)	<0.050	0.529	<0.050	<0.050	0.122
	Potassium (K)-Total (mg/L)	4.75	12.0	2.36	2.92	8.00
	Selenium (Se)-Total (mg/L)	0.00144	0.00448	0.000293	0.000149	0.00204
	Silicon (Si)-Total (mg/L)	8.32	20.0	6.77	5.80	10.9
	Silver (Ag)-Total (mg/L)	<0.000010	0.000359	<0.000010	0.000021	0.000067
	Sodium (Na)-Total (mg/L)	25.1	46.8	17.9	14.6	52.6
	Strontium (Sr)-Total (mg/L)	1.56	4.95	0.808	0.613	3.42
	Sulfur (S)-Total (mg/L)	62.1	84.8	21.0	22.0	88.4
	Thallium (Tl)-Total (mg/L)	<0.000010	0.000088	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	0.00031	<0.00010	<0.00010	0.00011
	Titanium (Ti)-Total (mg/L)	<0.0012 ^{DLM}	0.152	0.00129	0.00633	0.0149
	Uranium (U)-Total (mg/L)	0.00524	0.00850	0.00271	0.00254	0.00556
	Vanadium (V)-Total (mg/L)	0.00085	0.0307	0.00051	0.00101	0.00493
	Zinc (Zn)-Total (mg/L)	0.118	0.0457	0.0220	0.0373	0.387
	Zirconium (Zr)-Total (mg/L)	<0.00030	0.00040	<0.00030	0.00038	0.00095
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0045	0.0035	0.0025	0.0025	0.0070
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	0.00047	<0.00010	<0.00010	0.00013
	Arsenic (As)-Dissolved (mg/L)	0.00045	0.00169	0.00027	0.00049	0.00058
	Barium (Ba)-Dissolved (mg/L)	0.117	0.0392	0.0762	0.114	0.213
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.019	0.485	0.030	0.029	0.038
	Cadmium (Cd)-Dissolved (mg/L)	0.0000175	0.0000142	0.0000169	0.0000271	0.000227
	Calcium (Ca)-Dissolved (mg/L)	140	119	55.1	69.0	248
	Chromium (Cr)-Dissolved (mg/L)	0.00016	<0.00010	<0.00010	<0.00010	0.00073
	Cobalt (Co)-Dissolved (mg/L)	0.00011	0.00053	<0.00010	0.00027	0.00156
	Copper (Cu)-Dissolved (mg/L)	0.0585	0.161	0.00401	0.00721	0.0541
	Iron (Fe)-Dissolved (mg/L)	0.020	0.067	0.023	0.178	0.248
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0020	0.0200	0.0034	0.0012	0.0047
	Magnesium (Mg)-Dissolved (mg/L)	43.2	85.6	30.8	19.7	71.8
	Manganese (Mn)-Dissolved (mg/L)	0.0427	0.175	0.0971	0.796	5.75
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2067825-6 Water 13-MAR-18 10:25 W12	L2067825-7 Water 13-MAR-18 13:50 W45	L2067825-8 Water 13-MAR-18 14:10 W14	L2067825-9 Water 13-MAR-18 14:50 W16	L2067825-10 Water 13-MAR-18 DUP1
Grouping	Analyte					
WATER						
Total Metals	Molybdenum (Mo)-Total (mg/L)	0.0887	0.112		0.00453	0.00393
	Nickel (Ni)-Total (mg/L)	0.0037	0.0092		0.00154	0.00060
	Phosphorus (P)-Total (mg/L)	<0.10 ^{DLA}	<0.10 ^{DLA}		0.107	<0.050
	Potassium (K)-Total (mg/L)	52.3	66.3		4.68	2.38
	Selenium (Se)-Total (mg/L)	0.00984	0.00872		0.00102	0.000343
	Silicon (Si)-Total (mg/L)	4.28	5.47		8.84	6.75
	Silver (Ag)-Total (mg/L)	<0.000020 ^{DLA}	0.000044		0.000241	<0.000010
	Sodium (Na)-Total (mg/L)	143	166		13.7	17.4
	Strontium (Sr)-Total (mg/L)	7.07	7.92		0.621	0.812
	Sulfur (S)-Total (mg/L)	530	613		32.9	21.6
	Thallium (Tl)-Total (mg/L)	<0.000020 ^{DLA}	<0.000020 ^{DLA}		0.000031	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00020 ^{DLA}	<0.00020 ^{DLA}		0.00020	<0.00010
	Titanium (Ti)-Total (mg/L)	<0.0018 ^{DLM}	0.0678		0.115	0.00033
	Uranium (U)-Total (mg/L)	0.00933	0.00936		0.00134	0.00286
	Vanadium (V)-Total (mg/L)	<0.0010 ^{DLA}	0.0043		0.00921	<0.00050
	Zinc (Zn)-Total (mg/L)	0.0079	0.0145		0.0497	0.0224
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030		0.00092	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0050	0.0104	0.0268	0.0134	0.0018
	Antimony (Sb)-Dissolved (mg/L)	0.00028	0.00043	0.00062	0.00026	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00040	0.00052	0.00055	0.00038	0.00023
	Barium (Ba)-Dissolved (mg/L)	0.0961	0.139	0.224	0.0714	0.0701
	Beryllium (Be)-Dissolved (mg/L)	<0.000040 ^{DLA}	<0.000040 ^{DLA}	<0.000040 ^{DLA}	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.00010 ^{DLA}	<0.00010 ^{DLA}	<0.00010 ^{DLA}	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.299	0.354	0.270	0.023	0.022
	Cadmium (Cd)-Dissolved (mg/L)	0.000114	0.000040	0.000037	0.000154	0.0000100
	Calcium (Ca)-Dissolved (mg/L)	404	435	308	62.3	57.9
	Chromium (Cr)-Dissolved (mg/L)	<0.00020 ^{DLA}	<0.00020 ^{DLA}	<0.00020 ^{DLA}	0.00028	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	0.00241	0.00097	0.00034	0.00011	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.0373	0.00855	0.00363	0.0553	0.00336
	Iron (Fe)-Dissolved (mg/L)	0.025	<0.020 ^{DLA}	<0.020 ^{DLA}	0.033	0.022
	Lead (Pb)-Dissolved (mg/L)	<0.00010 ^{DLA}	<0.00010 ^{DLA}	<0.00010 ^{DLA}	0.000112	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0211	0.0355	0.0429	0.0012	0.0030
	Magnesium (Mg)-Dissolved (mg/L)	78.0	98.3	110	18.3	31.9
	Manganese (Mn)-Dissolved (mg/L)	1.59	1.17	0.475	0.0672	0.0850
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2067825-11 Water 13-MAR-18 DUP2	L2067825-12 Water 13-MAR-18 T-BL		
Grouping	Analyte					
WATER						
Total Metals	Molybdenum (Mo)-Total (mg/L)	0.114	<0.000050			
	Nickel (Ni)-Total (mg/L)	0.0090	<0.00050			
	Phosphorus (P)-Total (mg/L)	<0.10 ^{DLA}	<0.050			
	Potassium (K)-Total (mg/L)	68.5	<0.10			
	Selenium (Se)-Total (mg/L)	0.00896	<0.000050			
	Silicon (Si)-Total (mg/L)	4.75	<0.10			
	Silver (Ag)-Total (mg/L)	<0.000020 ^{DLA}	<0.000010			
	Sodium (Na)-Total (mg/L)	168	<0.050			
	Strontium (Sr)-Total (mg/L)	7.73	<0.00020			
	Sulfur (S)-Total (mg/L)	643	<0.50			
	Thallium (Tl)-Total (mg/L)	<0.000020 ^{DLA}	<0.000010			
	Tin (Sn)-Total (mg/L)	<0.00020 ^{DLA}	<0.00010			
	Titanium (Ti)-Total (mg/L)	0.0390	<0.00030			
	Uranium (U)-Total (mg/L)	0.0101	<0.000010			
	Vanadium (V)-Total (mg/L)	0.0027	<0.00050			
	Zinc (Zn)-Total (mg/L)	0.0074	<0.0030			
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030			
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD				
	Dissolved Metals Filtration Location	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	0.0106				
	Antimony (Sb)-Dissolved (mg/L)	0.00046				
	Arsenic (As)-Dissolved (mg/L)	0.00051				
	Barium (Ba)-Dissolved (mg/L)	0.136				
	Beryllium (Be)-Dissolved (mg/L)	<0.000040 ^{DLA}				
	Bismuth (Bi)-Dissolved (mg/L)	<0.00010 ^{DLA}				
	Boron (B)-Dissolved (mg/L)	0.364				
	Cadmium (Cd)-Dissolved (mg/L)	<0.000040 ^{DLM}				
	Calcium (Ca)-Dissolved (mg/L)	434				
	Chromium (Cr)-Dissolved (mg/L)	<0.00020 ^{DLA}				
	Cobalt (Co)-Dissolved (mg/L)	0.00096				
	Copper (Cu)-Dissolved (mg/L)	0.00857				
	Iron (Fe)-Dissolved (mg/L)	<0.020 ^{DLA}				
	Lead (Pb)-Dissolved (mg/L)	<0.00010 ^{DLA}				
	Lithium (Li)-Dissolved (mg/L)	0.0387				
	Magnesium (Mg)-Dissolved (mg/L)	99.2				
	Manganese (Mn)-Dissolved (mg/L)	1.18				
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2067825-1 Water 12-MAR-18 11:20 W62	L2067825-2 Water 09-MAR-18 16:25 W51	L2067825-3 Water 13-MAR-18 08:40 W3	L2067825-4 Water 13-MAR-18 09:00 W17	L2067825-5 Water 13-MAR-18 09:55 W8A
Grouping	Analyte					
WATER						
Dissolved Metals	Molybdenum (Mo)-Dissolved (mg/L)	0.00533	0.00436	0.00298	0.00378	0.00687
	Nickel (Ni)-Dissolved (mg/L)	0.00110	0.00075	0.00060	0.00154	0.00193
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	0.053
	Potassium (K)-Dissolved (mg/L)	5.07	10.3	2.61	3.05	8.30
	Selenium (Se)-Dissolved (mg/L)	0.00159	0.00406	0.000357	0.000171	0.00174
	Silicon (Si)-Dissolved (mg/L)	8.29	7.63	6.61	5.42	10.0
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	0.000012
	Sodium (Na)-Dissolved (mg/L)	26.2	49.0	18.6	15.4	55.8
	Strontium (Sr)-Dissolved (mg/L)	1.51	4.39	0.780	0.586	3.30
	Sulfur (S)-Dissolved (mg/L)	61.2	83.2	20.3	21.5	85.5
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	0.000011	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00090 ^{DLM}
	Uranium (U)-Dissolved (mg/L)	0.00481	0.00746	0.00242	0.00233	0.00432
	Vanadium (V)-Dissolved (mg/L)	0.00068	0.00070	<0.00050	<0.00050	0.00170
	Zinc (Zn)-Dissolved (mg/L)	0.118	0.0022	0.0212	0.0209	0.271
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	0.00095

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2067825-6 Water 13-MAR-18 10:25 W12	L2067825-7 Water 13-MAR-18 13:50 W45	L2067825-8 Water 13-MAR-18 14:10 W14	L2067825-9 Water 13-MAR-18 14:50 W16	L2067825-10 Water 13-MAR-18 DUP1
Grouping	Analyte					
WATER						
Dissolved Metals	Molybdenum (Mo)-Dissolved (mg/L)	0.0894	0.106	0.129	0.00397	0.00369
	Nickel (Ni)-Dissolved (mg/L)	0.0035	0.0086	0.0064	0.00074	0.00054
	Phosphorus (P)-Dissolved (mg/L)	<0.10 ^{DLA}	<0.10 ^{DLA}	<0.10 ^{DLA}	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	54.3	71.3	77.9	4.08	2.36
	Selenium (Se)-Dissolved (mg/L)	0.00940	0.00880	0.00937	0.000726	0.000247
	Silicon (Si)-Dissolved (mg/L)	4.27	3.32	2.20	3.29	6.05
	Silver (Ag)-Dissolved (mg/L)	<0.000020 ^{DLA}	<0.000020 ^{DLA}	<0.000020 ^{DLA}	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	154	175	179	14.7	19.3
	Strontium (Sr)-Dissolved (mg/L)	7.04	7.36	7.84	0.625	0.834
	Sulfur (S)-Dissolved (mg/L)	529	611	538	30.5	20.2
	Thallium (Tl)-Dissolved (mg/L)	<0.000020 ^{DLA}	<0.000020 ^{DLA}	<0.000020 ^{DLA}	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00020 ^{DLA}	<0.00020 ^{DLA}	<0.00020 ^{DLA}	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00060 ^{DLA}	<0.00060 ^{DLA}	<0.00060 ^{DLA}	0.00061	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.0100	0.00943	0.00922	0.00124	0.00245
	Vanadium (V)-Dissolved (mg/L)	<0.0010 ^{DLA}	<0.0010 ^{DLA}	<0.0010 ^{DLA}	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0058	0.0048	<0.0020 ^{DLA}	0.0281	0.0241
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	0.00043	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2067825-11 Water 13-MAR-18 DUP2	L2067825-12 Water 13-MAR-18 T-BL			
Grouping	Analyte					
WATER						
Dissolved Metals	Molybdenum (Mo)-Dissolved (mg/L)	0.110				
	Nickel (Ni)-Dissolved (mg/L)	0.0090				
	Phosphorus (P)-Dissolved (mg/L)	<0.10 ^{DLA}				
	Potassium (K)-Dissolved (mg/L)	70.8				
	Selenium (Se)-Dissolved (mg/L)	0.00861				
	Silicon (Si)-Dissolved (mg/L)	3.33				
	Silver (Ag)-Dissolved (mg/L)	<0.000020 ^{DLA}				
	Sodium (Na)-Dissolved (mg/L)	178				
	Strontium (Sr)-Dissolved (mg/L)	7.63				
	Sulfur (S)-Dissolved (mg/L)	609				
	Thallium (Tl)-Dissolved (mg/L)	<0.000020 ^{DLA}				
	Tin (Sn)-Dissolved (mg/L)	<0.00020 ^{DLA}				
	Titanium (Ti)-Dissolved (mg/L)	<0.00060 ^{DLA}				
	Uranium (U)-Dissolved (mg/L)	0.00971				
	Vanadium (V)-Dissolved (mg/L)	<0.0010 ^{DLA}				
	Zinc (Zn)-Dissolved (mg/L)	<0.0020 ^{DLA}				
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Barium (Ba)-Total	B	L2067825-1, -10, -11, -2, -3, -4, -5, -6, -7, -9
Method Blank	Antimony (Sb)-Total	MB-LOR	L2067825-1, -10, -11, -2, -3, -4, -5, -6, -7, -9
Method Blank	Thallium (Tl)-Total	MB-LOR	L2067825-12
Laboratory Control Sample	Antimony (Sb)-Total	MES	L2067825-1, -10, -11, -2, -3, -4, -5, -6, -7, -9
Matrix Spike	Dissolved Organic Carbon	MS-B	L2067825-11, -7, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2067825-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2067825-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Copper (Cu)-Dissolved	MS-B	L2067825-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2067825-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2067825-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2067825-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2067825-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2067825-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2067825-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Uranium (U)-Dissolved	MS-B	L2067825-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Total	MS-B	L2067825-1, -10, -11, -2, -3, -4, -5, -6, -7, -9
Matrix Spike	Barium (Ba)-Total	MS-B	L2067825-12
Matrix Spike	Calcium (Ca)-Total	MS-B	L2067825-1, -10, -11, -2, -3, -4, -5, -6, -7, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L2067825-12
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2067825-1, -10, -11, -2, -3, -4, -5, -6, -7, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2067825-12
Matrix Spike	Manganese (Mn)-Total	MS-B	L2067825-1, -10, -11, -2, -3, -4, -5, -6, -7, -9
Matrix Spike	Manganese (Mn)-Total	MS-B	L2067825-12
Matrix Spike	Molybdenum (Mo)-Total	MS-B	L2067825-12
Matrix Spike	Sodium (Na)-Total	MS-B	L2067825-1, -10, -11, -2, -3, -4, -5, -6, -7, -9
Matrix Spike	Sodium (Na)-Total	MS-B	L2067825-12
Matrix Spike	Strontium (Sr)-Total	MS-B	L2067825-1, -10, -11, -2, -3, -4, -5, -6, -7, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L2067825-12
Matrix Spike	Sulfur (S)-Total	MS-B	L2067825-1, -10, -11, -2, -3, -4, -5, -6, -7, -9
Matrix Spike	Sulfur (S)-Total	MS-B	L2067825-12
Matrix Spike	Uranium (U)-Total	MS-B	L2067825-12
Matrix Spike	Sulfate (SO4)	MS-B	L2067825-10, -11, -12, -5, -6

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
DLA	Detection Limit adjusted for required dilution
DLB	Detection Limit Raised. Analyte detected at comparable level in Method Blank.
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
HTC	Hardness was calculated from Total Ca and/or Mg concentrations and may be biased high (dissolved Ca/Mg results unavailable).
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Reference Information

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

BE-T-L-CCMS-VA Water Total Be (Low) in Water by CRC ICPMS EPA 200.2/6020A (mod)
 Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

BR-L-IC-N-VA Water Bromide in Water by IC (Low Level) EPA 300.1 (mod)
 Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

CARBONS-DOC-VA Water Dissolved organic carbon by combustion APHA 5310B TOTAL ORGANIC CARBON (TOC)
 This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.

CL-IC-N-VA Water Chloride in Water by IC EPA 300.1 (mod)
 Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

EC-PCT-VA Water Conductivity (Automated) APHA 2510 Auto. Conduc.
 This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-SCREEN-VA Water Conductivity Screen (Internal Use Only) APHA 2510
 Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

F-IC-N-VA Water Fluoride in Water by IC EPA 300.1 (mod)
 Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

HARDNESS-CALC-VA Water Hardness APHA 2340B
 Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)
 Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)
 Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E
 Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)
 Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)
 Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
 This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)
 Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

Reference Information

NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
SO4-IC-N-VA	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)
This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".			
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.			
TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.			
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-03-14 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2067825-COFC

COC Number: 2018-03-14 A

Page 1 of 2

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Report To Contact and company name below will appear on the final report		Report Format / Distribution			Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply															
Company: Minto Explorations Ltd.		Select Report Format: ☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)			Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply															
Contact: Minto Environment - Coordinator		Quality Control (QC) Report with Report ☒ YES ☐ NO			PRIORITY (Business Days) 4 day [P4] ☐ 3 day [P3] ☐ 2 day [P2] ☐				EMERGENCY 1 Business day [E1] ☐ Same Day, Weekend or Statutory holiday [E0] ☐											
Phone: 1-604-759-4659		☒ Compare Results to Criteria on Report - provide details below if box checked																		
Company address below will appear on the final report		Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX			Date and Time Required for all E&P TATs: (determined by client)															
Street: 2100-510 West Georgia St.		Email 1 or Fax minto_environment@mintomine.com			For tests that can not be performed according to the service level selected, you will be contacted.															
City/Province: Vancouver, British Columbia		Email 2			Analysis Request Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below															
Postal Code: V6B 0M3		Email 3																		
Invoice To		Invoice Distribution																		
Same as Report To ☐ YES ☒ NO		Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX																		
Copy of Invoice with Report ☐ YES ☒ NO		Email 1 or Fax ap@mintomine.com																		
Company: Minto Explorations Ltd.		Email 2																		
Contact: Ruth Cayetano																				
Project Information		Oil and Gas Required Fields (client use)																		
ALS Account # / Quote #:		AFE/Cost Center:																		
Job #:		Major/Minor Code:																		
PO / AFE: 229096 (WUL)		Requisitioner:																		
LSD:		Location:																		
ALS Lab Work Order # (lab use only)		ALS Contact: Shane Stack			Sampler: CR															
ALS Sample # (lab use only)		Sample Identification and/or Coordinates (This description will appear on the report)		Date (dd-mmm-yy)	Time (hh:mm)	Sample Type														
W62				12-Mar-18	11:20	Water														
W51				9-Mar-18	16:25	Water														
W3				13-Mar-18	8:40	Water														
W17				13-Mar-18	9:00	Water														
W8A				13-Mar-18	9:55	Water														
W12				13-Mar-18	10:25	Water														
W45				13-Mar-18	13:50	Water														
W14				13-Mar-18	14:10	Water														
W16				13-Mar-18	14:50	Water														
Dup 1				13-Mar-18		Water														
Drinking Water (DW) Samples¹ (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)					SAMPLE CONDITION AS RECEIVED (lab use only)													
Are samples taken from a Regulated DW System? ☐ YES ☒ NO							Frozen ☐ SIF Observations Yes ☐ No ☐ Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐ Cooling Initiated ☐													
Are samples for human drinking water use? ☐ YES ☒ NO																				
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)					FINAL SHIPMENT RECEPTION (lab use only)													
Released by: Corey Roberts		Date: 2018-03-13		Time:		Received by:	Date: MAR 14/18		Time: 15:25		Received by: JC		Date: MAR 15 2018		Time: 11:54					

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 21-MAR-18
Report Date: 05-APR-18 18:00 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2070760
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-03-21 C
Legal Site Desc:

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2070760-1 Water 20-MAR-18 09:50 W8A	L2070760-2 Water 20-MAR-18 14:40 W3	L2070760-3 Water 20-MAR-18 14:50 W17		
Grouping	Analyte						
WATER							
Physical Tests	Conductivity (uS/cm)		1680	535	510		
	Hardness (as CaCO3) (mg/L)		1030	275	272		
	pH (pH)		7.67	8.16	8.14		
	Total Suspended Solids (mg/L)		154	<3.0	3.9		
	TDS (Calculated) (mg/L)		1210	319	320		
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)		829	237	221		
	Alkalinity, Carbonate (as CaCO3) (mg/L)		<1.0	<1.0	<1.0		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)		<1.0	<1.0	<1.0		
	Alkalinity, Total (as CaCO3) (mg/L)		829	237	221		
	Ammonia, Total (as N) (mg/L)		0.385	0.0114	0.0519		
	Chloride (Cl) (mg/L)		20.7	5.03	7.48		
	Nitrate and Nitrite (as N) (mg/L)		0.215	0.136	0.0731		
	Nitrate (as N) (mg/L)		0.058	0.136	0.0718		
	Nitrite (as N) (mg/L)		0.157	<0.0010	0.0012		
	Sulfate (SO4) (mg/L)		243	58.9	63.3		
	Anion Sum (meq/L)		22.2	6.10	5.94		
	Cation Sum (meq/L)		24.3	6.41	6.31		
	Cation - Anion Balance (%)		4.5	2.4	3.0		
	Organic / Inorganic Carbon						
	Dissolved Organic Carbon (mg/L)			5.13	8.67		
Total Metals	Aluminum (Al)-Total (mg/L)		0.159	0.0045	0.0217		
	Antimony (Sb)-Total (mg/L)		0.00048	<0.00010	0.00011		
	Arsenic (As)-Total (mg/L)		0.00092	0.00023	0.00058		
	Barium (Ba)-Total (mg/L)		0.204	0.0655	0.0975		
	Beryllium (Be)-Total (mg/L)		0.000027	<0.000020	<0.000020		
	Bismuth (Bi)-Total (mg/L)		<0.000050	<0.000050	<0.000050		
	Boron (B)-Total (mg/L)		0.043	0.025	0.028		
	Cadmium (Cd)-Total (mg/L)		0.000303	0.0000096	0.0000362		
	Calcium (Ca)-Total (mg/L)		274	60.3	74.7		
	Chromium (Cr)-Total (mg/L)		0.00136	<0.00010	0.00020		
	Cobalt (Co)-Total (mg/L)		0.00187	<0.00010	0.00033		
	Copper (Cu)-Total (mg/L)		0.148	0.00339	0.0106		
	Iron (Fe)-Total (mg/L)		2.72	0.028	0.326		
	Lead (Pb)-Total (mg/L)		0.000284	<0.000050	0.000162		
	Lithium (Li)-Total (mg/L)		0.0044	0.0031	<0.0010		
	Magnesium (Mg)-Total (mg/L)		76.7	30.7	20.5		
	Manganese (Mn)-Total (mg/L)		6.20	0.0805	0.936		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2070760-1 Water 20-MAR-18 09:50 W8A	L2070760-2 Water 20-MAR-18 14:40 W3	L2070760-3 Water 20-MAR-18 14:50 W17		
Grouping	Analyte						
WATER							
Total Metals	Mercury (Hg)-Total (mg/L)	0.0000103	<0.0000050	<0.0000050			
	Molybdenum (Mo)-Total (mg/L)	0.00860	0.00432	0.00524			
	Nickel (Ni)-Total (mg/L)	0.00213	0.00062	0.00172			
	Phosphorus (P)-Total (mg/L)	0.103	<0.050	<0.050			
	Potassium (K)-Total (mg/L)	8.52	2.35	2.88			
	Selenium (Se)-Total (mg/L)	0.00138	0.000265	0.000130			
	Silicon (Si)-Total (mg/L)	9.34	5.81	4.86			
	Silver (Ag)-Total (mg/L)	0.000063	<0.000010	<0.000010			
	Sodium (Na)-Total (mg/L)	59.3	18.7	15.5			
	Strontium (Sr)-Total (mg/L)	3.41	0.793	0.608			
	Sulfur (S)-Total (mg/L)	82.9	21.0	22.1			
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010			
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010			
	Titanium (Ti)-Total (mg/L)	0.0107	<0.00030	<0.0012 ^{DLM}			
	Uranium (U)-Total (mg/L)	0.00568	0.00283	0.00266			
	Vanadium (V)-Total (mg/L)	0.00468	<0.00050	<0.00050			
	Zinc (Zn)-Total (mg/L)	0.143	0.0042	0.0144			
	Zirconium (Zr)-Total (mg/L)	0.00113	<0.00030	<0.00030			
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD			
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD			
	Aluminum (Al)-Dissolved (mg/L)	0.0113	0.0016	0.0032			
	Antimony (Sb)-Dissolved (mg/L)	0.00015	<0.00010	<0.00010			
	Arsenic (As)-Dissolved (mg/L)	0.00091	0.00020	0.00055			
	Barium (Ba)-Dissolved (mg/L)	0.245	0.0706	0.101			
	Beryllium (Be)-Dissolved (mg/L)	0.000020	<0.000020	<0.000020			
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050			
	Boron (B)-Dissolved (mg/L)	0.040	0.025	0.029			
	Cadmium (Cd)-Dissolved (mg/L)	0.000224	0.0000093	0.0000300			
	Calcium (Ca)-Dissolved (mg/L)	272	60.2	74.2			
	Chromium (Cr)-Dissolved (mg/L)	0.00108	<0.00010	0.00011			
	Cobalt (Co)-Dissolved (mg/L)	0.00207	<0.00010	0.00033			
	Copper (Cu)-Dissolved (mg/L)	0.0452	0.00358	0.00759			
	Iron (Fe)-Dissolved (mg/L)	0.761	0.027	0.226			
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050			
	Lithium (Li)-Dissolved (mg/L)	0.0039	0.0027	<0.0010			
	Magnesium (Mg)-Dissolved (mg/L)	85.6	30.2	21.2			
	Manganese (Mn)-Dissolved (mg/L)	7.42	0.0850	1.03			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2070760-1 Water 20-MAR-18 09:50 W8A	L2070760-2 Water 20-MAR-18 14:40 W3	L2070760-3 Water 20-MAR-18 14:50 W17		
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	0.0000081	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Dissolved (mg/L)	0.00846	0.00411	0.00471		
	Nickel (Ni)-Dissolved (mg/L)	0.00207	0.00063	0.00173		
	Phosphorus (P)-Dissolved (mg/L)	0.069	<0.050	<0.050		
	Potassium (K)-Dissolved (mg/L)	10.4	2.47	3.08		
	Selenium (Se)-Dissolved (mg/L)	0.00156	0.000304	0.000149		
	Silicon (Si)-Dissolved (mg/L)	10.7	6.27	5.25		
	Silver (Ag)-Dissolved (mg/L)	0.000016	<0.000010	<0.000010		
	Sodium (Na)-Dissolved (mg/L)	70.7	19.5	16.9		
	Strontium (Sr)-Dissolved (mg/L)	3.66	0.838	0.601		
	Sulfur (S)-Dissolved (mg/L)	86.8	19.5	21.4		
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010		
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010		
	Titanium (Ti)-Dissolved (mg/L)	0.00136	<0.00030	<0.00030		
	Uranium (U)-Dissolved (mg/L)	0.00515	0.00250	0.00230		
	Vanadium (V)-Dissolved (mg/L)	0.00276	<0.00050	<0.00050		
	Zinc (Zn)-Dissolved (mg/L)	0.130	0.0048	0.0143		
	Zirconium (Zr)-Dissolved (mg/L)	0.00121	<0.00030	<0.00030		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Alkalinity, Total (as CaCO ₃)	B	L2070760-1
Method Blank	Alkalinity, Total (as CaCO ₃)	B	L2070760-2, -3
Method Blank	Molybdenum (Mo)-Total	MB-LOR	L2070760-1, -2, -3
Matrix Spike	Dissolved Organic Carbon	MS-B	L2070760-2, -3
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2070760-1, -2, -3
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2070760-1, -2, -3
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2070760-1, -2, -3
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2070760-1, -2, -3
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2070760-1, -2, -3
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2070760-1, -2, -3
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2070760-1, -2, -3
Matrix Spike	Boron (B)-Total	MS-B	L2070760-1, -2, -3
Matrix Spike	Calcium (Ca)-Total	MS-B	L2070760-1, -2, -3
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2070760-1, -2, -3
Matrix Spike	Manganese (Mn)-Total	MS-B	L2070760-1, -2, -3
Matrix Spike	Molybdenum (Mo)-Total	MS-B	L2070760-1, -2, -3
Matrix Spike	Sodium (Na)-Total	MS-B	L2070760-1, -2, -3
Matrix Spike	Strontium (Sr)-Total	MS-B	L2070760-1, -2, -3
Matrix Spike	Sulfur (S)-Total	MS-B	L2070760-1, -2, -3
Matrix Spike	Nitrate (as N)	MS-B	L2070760-1, -2, -3

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510

Reference Information

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
SO4-IC-N-VA	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)
This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.			
TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Reference Information

Laboratory Definition Code	Laboratory Location
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VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
----	---

Chain of Custody Numbers:

2018-03-21 C

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lw - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

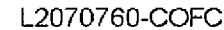
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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Page 1 of 1

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

f. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 29-MAR-18
Report Date: 12-APR-18 14:56 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2074250
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-03-29 A
Legal Site Desc:

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2074250-1 Water 27-MAR-18 16:55 W3	L2074250-2 Water 27-MAR-18 17:10 W17	L2074250-3 Water 28-MAR-18 09:20 W8A	L2074250-4 Water 28-MAR-18 DUP	
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	533	516	1540	1550	
	Hardness (as CaCO3) (mg/L)	296	264	1000	989	
	pH (pH)	8.34	8.25	7.89	7.82	
	Total Suspended Solids (mg/L)	5.6	6.0	18.8	33.2	
	TDS (Calculated) (mg/L)	326	308	1130	1110	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	228	211	764	754	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	6.6	<1.0	<1.0	<1.0	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Total (as CaCO3) (mg/L)	235	211	764	754	
	Ammonia, Total (as N) (mg/L)	0.0082	0.0480	0.357	0.358	
	Chloride (Cl) (mg/L)	5.16	7.43	19.4	18.3	
	Nitrate and Nitrite (as N) (mg/L)	0.142	0.0546	0.466	0.734	
	Nitrate (as N) (mg/L)	0.142	0.0546	0.261	0.514	
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	0.205	0.220	
	Sulfate (SO4) (mg/L)	58.7	61.4	227	214	
	Anion Sum (meq/L)	6.07	5.71	20.6	20.1	
	Cation Sum (meq/L)	6.88	6.07	23.3	22.9	
	Cation - Anion Balance (%)	6.2	3.1	6.2	6.5	
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	4.83	8.67			
Total Metals	Aluminum (Al)-Total (mg/L)	0.0097	0.0068	0.212	0.272	
	Antimony (Sb)-Total (mg/L)	<0.00010	0.00015	0.00023	0.00021	
	Arsenic (As)-Total (mg/L)	0.00021	0.00059	0.00087	0.00081	
	Barium (Ba)-Total (mg/L)	0.0715	0.102	0.241	0.237	
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	0.000024	0.000027	
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Total (mg/L)	0.023	0.026	0.038	0.037	
	Cadmium (Cd)-Total (mg/L)	0.0000547	0.0000423	0.000232	0.000206	
	Calcium (Ca)-Total (mg/L)	55.6	69.1	259	253	
	Chromium (Cr)-Total (mg/L)	<0.00010	0.00012	0.00160	0.00216	
	Cobalt (Co)-Total (mg/L)	<0.00010	0.00031	0.00203	0.00202	
	Copper (Cu)-Total (mg/L)	0.00522	0.00808	0.183	0.199	
	Iron (Fe)-Total (mg/L)	0.044	0.322	3.19	3.03	
	Lead (Pb)-Total (mg/L)	<0.000050	0.000051	0.000197	0.000743	
	Lithium (Li)-Total (mg/L)	0.0035	0.0014	0.0046	0.0045	
	Magnesium (Mg)-Total (mg/L)	30.9	20.6	76.0	75.4	
	Manganese (Mn)-Total (mg/L)	0.0812	0.884	6.45	6.31	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2074250-1 Water 27-MAR-18 16:55 W3	L2074250-2 Water 27-MAR-18 17:10 W17	L2074250-3 Water 28-MAR-18 09:20 W8A	L2074250-4 Water 28-MAR-18 DUP	
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	0.0000072	<0.0000050	
	Molybdenum (Mo)-Total (mg/L)	0.00464	0.00467	0.00824	0.00828	
	Nickel (Ni)-Total (mg/L)	0.00069	0.00172	0.00228	0.00225	
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	0.125	0.111	
	Potassium (K)-Total (mg/L)	2.36	2.95	9.52	8.44	
	Selenium (Se)-Total (mg/L)	0.000271	0.000182	0.00151	0.00152	
	Silicon (Si)-Total (mg/L)	6.49	5.43	11.0	10.8	
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	0.000070	0.000104	
	Sodium (Na)-Total (mg/L)	19.4	16.4	64.6	59.0	
	Strontium (Sr)-Total (mg/L)	0.865	0.613	3.65	3.63	
	Sulfur (S)-Total (mg/L)	21.2	22.5	89.0	87.1	
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	0.00017	<0.00010	
	Titanium (Ti)-Total (mg/L)	0.00072	0.00031	0.0134	0.0185	
	Uranium (U)-Total (mg/L)	0.00305	0.00230	0.00559	0.00550	
	Vanadium (V)-Total (mg/L)	<0.00050	<0.00050	0.00508	0.00475	
	Zinc (Zn)-Total (mg/L)	0.0100	0.0159	0.197	0.196	
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	0.00116	0.00116	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0015	0.0022	0.0089	0.0108	
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	0.00013	0.00012	
	Arsenic (As)-Dissolved (mg/L)	0.00020	0.00049	0.00067	0.00063	
	Barium (Ba)-Dissolved (mg/L)	0.0796	0.103	0.240	0.227	
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	0.023	0.025	0.035	0.035	
	Cadmium (Cd)-Dissolved (mg/L)	0.0000229	0.0000344	0.000156	0.000146	
	Calcium (Ca)-Dissolved (mg/L)	63.5	72.2	267	268	
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	0.00067	0.00072	
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00028	0.00196	0.00187	
	Copper (Cu)-Dissolved (mg/L)	0.00291	0.00625	0.0531	0.0497	
	Iron (Fe)-Dissolved (mg/L)	0.025	0.187	0.387	0.362	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.0032	<0.0010	0.0040	0.0039	
	Magnesium (Mg)-Dissolved (mg/L)	33.5	20.4	81.7	77.8	
	Manganese (Mn)-Dissolved (mg/L)	0.0815	0.853	6.61	6.25	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2074250-1 Water 27-MAR-18 16:55 W3	L2074250-2 Water 27-MAR-18 17:10 W17	L2074250-3 Water 28-MAR-18 09:20 W8A	L2074250-4 Water 28-MAR-18 DUP	
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Dissolved (mg/L)	0.00449	0.00461	0.00774	0.00778	
	Nickel (Ni)-Dissolved (mg/L)	0.00077	0.00169	0.00237	0.00219	
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	0.058	0.055	
	Potassium (K)-Dissolved (mg/L)	2.64	3.03	9.21	8.95	
	Selenium (Se)-Dissolved (mg/L)	0.000211	0.000124	0.00129	0.00120	
	Silicon (Si)-Dissolved (mg/L)	6.22	5.16	10.2	9.77	
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	0.000016	0.000016	
	Sodium (Na)-Dissolved (mg/L)	20.4	15.4	63.0	60.2	
	Strontium (Sr)-Dissolved (mg/L)	0.890	0.613	3.61	3.65	
	Sulfur (S)-Dissolved (mg/L)	19.4	20.8	82.9	80.0	
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00090 ^{DLM}	0.00133	
	Uranium (U)-Dissolved (mg/L)	0.00304	0.00229	0.00546	0.00533	
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	0.00210	0.00196	
	Zinc (Zn)-Dissolved (mg/L)	0.0066	0.0131	0.144	0.135	
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	0.00111	0.00111	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Barium (Ba)-Total	MS-B	L2074250-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Total	MS-B	L2074250-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2074250-1, -2, -3, -4
Matrix Spike	Manganese (Mn)-Total	MS-B	L2074250-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Total	MS-B	L2074250-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Total	MS-B	L2074250-1, -2, -3, -4
Matrix Spike	Sulfur (S)-Total	MS-B	L2074250-1, -2, -3, -4

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			

Reference Information

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
----------------------------	---------------------

VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
----	---

Chain of Custody Numbers:

2018-03-29 A

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lw - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



L2074250-COFC

COC Number: 2018-03-29 A

Page of

www.aesglobal.com					
Report To Contact and company name below will appear on the final report					
Company: Minto Explorations Ltd.					
Contact: Minto Environment - Coordinator					
Phone: 1-604-759-4659					
Company address below will appear on the final report					
Street: 2100-510 West Georgia St.					
City/Province: Vancouver, British Columbia					
Postal Code: V6B 0M3					
Invoice To Same as Report To ☐ YES ☒ NO					
Copy of Invoice with Report ☐ YES ☒ NO					
Company: Minto Explorations Ltd.					
Contact: Ruth Cayetano					
Project Information					
ALS Account # / Quote #:					
Job #:					
PO / AFE: 229096 (WUL)					
LSD:					
ALS Lab Work Order # (lab use only)					
Oil and Gas Required Fields (client use)					
AFE/Cost Center:					
Major/Minor Code:					
Requisitioner:					
Location:					
ALS Contact: Shane Stack Sampler: SR					
Sample Identification and/or Coordinates (This description will appear on the report)					
Date (dd-mmm-yy)					
Time (hh:mm)					
Sample Type					
Drinking Water (DW) Samples ¹ (client use)					
Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)					
Are samples taken from a Regulated DW System? ☐ YES ☒ NO					
Are samples for human drinking water use? ☐ YES ☒ NO					
SHIPMENT RELEASE (client use)					
Released by: Shaun Roberts Date: 2018-03-29 Time: 10:30					
Received by: [Signature] Date: Mar 29 / 18 Time: 15:38					
INITIAL SHIPMENT RECEPTION (lab use only)					
FINAL SHIPMENT RECEPTION (lab use only)					
SAMPLE CONDITION AS RECEIVED (lab use only)					
Frozen ☐ SIF Observations Yes ☐ No ☐					
Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐					
Cooling Initiated ☒					
INITIAL COOLER TEMPERATURES °C 7°C FINAL COOLER TEMPERATURES °C 7					

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FROM



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 04-APR-18
Report Date: 17-APR-18 14:09 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2075865
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-04-04 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2075865-1 Water 03-APR-18 09:35 W3	L2075865-2 Water 03-APR-18 09:50 W17	L2075865-3 Water 03-APR-18 10:30 W8A	L2075865-4 Water 03-APR-18 DUP	
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	521	506	1430	506	
	Hardness (as CaCO3) (mg/L)	262	256	918	244	
	pH (pH)	8.46	8.32	7.81	8.41	
	Total Suspended Solids (mg/L)	<3.0	<3.0	20.0	<3.0	
	TDS (Calculated) (mg/L)	312	307	1060	298	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	220	211	691	198	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	14.2	4.6	<1.0	10.2	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Total (as CaCO3) (mg/L)	234	215	691	208	
	Ammonia, Total (as N) (mg/L)	0.0078	0.0600	0.351	0.0577	
	Chloride (Cl) (mg/L)	5.25	7.56	19.9	7.58	
	Nitrate and Nitrite (as N) (mg/L)	0.154	0.0573	1.14	0.0575	
	Nitrate (as N) (mg/L)	0.154	0.0573	0.915	0.0575	
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	0.229	<0.0010	
	Sulfate (SO4) (mg/L)	59.2	61.7	233	61.8	
	Anion Sum (meq/L)	6.08	5.80	19.3	5.67	
	Cation Sum (meq/L)	6.11	5.92	21.3	5.66	
	Cation - Anion Balance (%)	0.3	1.0	5.0	-0.1	
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	5.09	8.86		8.99	
Total Metals	Aluminum (Al)-Total (mg/L)	0.0052	0.0034	0.322	0.0061	
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	0.00042	0.00018	
	Arsenic (As)-Total (mg/L)	0.00027	0.00065	0.00086	0.00065	
	Barium (Ba)-Total (mg/L)	0.0717	0.110	0.223	0.0985	
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	0.000029	<0.000020	
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Total (mg/L)	0.025	0.026	0.039	0.027	
	Cadmium (Cd)-Total (mg/L)	0.0000548	0.0000371	0.000251	0.0000328	
	Calcium (Ca)-Total (mg/L)	62.1	73.0	261	70.5	
	Chromium (Cr)-Total (mg/L)	<0.00010	0.00011	0.00180	0.00012	
	Cobalt (Co)-Total (mg/L)	<0.00010	0.00030	0.00192	0.00033	
	Copper (Cu)-Total (mg/L)	<0.0040 ^{DLB}	0.00685	0.248	0.00712	
	Iron (Fe)-Total (mg/L)	0.033	0.219 ^{DTMF}	3.75	0.294	
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	0.000354	0.000070	
	Lithium (Li)-Total (mg/L)	0.0031	<0.0010	0.0050	<0.0010	
	Magnesium (Mg)-Total (mg/L)	30.9	20.2	77.8	20.6	
	Manganese (Mn)-Total (mg/L)	0.0810	0.998	6.32	0.999	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2075865-1 Water 03-APR-18 09:35 W3	L2075865-2 Water 03-APR-18 09:50 W17	L2075865-3 Water 03-APR-18 10:30 W8A	L2075865-4 Water 03-APR-18 DUP	
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	0.0000060	<0.0000050	
	Molybdenum (Mo)-Total (mg/L)	0.00485	0.00506	0.00790	0.00463	
	Nickel (Ni)-Total (mg/L)	0.00074	0.00179	0.00234	0.00177	
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	0.105	<0.050	
	Potassium (K)-Total (mg/L)	2.31	2.88	8.72	2.92	
	Selenium (Se)-Total (mg/L)	0.000277	0.000138	0.00145	0.000191	
	Silicon (Si)-Total (mg/L)	6.06	5.08	11.4	5.64	
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	0.000100	<0.000010	
	Sodium (Na)-Total (mg/L)	18.2	14.3	60.4	15.7	
	Strontium (Sr)-Total (mg/L)	0.841	0.623	3.51	0.598	
	Sulfur (S)-Total (mg/L)	19.7	20.6	88.3	22.8	
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Total (mg/L)	0.00030	<0.00030	0.0214	0.00037	
	Uranium (U)-Total (mg/L)	0.00310	0.00222	0.00558	0.00222	
	Vanadium (V)-Total (mg/L)	<0.00050	<0.00050	0.00510	<0.00050	
	Zinc (Zn)-Total (mg/L)	0.0079	0.0128	0.345	0.0148	
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	0.00105	<0.00030	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0016	0.0072	0.0083	0.0030	
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	0.00014	<0.00010	
	Arsenic (As)-Dissolved (mg/L)	0.00020	0.00055	0.00058	0.00059	
	Barium (Ba)-Dissolved (mg/L)	0.0762	0.106	0.232	0.107	
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	0.023	0.025	0.038	0.024	
	Cadmium (Cd)-Dissolved (mg/L)	0.0000085	0.0000429	0.000149	0.0000314	
	Calcium (Ca)-Dissolved (mg/L)	54.1	68.3	243	63.6	
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00013	0.00084	0.00011	
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00030	0.00166	0.00031	
	Copper (Cu)-Dissolved (mg/L)	0.00244	0.00772	0.0414	0.00643	
	Iron (Fe)-Dissolved (mg/L)	0.030	0.302	0.761	0.242	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	0.000128	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.0034	0.0011	0.0049	<0.0010	
	Magnesium (Mg)-Dissolved (mg/L)	30.8	20.8	76.0	20.7	
	Manganese (Mn)-Dissolved (mg/L)	0.0760	0.945	6.08	0.973	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2075865-1 Water 03-APR-18 09:35 W3	L2075865-2 Water 03-APR-18 09:50 W17	L2075865-3 Water 03-APR-18 10:30 W8A	L2075865-4 Water 03-APR-18 DUP	
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Dissolved (mg/L)	0.00459	0.00460	0.00786	0.00467	
	Nickel (Ni)-Dissolved (mg/L)	0.00064	0.00168	0.00188	0.00169	
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	0.058	<0.050	
	Potassium (K)-Dissolved (mg/L)	2.50	3.07	8.96	3.01	
	Selenium (Se)-Dissolved (mg/L)	0.000248	0.000160	0.00129	0.000155	
	Silicon (Si)-Dissolved (mg/L)	5.91	5.10	9.84	5.17	
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	0.000023	<0.000010	
	Sodium (Na)-Dissolved (mg/L)	18.5	15.3	56.7	15.1	
	Strontium (Sr)-Dissolved (mg/L)	0.881	0.621	3.61	0.603	
	Sulfur (S)-Dissolved (mg/L)	18.4	19.1	79.9	20.7	
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	0.00052	<0.0012 ^{DLM}	<0.00030	
	Uranium (U)-Dissolved (mg/L)	0.00313	0.00222	0.00592	0.00224	
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	0.00207	<0.00050	
	Zinc (Zn)-Dissolved (mg/L)	0.0039	0.0139	0.242	0.0131	
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	0.00116	<0.00030	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Copper (Cu)-Total	MB-LOR	L2075865-1, -2
Matrix Spike	Dissolved Organic Carbon	MS-B	L2075865-1, -2, -4
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2075865-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2075865-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2075865-1, -2, -3, -4
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2075865-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2075865-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2075865-1, -2, -3, -4
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2075865-1, -2, -3, -4
Matrix Spike	Aluminum (Al)-Total	MS-B	L2075865-3, -4
Matrix Spike	Aluminum (Al)-Total	MS-B	L2075865-4
Matrix Spike	Barium (Ba)-Total	MS-B	L2075865-1, -2
Matrix Spike	Barium (Ba)-Total	MS-B	L2075865-3, -4
Matrix Spike	Barium (Ba)-Total	MS-B	L2075865-4
Matrix Spike	Calcium (Ca)-Total	MS-B	L2075865-1, -2
Matrix Spike	Calcium (Ca)-Total	MS-B	L2075865-3, -4
Matrix Spike	Calcium (Ca)-Total	MS-B	L2075865-4
Matrix Spike	Copper (Cu)-Total	MS-B	L2075865-3, -4
Matrix Spike	Iron (Fe)-Total	MS-B	L2075865-3, -4
Matrix Spike	Lead (Pb)-Total	MS-B	L2075865-4
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2075865-1, -2
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2075865-3, -4
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2075865-4
Matrix Spike	Manganese (Mn)-Total	MS-B	L2075865-1, -2
Matrix Spike	Manganese (Mn)-Total	MS-B	L2075865-3, -4
Matrix Spike	Manganese (Mn)-Total	MS-B	L2075865-4
Matrix Spike	Potassium (K)-Total	MS-B	L2075865-3, -4
Matrix Spike	Potassium (K)-Total	MS-B	L2075865-4
Matrix Spike	Silicon (Si)-Total	MS-B	L2075865-3, -4
Matrix Spike	Silicon (Si)-Total	MS-B	L2075865-4
Matrix Spike	Sodium (Na)-Total	MS-B	L2075865-1, -2
Matrix Spike	Sodium (Na)-Total	MS-B	L2075865-3, -4
Matrix Spike	Sodium (Na)-Total	MS-B	L2075865-4
Matrix Spike	Strontium (Sr)-Total	MS-B	L2075865-1, -2
Matrix Spike	Strontium (Sr)-Total	MS-B	L2075865-3, -4
Matrix Spike	Strontium (Sr)-Total	MS-B	L2075865-4
Matrix Spike	Sulfur (S)-Total	MS-B	L2075865-1, -2
Matrix Spike	Sulfur (S)-Total	MS-B	L2075865-3, -4
Matrix Spike	Sulfur (S)-Total	MS-B	L2075865-4
Matrix Spike	Uranium (U)-Total	MS-B	L2075865-3, -4
Matrix Spike	Sulfate (SO4)	MS-B	L2075865-4

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLB	Detection Limit Raised. Analyte detected at comparable level in Method Blank.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DTMF	Dissolved concentration exceeds total for field-filtered metals sample. Metallic contaminants may have been introduced to dissolved sample during field filtration.
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
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Reference Information

ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)

Reference Information

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-MAN-WR Water Total Suspended Solids by Gravimetric APHA 2540 D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids are determined by filtering a sample through a glass fibre filter and drying the filter at 104 degrees celsius.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-04-04 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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L2075865-COFC

COC Number: 2018-04-04 A

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REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 11-APR-18
Report Date: 24-APR-18 14:43 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2078933
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-04-11 A
Legal Site Desc:

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2078933-1 Water 09-APR-18 08:50 W12	L2078933-2 Water 09-APR-18 09:00 W14	L2078933-3 Water 09-APR-18 09:35 W15	L2078933-4 Water 09-APR-18 10:05 W35	L2078933-5 Water 09-APR-18 16:35 W62
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	2690	3330	1530	228	1010
	Hardness (as CaCO3) (mg/L)	1240	1470	753	104	525
	pH (pH)	7.94	8.03	8.19	8.18	8.25
	Total Suspended Solids (mg/L)	5.2		39.8	15.2	8.6
	TDS (Calculated) (mg/L)	2300		1050	125	662
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	195	105	293	109	343
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	195	105	293	109	343
	Ammonia, Total (as N) (mg/L)	4.21	5.16	0.108	0.0460	0.0128
	Chloride (Cl) (mg/L)	39	49	10.5	1.30	28.0
	Nitrate and Nitrite (as N) (mg/L)	14.5	25.1	46.9	0.233	4.99
	Nitrate (as N) (mg/L)	6.05	17.1	46.7	0.217	4.93
	Nitrite (as N) (mg/L)	8.49	7.96	0.224	0.0164	0.0603
	Sulfate (SO4) (mg/L)	1440	1820	362	14.9	191
	Anion Sum (meq/L)	35.9	43.3	17.0	2.53	12.0
	Cation Sum (meq/L)	33.0	40.7	16.7	2.24	11.8
	Cation - Anion Balance (%)	-4.2	-3.0	-0.9	-6.1	-0.8
	Organic / Inorganic Carbon			24.9	6.82	
Total Metals	Aluminum (Al)-Total (mg/L)	0.0373		0.724	0.347	0.0792
	Antimony (Sb)-Total (mg/L)	0.00031		0.00058	0.00017	0.00012
	Arsenic (As)-Total (mg/L)	0.00042		0.00059	0.00084	0.00049
	Barium (Ba)-Total (mg/L)	0.0813		0.0886	0.0747	0.0931
	Beryllium (Be)-Total (mg/L)	<0.000040 ^{DLA}		0.000030	0.000023	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.00010 ^{DLA}		<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.257		0.031	<0.010	0.020
	Cadmium (Cd)-Total (mg/L)	<0.00022 ^{DLM}		0.0000354	0.0000531	0.0000512
	Calcium (Ca)-Total (mg/L)	351		183	31.7	123
	Chromium (Cr)-Total (mg/L)	<0.00020 ^{DLA}		0.00048	0.00042	0.00035
	Cobalt (Co)-Total (mg/L)	0.00209		0.00056	0.00040	0.00015
	Copper (Cu)-Total (mg/L)	0.0713		0.0914	0.108	0.0668
	Iron (Fe)-Total (mg/L)	0.108		1.23	0.688	0.190
	Lead (Pb)-Total (mg/L)	0.00018		0.000305	0.000268	0.000094
	Lithium (Li)-Total (mg/L)	0.0186		0.0062	0.0012	0.0025
	Magnesium (Mg)-Total (mg/L)	78.1		75.9	6.85	40.8
	Manganese (Mn)-Total (mg/L)	1.44		0.0991	0.433	0.0343

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2078933-6 Water 09-APR-18 14:50 W16	L2078933-7 Water 10-APR-18 08:05 W3	L2078933-8 Water 10-APR-18 08:27 W17	L2078933-9 Water 10-APR-18 09:10 W8A	L2078933-10 Water 10-APR-18 16:40 W2
Grouping	Analyte						
WATER							
Physical Tests	Conductivity (uS/cm)		577	528	534	1580	402
	Hardness (as CaCO3) (mg/L)		270	255	253	1000	182
	pH (pH)		8.08	8.15	8.28	7.68	8.15
	Total Suspended Solids (mg/L)		35.9	<3.0	15.7	34.3	95.3
	TDS (Calculated) (mg/L)		342	299	309	1140	237
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)		217	226	220	792	153
	Alkalinity, Carbonate (as CaCO3) (mg/L)		<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)		<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)		217	226	220	792	153
	Ammonia, Total (as N) (mg/L)		0.0693	0.0091	0.0528	0.392	0.0071
	Chloride (Cl) (mg/L)		9.32	4.65	7.28	19.0	39.2
	Nitrate and Nitrite (as N) (mg/L)		1.57	0.205	0.0643	0.654	0.181
	Nitrate (as N) (mg/L)		1.56	0.205	0.0608	0.125	0.179
	Nitrite (as N) (mg/L)		0.0096	<0.0010	0.0035	0.529	0.0014
	Sulfate (SO4) (mg/L)		80.0	53.2	60.5	215	23.6
	Anion Sum (meq/L)		6.38	5.78	5.87	20.9	4.66
	Cation Sum (meq/L)		6.31	5.93	5.86	23.1	4.26
	Cation - Anion Balance (%)		-0.6	1.4	-0.1	4.9	-4.5
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)		15.5	5.28	8.99		11.0
Total Metals	Aluminum (Al)-Total (mg/L)		2.49	0.0543	0.0345	0.272	10.1
	Antimony (Sb)-Total (mg/L)		0.00040	<0.00010	<0.00010	0.00035	0.00049
	Arsenic (As)-Total (mg/L)		0.00090	0.00025	0.00063	0.00075	0.00561
	Barium (Ba)-Total (mg/L)		0.121	0.0642	0.104	0.218	0.249
	Beryllium (Be)-Total (mg/L)		0.000090	<0.000020	<0.000020	0.000028	0.000270
	Bismuth (Bi)-Total (mg/L)		<0.000050	<0.000050	<0.000050	<0.000050	0.000078
	Boron (B)-Total (mg/L)		0.029	0.022	0.025	0.037	0.023
	Cadmium (Cd)-Total (mg/L)		0.000258	0.0000235	0.0000422	0.000293	0.000142
	Calcium (Ca)-Total (mg/L)		65.1	48.9	64.3	236	54.4
	Chromium (Cr)-Total (mg/L)		0.00179	<0.00010	0.00017	0.00166	0.0163
	Cobalt (Co)-Total (mg/L)		0.00137	<0.00010	0.00039	0.00162	0.00669
	Copper (Cu)-Total (mg/L)		0.316	0.00619	0.0170	0.203	0.163
	Iron (Fe)-Total (mg/L)		3.90	0.097	0.463	3.54	14.1
	Lead (Pb)-Total (mg/L)		0.000920	<0.000050	0.000214	0.000322	0.00388
	Lithium (Li)-Total (mg/L)		0.0034	0.0033	0.0011	0.0044	0.0332
	Magnesium (Mg)-Total (mg/L)		24.4	27.2	19.8	73.8	16.9
	Manganese (Mn)-Total (mg/L)		0.197	0.0828	1.11	5.94	0.411

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2078933-11 Water 09-APR-18 DUP	L2078933-12 Water 10-APR-18 DUP 1	L2078933-13 Water 09-APR-18 12:00 F-BL		
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	580	520	<2.0		
	Hardness (as CaCO3) (mg/L)	272	255	<0.50		
	pH (pH)	8.21	8.43	5.51		
	Total Suspended Solids (mg/L)	28.7	<3.0	<3.0		
	TDS (Calculated) (mg/L)	342	300	<1.0		
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	217	217	<1.0		
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	11.2	<1.0		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0		
	Alkalinity, Total (as CaCO3) (mg/L)	217	228	<1.0		
	Ammonia, Total (as N) (mg/L)	0.0672	0.0101	<0.0050		
	Chloride (Cl) (mg/L)	9.30	4.64	<0.50		
	Nitrate and Nitrite (as N) (mg/L)	1.54	0.207	<0.0051		
	Nitrate (as N) (mg/L)	1.53	0.207	<0.0050		
	Nitrite (as N) (mg/L)	0.0088	<0.0010	<0.0010		
	Sulfate (SO4) (mg/L)	78.6	53.3	<0.30		
	Anion Sum (meq/L)	6.34	5.82	<0.10		
	Cation Sum (meq/L)	6.36	5.92	<0.10		
	Cation - Anion Balance (%)	0.1	0.9	0.0		
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	15.1	5.22	0.52 ^{RRV}		
Total Metals	Aluminum (Al)-Total (mg/L)	2.56	0.0464	<0.0030		
	Antimony (Sb)-Total (mg/L)	0.00041	<0.00010	<0.00010		
	Arsenic (As)-Total (mg/L)	0.00087	0.00024	<0.00010		
	Barium (Ba)-Total (mg/L)	0.127	0.0646	0.00022 ^{RRV}		
	Beryllium (Be)-Total (mg/L)	0.000090	<0.000020	<0.000020		
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050		
	Boron (B)-Total (mg/L)	0.030	0.022	<0.010		
	Cadmium (Cd)-Total (mg/L)	0.000254	0.0000206	0.0000076 ^{RRV}		
	Calcium (Ca)-Total (mg/L)	67.5	49.6	0.121 ^{RRV}		
	Chromium (Cr)-Total (mg/L)	0.00178	0.00011	<0.00010		
	Cobalt (Co)-Total (mg/L)	0.00138	<0.00010	<0.00010		
	Copper (Cu)-Total (mg/L)	0.323	0.00655	0.00062 ^{RRV}		
	Iron (Fe)-Total (mg/L)	3.90	0.087	<0.010		
	Lead (Pb)-Total (mg/L)	0.000967	0.000128	<0.000050		
	Lithium (Li)-Total (mg/L)	0.0042	0.0033	<0.0010		
	Magnesium (Mg)-Total (mg/L)	23.2	26.8	<0.10		
	Manganese (Mn)-Total (mg/L)	0.194	0.0806	0.00122 ^{RRV}		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2078933-1 Water 09-APR-18 08:50 W12	L2078933-2 Water 09-APR-18 09:00 W14	L2078933-3 Water 09-APR-18 09:35 W15	L2078933-4 Water 09-APR-18 10:05 W35	L2078933-5 Water 09-APR-18 16:35 W62
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.000025 ^{DLM}	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.0909		0.0189	0.00624	0.00741
	Nickel (Ni)-Total (mg/L)	0.0042		0.00080	0.00062	0.00121
	Phosphorus (P)-Total (mg/L)	<0.10 ^{DLA}		0.068	<0.050	<0.050
	Potassium (K)-Total (mg/L)	49.2		10.8	2.85	4.76
	Selenium (Se)-Total (mg/L)	0.00903		0.0165	0.000350	0.00247
	Silicon (Si)-Total (mg/L)	3.80		11.9	2.45	7.05
	Silver (Ag)-Total (mg/L)	0.000022		0.000027	0.000030	0.000015
	Sodium (Na)-Total (mg/L)	160		35.8	2.15	28.0
	Strontium (Sr)-Total (mg/L)	7.35		3.19	0.424	1.48
	Sulfur (S)-Total (mg/L)	492		138	5.42	67.8
	Thallium (Tl)-Total (mg/L)	<0.000020 ^{DLA}		0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.000020 ^{DLA}		<0.000010	<0.000010	<0.000010
	Titanium (Ti)-Total (mg/L)	<0.0015 ^{DLM}		0.0397	0.0130	0.00399
	Uranium (U)-Total (mg/L)	0.0100		0.00813	0.00128	0.00514
	Vanadium (V)-Total (mg/L)	<0.0010 ^{DLA}		0.00304	0.00189	0.00086
	Zinc (Zn)-Total (mg/L)	0.0099		0.0070	0.0044	0.116
	Zirconium (Zr)-Total (mg/L)	<0.00030		<0.00030	<0.00030	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD		FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0051	0.0164	0.0039	0.0115	0.0029
	Antimony (Sb)-Dissolved (mg/L)	0.00029	0.00063	0.00059	0.00012	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00042	0.00045	0.00041	0.00066	0.00044
	Barium (Ba)-Dissolved (mg/L)	0.0737	0.134 ^{DLA}	0.0759	0.0723	0.0887
	Beryllium (Be)-Dissolved (mg/L)	<0.000040 ^{DLA}	<0.000040 ^{DLA}	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.00010 ^{DLA}	<0.00010 ^{DLA}	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.265	0.271	0.029	<0.010	0.020
	Cadmium (Cd)-Dissolved (mg/L)	0.000081	0.000057	<0.0000050	0.0000337	0.0000261
	Calcium (Ca)-Dissolved (mg/L)	372 ^{DLA}	467 ^{DLA}	181	31.5	144
	Chromium (Cr)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00010	<0.00010	0.00015
	Cobalt (Co)-Dissolved (mg/L)	0.00194	0.00259	0.00017	0.00018	0.00011
	Copper (Cu)-Dissolved (mg/L)	0.0390	0.00635 ^{DLA}	0.0315	0.0479	0.0449
	Iron (Fe)-Dissolved (mg/L)	0.021	<0.020 ^{DLA}	<0.010	0.015	0.013
	Lead (Pb)-Dissolved (mg/L)	0.00011	<0.00010 ^{DLA}	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0183	0.0239	0.0068	0.0010	0.0017
	Magnesium (Mg)-Dissolved (mg/L)	75.1	73.2	73.3	6.05	40.3
	Manganese (Mn)-Dissolved (mg/L)	1.25	1.67	0.0570	0.394	0.0277

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2078933-6 Water 09-APR-18 14:50 W16	L2078933-7 Water 10-APR-18 08:05 W3	L2078933-8 Water 10-APR-18 08:27 W17	L2078933-9 Water 10-APR-18 09:10 W8A	L2078933-10 Water 10-APR-18 16:40 W2
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.00010 ^{DLM}	<0.0000050	<0.0000050	0.0000074	<0.00010 ^{DLM}
	Molybdenum (Mo)-Total (mg/L)	0.00381	0.00443	0.00485	0.00766	0.00228
	Nickel (Ni)-Total (mg/L)	0.00194	0.00073	0.00193	0.00209	0.0151
	Phosphorus (P)-Total (mg/L)	0.067	<0.050	<0.050	0.118	0.330
	Potassium (K)-Total (mg/L)	4.69	2.32	2.75	8.17	6.79
	Selenium (Se)-Total (mg/L)	0.000943	0.000302	0.000138	0.00160	0.000587
	Silicon (Si)-Total (mg/L)	9.38	5.80	5.14	10.4	22.9
	Silver (Ag)-Total (mg/L)	0.000119	<0.000010	<0.000010	0.000075	0.000163
	Sodium (Na)-Total (mg/L)	19.7	18.5	16.0	62.2	12.5
	Strontium (Sr)-Total (mg/L)	0.728	0.734	0.559	3.47	0.617
	Sulfur (S)-Total (mg/L)	28.9	19.3	21.5	81.6	9.30
	Thallium (Tl)-Total (mg/L)	0.000022	<0.000010	<0.000010	<0.000010	0.000083
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	0.00017
	Titanium (Ti)-Total (mg/L)	0.105	0.00239	0.00160	0.0147	0.332
	Uranium (U)-Total (mg/L)	0.00185	0.00288	0.00243	0.00584	0.00255
	Vanadium (V)-Total (mg/L)	0.00811	<0.00050	0.00051	0.00529	0.0307
	Zinc (Zn)-Total (mg/L)	0.0337	0.0058	0.0173	0.266	0.0405
	Zirconium (Zr)-Total (mg/L)	0.00054	<0.00030	<0.00030	0.00112	0.00167
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0125	0.0021	0.0028	0.0081	0.0167
	Antimony (Sb)-Dissolved (mg/L)	0.00032	<0.00010	<0.00010	0.00013	0.00019
	Arsenic (As)-Dissolved (mg/L)	0.00039	0.00019	0.00053	0.00058	0.00083
	Barium (Ba)-Dissolved (mg/L)	0.0842	0.0655	0.0964	0.198	0.0844
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.029	0.022	0.026	0.037	0.022
	Cadmium (Cd)-Dissolved (mg/L)	0.000154	0.0000087	0.0000341	0.000184	0.0000075
	Calcium (Ca)-Dissolved (mg/L)	69.9	56.3	69.0	279	52.5
	Chromium (Cr)-Dissolved (mg/L)	0.00026	<0.00010	0.00013	0.00107	0.00027
	Cobalt (Co)-Dissolved (mg/L)	0.00013	<0.00010	0.00035	0.00144	0.00011
	Copper (Cu)-Dissolved (mg/L)	0.0513	0.00300	0.00663	0.0474	0.0184
	Iron (Fe)-Dissolved (mg/L)	0.043	0.027	0.226	0.369	0.030
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0021	0.0025	<0.0010	0.0038	0.0217
	Magnesium (Mg)-Dissolved (mg/L)	23.3	27.8	19.6	73.9	12.3
	Manganese (Mn)-Dissolved (mg/L)	0.0745	0.0739	1.06	5.53	0.0454

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2078933-11 Water 09-APR-18 DUP	L2078933-12 Water 10-APR-18 DUP 1	L2078933-13 Water 09-APR-18 12:00 F-BL		
Grouping	Analyte						
WATER							
Total Metals	Mercury (Hg)-Total (mg/L)		^{DLM} <0.00010	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Total (mg/L)		0.00386	0.00449	<0.000050		
	Nickel (Ni)-Total (mg/L)		0.00184	0.00067	<0.00050		
	Phosphorus (P)-Total (mg/L)		0.080	<0.050	<0.050		
	Potassium (K)-Total (mg/L)		4.54	2.28	<0.10		
	Selenium (Se)-Total (mg/L)		0.000835	0.000237	<0.000050		
	Silicon (Si)-Total (mg/L)		9.36	5.80	<0.10		
	Silver (Ag)-Total (mg/L)		0.000104	<0.000010	<0.000010		
	Sodium (Na)-Total (mg/L)		18.7	18.0	<0.050		
	Strontium (Sr)-Total (mg/L)		0.757	0.772	0.00067 ^{RRV}		
	Sulfur (S)-Total (mg/L)		28.3	19.0	<0.50		
	Thallium (Tl)-Total (mg/L)		0.000022	<0.000010	<0.000010		
	Tin (Sn)-Total (mg/L)		0.00010	<0.00010	<0.00010		
	Titanium (Ti)-Total (mg/L)		0.107	0.00200	<0.00030		
	Uranium (U)-Total (mg/L)		0.00187	0.00267	<0.000010		
	Vanadium (V)-Total (mg/L)		0.00828	<0.00050	<0.00050		
	Zinc (Zn)-Total (mg/L)		0.0344	0.0045	<0.0030		
	Zirconium (Zr)-Total (mg/L)		0.00056	<0.00030	<0.00030		
Dissolved Metals	Dissolved Mercury Filtration Location		FIELD	FIELD	FIELD		
	Dissolved Metals Filtration Location		FIELD	FIELD	FIELD		
	Aluminum (Al)-Dissolved (mg/L)		0.0132	0.0104	<0.0010		
	Antimony (Sb)-Dissolved (mg/L)		0.00030	<0.00010	<0.00010		
	Arsenic (As)-Dissolved (mg/L)		0.00037	0.00022	<0.00010		
	Barium (Ba)-Dissolved (mg/L)		0.0861	0.0643	<0.00010		
	Beryllium (Be)-Dissolved (mg/L)		<0.000020	<0.000020	<0.000020		
	Bismuth (Bi)-Dissolved (mg/L)		<0.000050	<0.000050	<0.000050		
	Boron (B)-Dissolved (mg/L)		0.029	0.023	<0.010		
	Cadmium (Cd)-Dissolved (mg/L)		0.000177	<0.0000050	<0.0000050		
	Calcium (Ca)-Dissolved (mg/L)		71.2	56.4	<0.050		
	Chromium (Cr)-Dissolved (mg/L)		0.00021	<0.00010	<0.00010		
	Cobalt (Co)-Dissolved (mg/L)		0.00012	<0.00010	<0.00010		
	Copper (Cu)-Dissolved (mg/L)		0.0535	0.00288	<0.00020		
	Iron (Fe)-Dissolved (mg/L)		0.045	0.038	<0.010		
	Lead (Pb)-Dissolved (mg/L)		<0.000050	<0.000050	<0.000050		
	Lithium (Li)-Dissolved (mg/L)		0.0024	0.0029	<0.0010		
	Magnesium (Mg)-Dissolved (mg/L)		22.9	27.8	<0.10		
	Manganese (Mn)-Dissolved (mg/L)		0.0773	0.0735	0.00025 ^{RRV}		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2078933-1 Water 09-APR-18 08:50 W12	L2078933-2 Water 09-APR-18 09:00 W14	L2078933-3 Water 09-APR-18 09:35 W15	L2078933-4 Water 09-APR-18 10:05 W35	L2078933-5 Water 09-APR-18 16:35 W62
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050		<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.0868	0.134	0.0194	0.00620	0.00747
	Nickel (Ni)-Dissolved (mg/L)	0.0036	0.0040	<0.00050	<0.00050	0.00101
	Phosphorus (P)-Dissolved (mg/L)	<0.10 ^{DLA}	<0.10 ^{DLA}	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	49.1	64.6	10.6	2.74	4.81
	Selenium (Se)-Dissolved (mg/L)	0.00860	0.0105	0.0157	0.000330	0.00241
	Silicon (Si)-Dissolved (mg/L)	3.71	2.48	10.6	1.84	6.64
	Silver (Ag)-Dissolved (mg/L)	<0.000020 ^{DLA}	<0.000020 ^{DLA}	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	154	215	32.7	1.85	26.9
	Strontium (Sr)-Dissolved (mg/L)	6.76	8.03	3.06	0.386	1.57
	Sulfur (S)-Dissolved (mg/L)	484	680	136	5.27	61.7
	Thallium (Tl)-Dissolved (mg/L)	<0.000020 ^{DLA}	<0.000020 ^{DLA}	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00020 ^{DLA}	<0.00020 ^{DLA}	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00060 ^{DLA}	<0.00060 ^{DLA}	<0.00060 ^{DLM}	<0.00060 ^{DLM}	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00940	0.0106	0.00789	0.00112	0.00493
	Vanadium (V)-Dissolved (mg/L)	<0.0010 ^{DLA}	<0.0010 ^{DLA}	0.00051	0.00057	0.00052
	Zinc (Zn)-Dissolved (mg/L)	0.0076	<0.0020 ^{DLA}	0.0017	0.0015	0.0942
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2078933-6 Water 09-APR-18 14:50 W16	L2078933-7 Water 10-APR-18 08:05 W3	L2078933-8 Water 10-APR-18 08:27 W17	L2078933-9 Water 10-APR-18 09:10 W8A	L2078933-10 Water 10-APR-18 16:40 W2
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00393	0.00432	0.00496	0.00765	0.00219
	Nickel (Ni)-Dissolved (mg/L)	0.00088	0.00065	0.00177	0.00184	0.00064
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	0.059	<0.050
	Potassium (K)-Dissolved (mg/L)	3.80	2.37	2.88	8.37	5.49
	Selenium (Se)-Dissolved (mg/L)	0.000750	0.000261	0.000135	0.00141	0.000346
	Silicon (Si)-Dissolved (mg/L)	4.66	5.57	5.04	9.88	4.37
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	0.000015	<0.000010
	Sodium (Na)-Dissolved (mg/L)	18.3	17.7	15.4	59.6	11.0
	Strontium (Sr)-Dissolved (mg/L)	0.764	0.756	0.587	3.68	0.557
	Sulfur (S)-Dissolved (mg/L)	27.4	18.3	20.7	77.2	8.74
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00111	<0.00030	<0.00030	0.00116	0.00155
	Uranium (U)-Dissolved (mg/L)	0.00178	0.00283	0.00232	0.00571	0.00218
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	0.00238	0.00080
	Zinc (Zn)-Dissolved (mg/L)	0.0150	0.0043	0.0121	0.162	0.0012
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	0.00128	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2078933-11 Water 09-APR-18 DUP	L2078933-12 Water 10-APR-18 DUP 1	L2078933-13 Water 09-APR-18 12:00 F-BL		
Grouping	Analyte						
WATER							
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050			
	Molybdenum (Mo)-Dissolved (mg/L)	0.00380	0.00421	<0.000050			
	Nickel (Ni)-Dissolved (mg/L)	0.00087	0.00065	<0.00050			
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050			
	Potassium (K)-Dissolved (mg/L)	4.08	2.53	<0.10			
	Selenium (Se)-Dissolved (mg/L)	0.000795	0.000252	<0.000050			
	Silicon (Si)-Dissolved (mg/L)	4.60	5.57	<0.050			
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010			
	Sodium (Na)-Dissolved (mg/L)	18.4	17.2	<0.050			
	Strontium (Sr)-Dissolved (mg/L)	0.734	0.725	<0.00020			
	Sulfur (S)-Dissolved (mg/L)	27.4	18.6	<0.50			
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010			
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010			
	Titanium (Ti)-Dissolved (mg/L)	0.00126	0.00035	<0.00030			
	Uranium (U)-Dissolved (mg/L)	0.00179	0.00285	<0.000010			
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050			
	Zinc (Zn)-Dissolved (mg/L)	0.0177	0.0041	<0.0010			
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Alkalinity, Total (as CaCO ₃)	B	L2078933-11, -13, -8, -9
Method Blank	Alkalinity, Total (as CaCO ₃)	B	L2078933-12
Method Blank	Alkalinity, Total (as CaCO ₃)	B	L2078933-10
Method Blank	Molybdenum (Mo)-Total	MB-LOR	L2078933-1, -10, -11, -12, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Dissolved Organic Carbon	MS-B	L2078933-10, -11, -12, -3, -4, -6, -7, -8
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2078933-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2078933-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2078933-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2078933-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Molybdenum (Mo)-Dissolved	MS-B	L2078933-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2078933-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2078933-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
DLA	Detection Limit adjusted for required dilution
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction			

Reference Information

with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)
 Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E
 Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)
 Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)
 Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
 This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)
 Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)
 Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value
 This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)
 Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)
 This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
 The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC
 This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-04-11 A

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lw - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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COC Number: 2018-04-11 A

Page 1 of 2

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Report To						Contact and company name below will appear on the final report											
Company:						Minto Explorations Ltd.											
Contact:						Minto Environment - Coordinator											
Phone:						1-604-759-4659											
						Company address below will appear on the final report											
Street:						2100-510 West Georgia St.											
City/Province:						Vancouver, British Columbia											
Postal Code:						V6B 0M3											
Invoice To						Same as Report To ☐ YES ☒ NO											
						Copy of Invoice with Report ☐ YES ☒ NO											
Company:						Minto Explorations Ltd.											
Contact:						Ruth Cayetano											
Project Information						Oil and Gas Required Fields (client use)											
ALS Account # / Quote #:						AFE/Cost Center:				PO#							
Job #:						Major/Minor Code:				Routing Code:							
PO / AFE: 229096 (WUL)						Requisitioner:											
LSD:						Location:											
ALS Lab Work Order # (lab use only)						ALS Contact:		Shane Stack		Sampler:		CR/CH/EB					
ALS Sample # (lab use only)		Sample Identification and/or Coordinates (This description will appear on the report)				Date (dd-mmm-yy)		Time (hh:mm)		Sample Type							
		W12				9-Apr-18		8:50		Water							
		W14				9-Apr-18		9:00		Water							
		W15				9-Apr-18		9:35		Water							
		W35				9-Apr-18		10:05		Water							
		W62				9-Apr-18		16:35		Water							
		W16				9-Apr-18		14:50		Water							
		W3				10-Apr-18		8:05		Water							
		W17				10-Apr-18		8:27		Water							
		W8A				10-Apr-18		9:10		Water							
		W2				10-Apr-18		16:40		Water							
Drinking Water (DW) Samples¹ (client use)						Special instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)						SAMPLE CONDITION AS RECEIVED (lab use only)					
Are samples taken from a Regulated DW System? ☐ YES ☒ NO												Frozen ☐ SIF Observations Yes ☐ No ☐					
Are samples for human drinking water use? ☐ YES ☒ NO												Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐					
												Cooling Initiated ☐					
												INITIAL COOLER TEMPERATURES °C					
												FINAL COOLER TEMPERATURES °C					
SHIPMENT RELEASE (client use)						INITIAL SHIPMENT RECEPTION (lab use only)						FINAL SHIPMENT RECEPTION (lab use only)					
Released by: Corey Roberts		Date: 2018-04-11		Time:		Received by: [Signature]		Date: April 11/18		Time: 14:22		Received by:		Date:		Time:	

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

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L2078933-COFC

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DECEMBER 2015 FROM

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1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 18-APR-18
Report Date: 03-MAY-18 17:05 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2081840
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-04-18 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2081840-1 Water 14-APR-18 14:40 MC1	L2081840-2 Water 16-APR-18 13:40 C10	L2081840-3 Water 16-APR-18 14:50 C4	L2081840-4 Water 17-APR-18 07:40 W3	L2081840-5 Water 17-APR-18 13:25 W2
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	268	495	479	533	508
	Hardness (as CaCO3) (mg/L)	222	252	253	293	281
	pH (pH)	8.47	8.52	8.53	8.50	8.52
	Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0	<3.0	<3.0
	TDS (Calculated) (mg/L)	265	304	295	334	319
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	191	218	213	233	225
	Alkalinity, Carbonate (as CaCO3) (mg/L)	11.4	16.2	16.0	16.4	16.6
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	202	235	229	249	242
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Chloride (Cl) (mg/L)	3.54	3.88	3.94	5.38	3.93
	Nitrate and Nitrite (as N) (mg/L)	<0.0051	<0.0051	<0.0051	0.159	<0.0051
	Nitrate (as N) (mg/L)	<0.0050	<0.0050	<0.0050	0.159	<0.0050
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	45.7	52.1	47.9	58.0	51.8
	Anion Sum (meq/L)	5.09	5.88	5.69	6.35	6.02
	Cation Sum (meq/L)	5.26	5.96	5.93	6.77	6.57
	Cation - Anion Balance (%)	1.7	0.6	2.0	3.2	4.4
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	12.4	16.0	10.8	5.22	14.8
Total Metals	Aluminum (Al)-Total (mg/L)	0.0086	0.0116	0.0199	0.0185	0.0706
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00044	0.00055	0.00035	0.00027	0.00061
	Barium (Ba)-Total (mg/L)	0.0663	0.0785	0.0736	0.0741	0.0837
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	<0.010	<0.010	0.011	0.024	<0.010
	Cadmium (Cd)-Total (mg/L)	0.0000273	0.0000284	0.0000120	0.0000054	0.0000129
	Calcium (Ca)-Total (mg/L)	50.2	58.0	54.8	60.9	60.9
	Chromium (Cr)-Total (mg/L)	0.00022	0.00024	0.00027	<0.00010	0.00034
	Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	0.00014
	Copper (Cu)-Total (mg/L)	0.00500	0.00568	0.0108	0.00301	0.0112
	Iron (Fe)-Total (mg/L)	0.017	0.025	0.039	0.055	0.105
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	0.0030	0.0035	0.0030	0.0035	0.0035
	Magnesium (Mg)-Total (mg/L)	23.8	26.2	27.0	29.4	27.9
	Manganese (Mn)-Total (mg/L)	0.0119	0.0159	0.00789	0.0854	0.0276

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2081840-6 Water 17-APR-18 07:55 W17	L2081840-7 Water 17-APR-18 08:50 W8A	L2081840-8 Water 17-APR-18 13:40 MC1	L2081840-9 Water 16-APR-18 DUP	L2081840-10 Water 17-APR-18 DUP
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	522	686	508	489	524
	Hardness (as CaCO3) (mg/L)	284	587	284	259	305
	pH (pH)	8.47	8.26	8.54	8.46	8.54
	Total Suspended Solids (mg/L)	12.7	33.3	<3.0	<3.0	<3.0
	TDS (Calculated) (mg/L)	326	711	329	294	339
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	214	463	237	213	233
	Alkalinity, Carbonate (as CaCO3) (mg/L)	13.8	<1.0	18.2	12.0	18.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	228	463	255	225	251
	Ammonia, Total (as N) (mg/L)	0.0097	0.0757	0.0144	<0.0050	0.0124
	Chloride (Cl) (mg/L)	7.80	11.1	3.89	3.93	5.39
	Nitrate and Nitrite (as N) (mg/L)	0.115	4.15	<0.0051	<0.0051	0.154
	Nitrate (as N) (mg/L)	0.115	3.54	<0.0050	<0.0050	0.154
	Nitrite (as N) (mg/L)	<0.0010	0.611	<0.0010	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	60.6	153	51.7	47.9	58.0
	Anion Sum (meq/L)	6.05	13.0	6.28	5.61	6.38
	Cation Sum (meq/L)	6.50	13.5	6.63	6.03	7.01
	Cation - Anion Balance (%)	3.6	1.6	2.7	3.6	4.7
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	8.97		14.4	10.3	5.40
Total Metals	Aluminum (Al)-Total (mg/L)	0.0820	0.365	0.0127	0.0154	0.0172
	Antimony (Sb)-Total (mg/L)	0.00070	0.00033	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00252	0.00101	0.00055	0.00035	0.00025
	Barium (Ba)-Total (mg/L)	0.0913	0.152	0.0841	0.0728	0.0767
	Beryllium (Be)-Total (mg/L)	<0.000020	0.000029	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.026	0.031	<0.010	0.011	0.023
	Cadmium (Cd)-Total (mg/L)	0.0000276	0.000226	0.0000199	0.0000291	0.0000096
	Calcium (Ca)-Total (mg/L)	74.2	158	63.3	54.7	61.9
	Chromium (Cr)-Total (mg/L)	0.0213	0.00091	0.00026	0.00012	<0.00010
	Cobalt (Co)-Total (mg/L)	0.00034	0.00149	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Total (mg/L)	0.0634	0.201	0.00598	0.00655	0.00323
	Iron (Fe)-Total (mg/L)	1.37	1.74	0.026	0.024	0.053
	Lead (Pb)-Total (mg/L)	0.000349	0.000350	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	0.0015	0.0043	0.0034	0.0030	0.0035
	Magnesium (Mg)-Total (mg/L)	21.0	43.6	28.3	26.8	30.8
	Manganese (Mn)-Total (mg/L)	0.595	2.38	0.0133	0.00810	0.0904

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2081840-1 Water 14-APR-18 14:40 MC1	L2081840-2 Water 16-APR-18 13:40 C10	L2081840-3 Water 16-APR-18 14:50 C4	L2081840-4 Water 17-APR-18 07:40 W3	L2081840-5 Water 17-APR-18 13:25 W2
Grouping	Analyte						
WATER							
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Total (mg/L)	0.00113	0.00124	0.00185	0.00493	0.00133	
	Nickel (Ni)-Total (mg/L)	0.00053	0.00065	0.00052	0.00066	0.00084	
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050	
	Potassium (K)-Total (mg/L)	3.70	4.54	3.30	2.42	4.66	
	Selenium (Se)-Total (mg/L)	0.000363	0.000346	0.000362	0.000307	0.000340	
	Silicon (Si)-Total (mg/L)	8.32	9.58	8.24	6.41	9.86	
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	
	Sodium (Na)-Total (mg/L)	16.6	18.2	17.4	18.6	18.9	
	Strontium (Sr)-Total (mg/L)	0.538	0.606	0.676	0.828	0.636	
	Sulfur (S)-Total (mg/L)	16.8	18.9	17.5	20.9	19.3	
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Total (mg/L)	<0.00060 ^{DLM}	0.00033	<0.0012 ^{DLM}	0.00088	0.00277	
	Uranium (U)-Total (mg/L)	0.00159	0.00185	0.00216	0.00302	0.00185	
	Vanadium (V)-Total (mg/L)	<0.00050	<0.00050	0.00056	0.00052	0.00078	
	Zinc (Zn)-Total (mg/L)	<0.0030	0.0050	0.0063	<0.0030	<0.0030	
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0113	0.0107	0.0095	0.0021	0.0101	
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
	Arsenic (As)-Dissolved (mg/L)	0.00042	0.00055	0.00034	0.00024	0.00055	
	Barium (Ba)-Dissolved (mg/L)	0.0705	0.0819	0.0788	0.0779	0.0869	
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	<0.010	<0.010	<0.010	0.023	<0.010	
	Cadmium (Cd)-Dissolved (mg/L)	0.0000158	0.0000181	0.0000122	0.0000072	0.0000097	
	Calcium (Ca)-Dissolved (mg/L)	51.3	57.8	57.5	68.4	67.0	
	Chromium (Cr)-Dissolved (mg/L)	0.00019	0.00022	<0.00010	<0.00010	0.00023	
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
	Copper (Cu)-Dissolved (mg/L)	0.00542	0.00607	0.00611	0.00272	0.0101	
	Iron (Fe)-Dissolved (mg/L)	0.025	0.027	0.015	0.033	0.018	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.0028	0.0031	0.0031	0.0040	0.0041	
	Magnesium (Mg)-Dissolved (mg/L)	22.8	26.1	26.7	29.6	27.6	
	Manganese (Mn)-Dissolved (mg/L)	0.0121	0.0161	0.00745	0.0878	0.0251	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2081840-6 Water 17-APR-18 07:55 W17	L2081840-7 Water 17-APR-18 08:50 W8A	L2081840-8 Water 17-APR-18 13:40 MC1	L2081840-9 Water 16-APR-18 DUP	L2081840-10 Water 17-APR-18 DUP
Grouping	Analyte						
WATER							
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	0.0000098	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Total (mg/L)	0.0101	0.00824	0.00139	0.00184	0.00503	
	Nickel (Ni)-Total (mg/L)	0.00778	0.00201	0.00066	<0.00050	0.00122	
	Phosphorus (P)-Total (mg/L)	<0.050	0.084	<0.050	<0.050	<0.050	
	Potassium (K)-Total (mg/L)	3.50	6.13	4.43	3.31	2.51	
	Selenium (Se)-Total (mg/L)	0.000270	0.00611	0.000410	0.000297	0.000338	
	Silicon (Si)-Total (mg/L)	5.64	7.55	10.1	8.16	6.45	
	Silver (Ag)-Total (mg/L)	0.000013	0.000070	<0.000010	<0.000010	<0.000010	
	Sodium (Na)-Total (mg/L)	15.5	34.9	19.2	17.4	19.6	
	Strontium (Sr)-Total (mg/L)	0.697	2.01	0.692	0.692	0.854	
	Sulfur (S)-Total (mg/L)	22.4	63.2	19.0	17.2	22.0	
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	
	Tin (Sn)-Total (mg/L)	0.00140	<0.00010	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Total (mg/L)	0.00562	0.0221	<0.00060 ^{DLM}	<0.00090 ^{DLM}	0.00083	
	Uranium (U)-Total (mg/L)	0.00305	0.00363	0.00190	0.00220	0.00315	
	Vanadium (V)-Total (mg/L)	0.00177	0.00296	<0.00050	<0.00050	<0.00050	
	Zinc (Zn)-Total (mg/L)	0.0155	0.226	0.0045	<0.0030	<0.0030	
	Zirconium (Zr)-Total (mg/L)	<0.00030	0.00047	<0.00030	<0.00030	<0.00030	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0057	0.0063	0.0076	0.0084	0.0028	
	Antimony (Sb)-Dissolved (mg/L)	0.00056	0.00017	<0.00010	<0.00010	<0.00010	
	Arsenic (As)-Dissolved (mg/L)	0.00216	0.00071	0.00051	0.00034	0.00022	
	Barium (Ba)-Dissolved (mg/L)	0.0903	0.145	0.0859	0.0763	0.0767	
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	0.026	0.030	<0.010	<0.010	0.024	
	Cadmium (Cd)-Dissolved (mg/L)	0.0000200	0.000169	0.0000166	0.0000155	0.0000091	
	Calcium (Ca)-Dissolved (mg/L)	79.5	168	68.4	59.4	72.8	
	Chromium (Cr)-Dissolved (mg/L)	0.00011	0.00039	0.00021	<0.00010	<0.00010	
	Cobalt (Co)-Dissolved (mg/L)	0.00027	0.00132	<0.00010	<0.00010	<0.00010	
	Copper (Cu)-Dissolved (mg/L)	0.0371	0.0805	0.00567	0.00584	0.00277	
	Iron (Fe)-Dissolved (mg/L)	0.110	0.109	0.018	0.015	0.034	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.0014	0.0042	0.0037	0.0032	0.0049	
	Magnesium (Mg)-Dissolved (mg/L)	20.9	40.7	27.5	26.8	29.9	
	Manganese (Mn)-Dissolved (mg/L)	0.540	2.18	0.0123	0.00733	0.0880	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2081840-1 Water 14-APR-18 14:40 MC1	L2081840-2 Water 16-APR-18 13:40 C10	L2081840-3 Water 16-APR-18 14:50 C4	L2081840-4 Water 17-APR-18 07:40 W3	L2081840-5 Water 17-APR-18 13:25 W2
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00105	0.00119	0.00174	0.00485	0.00127
	Nickel (Ni)-Dissolved (mg/L)	0.00052	0.00070	0.00050	0.00072	0.00072
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	3.77	4.58	3.40	2.56	4.70
	Selenium (Se)-Dissolved (mg/L)	0.000335	0.000294	0.000331	0.000262	0.000285
	Silicon (Si)-Dissolved (mg/L)	8.34	9.16	8.09	6.29	9.51
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	16.6	18.6	17.9	19.6	19.1
	Strontium (Sr)-Dissolved (mg/L)	0.550	0.618	0.704	0.853	0.666
	Sulfur (S)-Dissolved (mg/L)	14.8	16.6	15.2	18.6	16.8
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00070	<0.00060 ^{DLM}	<0.00030	<0.00030	0.00045
	Uranium (U)-Dissolved (mg/L)	0.00178	0.00203	0.00245	0.00346	0.00208
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0023	0.0024	0.0020	0.0015	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2081840-6 Water 17-APR-18 07:55 W17	L2081840-7 Water 17-APR-18 08:50 W8A	L2081840-8 Water 17-APR-18 13:40 MC1	L2081840-9 Water 16-APR-18 DUP	L2081840-10 Water 17-APR-18 DUP
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	0.0000058	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.0103	0.00828	0.00130	0.00177	0.00489
	Nickel (Ni)-Dissolved (mg/L)	0.00727	0.00171	0.00062	<0.00050	0.00073
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	3.56	5.98	4.57	3.36	2.48
	Selenium (Se)-Dissolved (mg/L)	0.000219	0.00573	0.000420	0.000386	0.000296
	Silicon (Si)-Dissolved (mg/L)	5.48	7.08	10.0	8.03	6.32
	Silver (Ag)-Dissolved (mg/L)	<0.000010	0.000038	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	16.0	34.3	19.3	17.8	19.4
	Strontium (Sr)-Dissolved (mg/L)	0.713	2.05	0.688	0.703	0.862
	Sulfur (S)-Dissolved (mg/L)	19.8	56.5	17.3	15.5	19.5
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	0.00038	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	0.00046	<0.00030	0.00035	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00289	0.00397	0.00209	0.00244	0.00339
	Vanadium (V)-Dissolved (mg/L)	<0.00050	0.00088	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0073	0.188	0.0023	0.0014	0.0015
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	0.00043	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Alkalinity, Total (as CaCO ₃)	B	L2081840-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Dissolved Organic Carbon	MS-B	L2081840-1, -2, -3
Matrix Spike	Dissolved Organic Carbon	MS-B	L2081840-10, -4, -5, -6, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2081840-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2081840-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2081840-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2081840-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2081840-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Total	MS-B	L2081840-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L2081840-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2081840-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Total	MS-B	L2081840-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Potassium (K)-Total	MS-B	L2081840-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Total	MS-B	L2081840-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L2081840-1, -10, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction			

Reference Information

with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)
 Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E
 Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)
 Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)
 Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
 This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)
 Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)
 Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value
 This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)
 Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)
 This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
 The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-MAN-WR Water Total Suspended Solids by Gravimetric APHA 2540 D
 This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids are determined by filtering a sample through a glass fibre filter and drying the filter at 104 degrees celsius.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-04-18 A

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lw - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

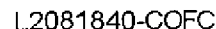
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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COC Number: 2018-04-18 A

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REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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OCTOBER 2015 FROM

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 26-APR-18
Report Date: 08-MAY-18 18:26 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2085355
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-04-25 A
Legal Site Desc:

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2085355-1 Water 24-APR-18 08:40 W8A	L2085355-2 Water 24-APR-18 09:20 W3	L2085355-3 Water 24-APR-18 09:45 W17	L2085355-4 Water 24-APR-18 14:00 MC1	L2085355-5 Water 24-APR-18 14:15 W2
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	912	541	544	279	262
	Hardness (as CaCO3) (mg/L)	446	253	268	136	131
	pH (pH)	8.34	8.49	8.49	8.19	8.17
	Total Suspended Solids (mg/L)	91.3	<3.0	37.3	<3.0	181
	TDS (Calculated) (mg/L)	618	313	324	160	156
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	245	229	223	129	128
	Alkalinity, Carbonate (as CaCO3) (mg/L)	7.6	17.2	16.2	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	252	247	239	129	128
	Ammonia, Total (as N) (mg/L)	0.0767	0.0099	0.0120	0.0082	0.0103
	Chloride (Cl) (mg/L)	7.1	5.12	7.72	1.79	1.83
	Nitrate and Nitrite (as N) (mg/L)	17.1	0.140	0.0710	<0.0051	<0.0051
	Nitrate (as N) (mg/L)	16.9	0.140	0.0710	<0.0050	<0.0050
	Nitrite (as N) (mg/L)	0.110	<0.0010	<0.0010	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	194	56.5	59.6	22.6	22.0
	Anion Sum (meq/L)	10.5	6.26	6.25	3.11	3.07
	Cation Sum (meq/L)	10.2	5.85	6.14	3.18	3.07
	Cation - Anion Balance (%)	-1.5	-3.4	-0.9	1.2	0.0
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)		5.75	9.01	16.9	17.5
Total Metals	Aluminum (Al)-Total (mg/L)	1.49	0.0175	0.0289	0.0124	8.14
	Antimony (Sb)-Total (mg/L)	0.00048	<0.00010	<0.00010	<0.00010	0.00022
	Arsenic (As)-Total (mg/L)	0.00124	0.00027	0.00043	0.00034	0.00250
	Barium (Ba)-Total (mg/L)	0.150	0.0793	0.0838	0.0445	0.159
	Beryllium (Be)-Total (mg/L)	0.000064	<0.000020	<0.000020	<0.000020	0.000132
	Bismuth (Bi)-Total (mg/L)	0.000057	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.024	0.023	0.024	<0.010	<0.010
	Cadmium (Cd)-Total (mg/L)	0.000281	0.0000088	0.0000063	0.0000177	0.0000647
	Calcium (Ca)-Total (mg/L)	127	56.7	67.8	29.7	32.9
	Chromium (Cr)-Total (mg/L)	0.00199	0.00010	0.00030	0.00020	0.0104
	Cobalt (Co)-Total (mg/L)	0.00161	<0.00010	<0.00010	<0.00010	0.00280
	Copper (Cu)-Total (mg/L)	0.431	0.00435	0.0203	0.00990	0.0661
	Iron (Fe)-Total (mg/L)	4.47	0.054	0.087	0.029	5.88
	Lead (Pb)-Total (mg/L)	0.000950	<0.000050	0.000127	<0.000050	0.00158
	Lithium (Li)-Total (mg/L)	0.0033	0.0027	0.0013	0.0012	0.0048
	Magnesium (Mg)-Total (mg/L)	30.8	29.8	23.1	14.0	15.2
	Manganese (Mn)-Total (mg/L)	0.979	0.0860	0.0944	0.0129	0.176

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2085355-6 Water 24-APR-18 DUP				
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	520				
	Hardness (as CaCO3) (mg/L)	269				
	pH (pH)	8.25				
	Total Suspended Solids (mg/L)	4.0				
	TDS (Calculated) (mg/L)	308				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	214				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Total (as CaCO3) (mg/L)	214				
	Ammonia, Total (as N) (mg/L)	0.0153				
	Chloride (Cl) (mg/L)	7.67				
	Nitrate and Nitrite (as N) (mg/L)	0.0726				
	Nitrate (as N) (mg/L)	0.0726				
	Nitrite (as N) (mg/L)	<0.0010				
	Sulfate (SO4) (mg/L)	59.4				
	Anion Sum (meq/L)	5.73				
	Cation Sum (meq/L)	6.13				
	Cation - Anion Balance (%)	3.4				
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	9.35				
Total Metals	Aluminum (Al)-Total (mg/L)	0.162				
	Antimony (Sb)-Total (mg/L)	<0.00010				
	Arsenic (As)-Total (mg/L)	0.00059				
	Barium (Ba)-Total (mg/L)	0.0921				
	Beryllium (Be)-Total (mg/L)	<0.000020				
	Bismuth (Bi)-Total (mg/L)	<0.000050				
	Boron (B)-Total (mg/L)	0.024				
	Cadmium (Cd)-Total (mg/L)	0.0000194				
	Calcium (Ca)-Total (mg/L)	69.0				
	Chromium (Cr)-Total (mg/L)	0.00025				
	Cobalt (Co)-Total (mg/L)	0.00029				
	Copper (Cu)-Total (mg/L)	0.0358				
	Iron (Fe)-Total (mg/L)	0.965				
	Lead (Pb)-Total (mg/L)	0.000845				
	Lithium (Li)-Total (mg/L)	0.0015				
	Magnesium (Mg)-Total (mg/L)	22.7				
	Manganese (Mn)-Total (mg/L)	0.369				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2085355-1 Water 24-APR-18 08:40 W8A	L2085355-2 Water 24-APR-18 09:20 W3	L2085355-3 Water 24-APR-18 09:45 W17	L2085355-4 Water 24-APR-18 14:00 MC1	L2085355-5 Water 24-APR-18 14:15 W2
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	0.0000100	<0.0000050	<0.0000050	<0.0000050	0.0000170
	Molybdenum (Mo)-Total (mg/L)	0.00877	0.00488	0.00649	0.000949	0.00103
	Nickel (Ni)-Total (mg/L)	0.00278	0.00073	0.00097	0.00052	0.00662
	Phosphorus (P)-Total (mg/L)	0.180	<0.050	<0.050	<0.050	0.192
	Potassium (K)-Total (mg/L)	5.51	2.69	3.96	2.84	6.71
	Selenium (Se)-Total (mg/L)	0.00669	0.000227	0.000358	0.000163	0.000283
	Silicon (Si)-Total (mg/L)	8.37	6.29	5.78	5.12	23.3
	Silver (Ag)-Total (mg/L)	0.000156	<0.000010	<0.000010	<0.000010	0.000049
	Sodium (Na)-Total (mg/L)	26.2	18.9	15.9	9.66	10.5
	Strontium (Sr)-Total (mg/L)	1.51	0.849	0.863	0.359	0.368
	Sulfur (S)-Total (mg/L)	67.0	19.9	21.0	7.94	8.08
	Thallium (Tl)-Total (mg/L)	0.000020	<0.000010	<0.000010	<0.000010	0.000047
	Tin (Sn)-Total (mg/L)	0.00014	<0.00010	<0.00010	<0.00010	0.00017
	Titanium (Ti)-Total (mg/L)	0.0773	<0.00090 ^{DLM}	0.00162	0.00048	0.446
	Uranium (U)-Total (mg/L)	0.00225	0.00285	0.00267	0.000760	0.00100
	Vanadium (V)-Total (mg/L)	0.00736	<0.00050	0.00059	<0.00050	0.0212
	Zinc (Zn)-Total (mg/L)	0.331	<0.0030	0.0031	<0.0030	0.0176
	Zirconium (Zr)-Total (mg/L)	0.00050	<0.00030	<0.00030	<0.00030	0.00351
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0108	0.0022	0.0014	0.0066	0.0144
	Antimony (Sb)-Dissolved (mg/L)	0.00011	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00046	0.00022	0.00035	0.00031	0.00034
	Barium (Ba)-Dissolved (mg/L)	0.102	0.0713	0.0741	0.0405	0.0416
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.023	0.022	0.023	<0.010	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	0.000226	0.0000056	<0.0000050	0.0000130	0.0000145
	Calcium (Ca)-Dissolved (mg/L)	129	55.0	70.9	32.3	31.0
	Chromium (Cr)-Dissolved (mg/L)	0.00021	<0.00010	<0.00010	0.00013	0.00017
	Cobalt (Co)-Dissolved (mg/L)	0.00073	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.0824	0.00349	0.00970	0.00783	0.00975
	Iron (Fe)-Dissolved (mg/L)	0.078	0.035	0.022	0.021	0.039
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0027	0.0028	0.0014	0.0016	0.0016
	Magnesium (Mg)-Dissolved (mg/L)	29.8	28.0	22.1	13.5	12.9
	Manganese (Mn)-Dissolved (mg/L)	0.922	0.0788	0.0692	0.0112	0.0186

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID				
		L2085355-6 Water 24-APR-18 DUP				
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050				
	Molybdenum (Mo)-Total (mg/L)	0.00628				
	Nickel (Ni)-Total (mg/L)	0.00121				
	Phosphorus (P)-Total (mg/L)	<0.050				
	Potassium (K)-Total (mg/L)	4.24				
	Selenium (Se)-Total (mg/L)	0.000315				
	Silicon (Si)-Total (mg/L)	6.01				
	Silver (Ag)-Total (mg/L)	0.000014				
	Sodium (Na)-Total (mg/L)	16.0				
	Strontium (Sr)-Total (mg/L)	0.817				
	Sulfur (S)-Total (mg/L)	20.9				
	Thallium (Tl)-Total (mg/L)	<0.000010				
	Tin (Sn)-Total (mg/L)	0.00014				
	Titanium (Ti)-Total (mg/L)	0.00850				
	Uranium (U)-Total (mg/L)	0.00267				
	Vanadium (V)-Total (mg/L)	0.00120				
	Zinc (Zn)-Total (mg/L)	0.0159				
	Zirconium (Zr)-Total (mg/L)	<0.00030				
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD				
	Dissolved Metals Filtration Location	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	0.0019				
	Antimony (Sb)-Dissolved (mg/L)	<0.00010				
	Arsenic (As)-Dissolved (mg/L)	0.00035				
	Barium (Ba)-Dissolved (mg/L)	0.0743				
	Beryllium (Be)-Dissolved (mg/L)	<0.000020				
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050				
	Boron (B)-Dissolved (mg/L)	0.024				
	Cadmium (Cd)-Dissolved (mg/L)	0.0000056				
	Calcium (Ca)-Dissolved (mg/L)	72.3				
	Chromium (Cr)-Dissolved (mg/L)	<0.00010				
	Cobalt (Co)-Dissolved (mg/L)	<0.00010				
	Copper (Cu)-Dissolved (mg/L)	0.00998				
	Iron (Fe)-Dissolved (mg/L)	0.031				
	Lead (Pb)-Dissolved (mg/L)	<0.000050				
	Lithium (Li)-Dissolved (mg/L)	0.0015				
	Magnesium (Mg)-Dissolved (mg/L)	21.6				
	Manganese (Mn)-Dissolved (mg/L)	0.0840				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2085355-1 Water 24-APR-18 08:40 W8A	L2085355-2 Water 24-APR-18 09:20 W3	L2085355-3 Water 24-APR-18 09:45 W17	L2085355-4 Water 24-APR-18 14:00 MC1	L2085355-5 Water 24-APR-18 14:15 W2
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00837	0.00429	0.00536	0.000856	0.000767
	Nickel (Ni)-Dissolved (mg/L)	0.00100	0.00066	0.00083	<0.00050	0.00056
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	4.90	2.61	4.17	2.85	2.95
	Selenium (Se)-Dissolved (mg/L)	0.00606	0.000254	0.000309	0.000196	0.000182
	Silicon (Si)-Dissolved (mg/L)	5.30	5.62	5.32	4.75	4.84
	Silver (Ag)-Dissolved (mg/L)	0.000013 ^{RRV}	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	25.1	16.7	15.3	8.91	8.68
	Strontium (Sr)-Dissolved (mg/L)	1.47	0.754	0.788	0.333	0.317
	Sulfur (S)-Dissolved (mg/L)	65.6	17.4	18.4	7.02	7.03
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00054	<0.00030	<0.00030	<0.00030	0.00114
	Uranium (U)-Dissolved (mg/L)	0.00250	0.00294	0.00280	0.000867	0.000878
	Vanadium (V)-Dissolved (mg/L)	0.00055	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.121	<0.0010	0.0018	0.0022	0.0013
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2085355-6 Water 24-APR-18 DUP				
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050				
	Molybdenum (Mo)-Dissolved (mg/L)	0.00560				
	Nickel (Ni)-Dissolved (mg/L)	0.00081				
	Phosphorus (P)-Dissolved (mg/L)	<0.050				
	Potassium (K)-Dissolved (mg/L)	3.90				
	Selenium (Se)-Dissolved (mg/L)	0.000323				
	Silicon (Si)-Dissolved (mg/L)	5.39				
	Silver (Ag)-Dissolved (mg/L)	<0.000010				
	Sodium (Na)-Dissolved (mg/L)	14.7				
	Strontium (Sr)-Dissolved (mg/L)	0.756				
	Sulfur (S)-Dissolved (mg/L)	19.1				
	Thallium (Tl)-Dissolved (mg/L)	<0.000010				
	Tin (Sn)-Dissolved (mg/L)	0.00019				
	Titanium (Ti)-Dissolved (mg/L)	<0.00030				
	Uranium (U)-Dissolved (mg/L)	0.00285				
	Vanadium (V)-Dissolved (mg/L)	<0.00050				
	Zinc (Zn)-Dissolved (mg/L)	0.0029				
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2085355-1, -2, -3, -4, -5, -6
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2085355-1, -2, -3, -4, -5, -6
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2085355-1, -2, -3, -4, -5, -6
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2085355-1, -2, -3, -4, -5, -6
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2085355-1, -2, -3, -4, -5, -6
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2085355-1, -2, -3, -4, -5, -6
Matrix Spike	Barium (Ba)-Total	MS-B	L2085355-1, -2, -3, -4, -5, -6
Matrix Spike	Calcium (Ca)-Total	MS-B	L2085355-1, -2, -3, -4, -5, -6
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2085355-1, -2, -3, -4, -5, -6
Matrix Spike	Manganese (Mn)-Total	MS-B	L2085355-1, -2, -3, -4, -5, -6
Matrix Spike	Sodium (Na)-Total	MS-B	L2085355-1, -2, -3, -4, -5, -6
Matrix Spike	Strontium (Sr)-Total	MS-B	L2085355-1, -2, -3, -4, -5, -6
Matrix Spike	Sulfur (S)-Total	MS-B	L2085355-1, -2, -3, -4, -5, -6
Matrix Spike	Nitrate (as N)	MS-B	L2085355-1, -2, -3, -4, -5, -6

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)

Reference Information

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-MAN-WR Water Total Suspended Solids by Gravimetric APHA 2540 D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids are determined by filtering a sample through a glass fibre filter and drying the filter at 104 degrees celsius.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-04-25 A

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lw - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

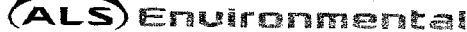
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



OCTOBER 2015 FRONT



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 02-MAY-18
Report Date: 10-MAY-18 17:59 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2088282
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-05-02 A
Legal Site Desc:

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2088282-1 Water 30-APR-18 10:25 MN-0.2	L2088282-2 Water 30-APR-18 13:50 MN-0.5	L2088282-3 Water 30-APR-18 14:30 MN-2.5	L2088282-4 Water 01-MAY-18 08:35 W3	L2088282-5 Water 01-MAY-18 08:50 W17
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	82.5	132	109	332	524
	Hardness (as CaCO3) (mg/L)	39.1	69.3	57.2	172	253
	pH (pH)	7.20	7.86	7.82	8.28	8.52
	Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0	<3.0	4.3
	TDS (Calculated) (mg/L)	45.5	72.4	60.0	191	308
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	20.7	56.4	50.7	146	213
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	16.4
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	20.7	56.4	50.7	146	230
	Ammonia, Total (as N) (mg/L)	0.0088	<0.0050	0.0093	0.0148	0.0089
	Chloride (Cl) (mg/L)	0.78	0.68	1.26	2.81	7.08
	Nitrate and Nitrite (as N) (mg/L)	<0.0051	<0.0051	<0.0051	0.0649	0.0471
	Nitrate (as N) (mg/L)	<0.0050	<0.0050	<0.0050	0.0649	0.0471
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	13.0	7.88	2.74	30.2	56.2
	Anion Sum (meq/L)	0.71	1.31	1.11	3.63	5.97
	Cation Sum (meq/L)	1.00	1.59	1.35	3.99	5.79
	Cation - Anion Balance (%)	17.4	9.7	9.9	4.8	-1.5
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	41.1	33.3	29.8	39.2	8.93
Total Metals	Aluminum (Al)-Total (mg/L)	0.111	0.0480	0.0550	0.111	0.0249
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00029	0.00032	0.00047	0.00048	0.00047
	Barium (Ba)-Total (mg/L)	0.0305	0.0341	0.0252	0.0567	0.0882
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	<0.010	<0.010	<0.010	0.016	0.025
	Cadmium (Cd)-Total (mg/L)	0.0000177	0.0000164	0.0000125	0.0000238	0.0000103
	Calcium (Ca)-Total (mg/L)	9.76	19.3	14.7	38.6	70.8
	Chromium (Cr)-Total (mg/L)	0.00029	0.00026	0.00029	0.00054	0.00015
	Cobalt (Co)-Total (mg/L)	0.00011	<0.00010	<0.00010	0.00013	0.00017
	Copper (Cu)-Total (mg/L)	0.0115	0.00551	0.00329	0.0324	0.0151
	Iron (Fe)-Total (mg/L)	0.184	0.103	0.119	0.186	1.52
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	0.000274
	Lithium (Li)-Total (mg/L)	<0.0010	<0.0010	<0.0010	0.0023	0.0018
	Magnesium (Mg)-Total (mg/L)	3.84	5.09	4.93	19.0	23.1
	Manganese (Mn)-Total (mg/L)	0.0102	0.0138	0.00837	0.0742	0.260

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2088282-6 Water 01-MAY-18 14:35 W2	L2088282-7 Water 01-MAY-18 15:00 MC1	L2088282-8 Water 01-MAY-18 DUP	L2088282-9 Water 30-APR-18 DUP		
Grouping	Analyte						
WATER							
Physical Tests	Conductivity (uS/cm)	110	103	110	109		
	Hardness (as CaCO3) (mg/L)	61.8	57.7	63.0	55.4		
	pH (pH)	7.70	7.68	7.73	7.81		
	Total Suspended Solids (mg/L)	40.3	3.1	90.9	<3.0		
	TDS (Calculated) (mg/L)	61.8	57.8	62.5	58.7		
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	48.9	44.6	49.2	50.0		
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0		
	Alkalinity, Total (as CaCO3) (mg/L)	48.9	44.6	49.2	50.0		
	Ammonia, Total (as N) (mg/L)	0.0162	0.0122	0.0150	0.0093		
	Chloride (Cl) (mg/L)	0.99	0.98	0.98	1.27		
	Nitrate and Nitrite (as N) (mg/L)	<0.0051	<0.0051	<0.0051	<0.0051		
	Nitrate (as N) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050		
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010		
	Sulfate (SO4) (mg/L)	4.70	5.11	4.70	2.75		
	Anion Sum (meq/L)	1.10	1.03	1.11	1.09		
	Cation Sum (meq/L)	1.44	1.35	1.46	1.31		
	Cation - Anion Balance (%)	13.1	13.6	13.7	9.1		
	Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	41.3	39.7	41.8	29.9	
	Total Metals	Aluminum (Al)-Total (mg/L)	2.59	0.0894	3.22	0.0441	
Antimony (Sb)-Total (mg/L)		0.00011	<0.00010	0.00013	<0.00010		
Arsenic (As)-Total (mg/L)		0.00157	0.00043	0.00181	0.00040		
Barium (Ba)-Total (mg/L)		0.0815	0.0307	0.0864	0.0252		
Beryllium (Be)-Total (mg/L)		0.000079	<0.000020	0.000095	<0.000020		
Bismuth (Bi)-Total (mg/L)		<0.000050	<0.000050	<0.000050	<0.000050		
Boron (B)-Total (mg/L)		<0.010	<0.010	<0.010	<0.010		
Cadmium (Cd)-Total (mg/L)		0.0000597	0.0000247	0.0000725	0.0000127		
Calcium (Ca)-Total (mg/L)		19.9	15.6	19.9	16.0		
Chromium (Cr)-Total (mg/L)		0.00438	0.00043	0.00514	0.00026		
Cobalt (Co)-Total (mg/L)		0.00179	0.00012	0.00214	<0.00010		
Copper (Cu)-Total (mg/L)		0.0444	0.0163	0.0489	0.00300		
Iron (Fe)-Total (mg/L)		3.55	0.138	4.24	0.103		
Lead (Pb)-Total (mg/L)		0.000959	<0.000050	0.00112	<0.000050		
Lithium (Li)-Total (mg/L)		0.0025	<0.0010	0.0028	<0.0010		
Magnesium (Mg)-Total (mg/L)		6.26	5.22	6.50	5.05		
Manganese (Mn)-Total (mg/L)		0.162	0.0220	0.177	0.00771		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID	L2088282-1	L2088282-2	L2088282-3	L2088282-4	L2088282-5
		Description	Water	Water	Water	Water	Water
		Sampled Date	30-APR-18	30-APR-18	30-APR-18	01-MAY-18	01-MAY-18
		Sampled Time	10:25	13:50	14:30	08:35	08:50
		Client ID	MN-0.2	MN-0.5	MN-2.5	W3	W17
Grouping	Analyte						
WATER							
Total Metals	Mercury (Hg)-Total (mg/L)		0.0000118	0.0000089	0.0000103	0.0000091	<0.0000050
	Molybdenum (Mo)-Total (mg/L)		0.000147	0.000551	0.000330	0.00300	0.00661
	Nickel (Ni)-Total (mg/L)		0.00116	0.00101	0.00117	0.00220	0.00102
	Phosphorus (P)-Total (mg/L)		0.064	<0.050	0.070	0.060	<0.050
	Potassium (K)-Total (mg/L)		2.87	2.02	2.50	2.54	4.14
	Selenium (Se)-Total (mg/L)		<0.000050	0.000195	0.000086	0.000216	0.000361
	Silicon (Si)-Total (mg/L)		3.61	4.01	4.33	5.80	6.00
	Silver (Ag)-Total (mg/L)		<0.000010	<0.000010	<0.000010	0.000013	<0.000010
	Sodium (Na)-Total (mg/L)		3.28	3.48	3.43	11.5	16.3
	Strontium (Sr)-Total (mg/L)		0.0585	0.172	0.0704	0.515	0.858
	Sulfur (S)-Total (mg/L)		5.26	3.05	1.17	12.1	21.6
	Thallium (Tl)-Total (mg/L)		<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)		<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	^{DLM}	<0.0018	0.00112	0.00183	0.00328	<0.0012 ^{DLM}
	Uranium (U)-Total (mg/L)		0.000019	0.000156	0.000025	0.00141	0.00255
	Vanadium (V)-Total (mg/L)		<0.00050	<0.00050	<0.00050	0.00076	0.00063
	Zinc (Zn)-Total (mg/L)		0.0050	<0.0030	0.0048	<0.0030	0.0108
	Zirconium (Zr)-Total (mg/L)		<0.00030	<0.00030	<0.00030	0.00065	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location		FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location		FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)		0.0984	0.0334	0.0185	0.0657	0.0017
	Antimony (Sb)-Dissolved (mg/L)		<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)		0.00025	0.00030	0.00038	0.00042	0.00039
	Barium (Ba)-Dissolved (mg/L)		0.0289	0.0350	0.0240	0.0540	0.0843
	Beryllium (Be)-Dissolved (mg/L)		<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)		<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)		<0.010	<0.010	<0.010	0.014	0.023
	Cadmium (Cd)-Dissolved (mg/L)		0.0000137	0.0000146	0.0000130	0.0000141	0.0000072
	Calcium (Ca)-Dissolved (mg/L)		9.65	19.3	15.0	38.8	67.1
	Chromium (Cr)-Dissolved (mg/L)		0.00026	0.00021	0.00022	0.00042	<0.00010
	Cobalt (Co)-Dissolved (mg/L)		<0.00010	<0.00010	<0.00010	0.00011	0.00010
	Copper (Cu)-Dissolved (mg/L)		0.00842	0.00371	0.00263	0.0291	0.00900
	Iron (Fe)-Dissolved (mg/L)		0.158	0.084	0.063	0.135	0.047
	Lead (Pb)-Dissolved (mg/L)		<0.000050	<0.000050	<0.000050	<0.000050	0.000062
	Lithium (Li)-Dissolved (mg/L)		<0.0010	<0.0010	<0.0010	0.0020	0.0017
	Magnesium (Mg)-Dissolved (mg/L)		3.65	5.11	4.80	18.3	20.8
	Manganese (Mn)-Dissolved (mg/L)		0.00933	0.0124	0.00620	0.0684	0.131

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2088282-6 Water 01-MAY-18 14:35 W2	L2088282-7 Water 01-MAY-18 15:00 MC1	L2088282-8 Water 01-MAY-18 DUP	L2088282-9 Water 30-APR-18 DUP	
Grouping	Analyte						
WATER							
Total Metals	Mercury (Hg)-Total (mg/L)	0.0000196	0.0000101	0.0000154	0.0000088		
	Molybdenum (Mo)-Total (mg/L)	0.000458	0.000425	0.000477	0.000317		
	Nickel (Ni)-Total (mg/L)	0.00515	0.00141	0.00602	0.00123		
	Phosphorus (P)-Total (mg/L)	0.252	0.081	0.232	0.057		
	Potassium (K)-Total (mg/L)	2.45	1.89	2.51	2.53		
	Selenium (Se)-Total (mg/L)	0.000124	0.000061	0.000151	0.000077		
	Silicon (Si)-Total (mg/L)	7.85	3.48	8.84	4.33		
	Silver (Ag)-Total (mg/L)	0.000030	<0.000010	0.000038	<0.000010		
	Sodium (Na)-Total (mg/L)	3.80	3.45	3.70	3.30		
	Strontium (Sr)-Total (mg/L)	0.152	0.129	0.159	0.0700		
	Sulfur (S)-Total (mg/L)	2.43	2.00	2.22	1.11		
	Thallium (Tl)-Total (mg/L)	0.000020	<0.000010	0.000026	<0.000010		
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010		
	Titanium (Ti)-Total (mg/L)	0.0982	0.00144	0.121	0.00116		
	Uranium (U)-Total (mg/L)	0.000247	0.000133	0.000251	0.000025		
	Vanadium (V)-Total (mg/L)	0.00780	0.00058	0.00932	<0.00050		
	Zinc (Zn)-Total (mg/L)	0.0152	0.0037	0.0157	<0.0030		
	Zirconium (Zr)-Total (mg/L)	0.00084	0.00036	0.00100	<0.00030		
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD		
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD		
	Aluminum (Al)-Dissolved (mg/L)	0.0736	0.0678	0.0738	0.0177		
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	0.00010	<0.00010		
	Arsenic (As)-Dissolved (mg/L)	0.00044	0.00041	0.00048	0.00036		
	Barium (Ba)-Dissolved (mg/L)	0.0303	0.0275	0.0301	0.0244		
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020		
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050		
	Boron (B)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010		
	Cadmium (Cd)-Dissolved (mg/L)	0.0000141	0.0000138	0.0000216	0.0000100		
	Calcium (Ca)-Dissolved (mg/L)	16.7	15.0	17.2	14.1		
	Chromium (Cr)-Dissolved (mg/L)	0.00039	0.00036	0.00038	<0.00010		
	Cobalt (Co)-Dissolved (mg/L)	0.00016	0.00011	0.00015	<0.00010		
	Copper (Cu)-Dissolved (mg/L)	0.0134	0.0138	0.0137	0.00257		
	Iron (Fe)-Dissolved (mg/L)	0.126	0.107	0.129	0.060		
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050		
	Lithium (Li)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010		
	Magnesium (Mg)-Dissolved (mg/L)	4.87	4.92	4.87	4.94		
	Manganese (Mn)-Dissolved (mg/L)	0.0467	0.0155	0.0468	0.00589		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2088282-1 Water 30-APR-18 10:25 MN-0.2	L2088282-2 Water 30-APR-18 13:50 MN-0.5	L2088282-3 Water 30-APR-18 14:30 MN-2.5	L2088282-4 Water 01-MAY-18 08:35 W3	L2088282-5 Water 01-MAY-18 08:50 W17
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	0.0000104	0.0000070	0.0000068	0.0000084	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.000121	0.000479	0.000289	0.00264	0.00617
	Nickel (Ni)-Dissolved (mg/L)	0.00102	0.00088	0.00107	0.00199	0.00080
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	2.76	2.04	2.47	2.39	3.90
	Selenium (Se)-Dissolved (mg/L)	0.000069	0.000168	0.000090	0.000258	0.000331
	Silicon (Si)-Dissolved (mg/L)	3.12	3.67	4.04	4.98	5.46
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	2.99	3.35	3.15	10.9	14.3
	Strontium (Sr)-Dissolved (mg/L)	0.0551	0.166	0.0640	0.469	0.776
	Sulfur (S)-Dissolved (mg/L)	4.39	2.45	0.96	10.0	20.6
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00120	0.00079	0.00044	<0.0018 ^{DLM}	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.000032	0.000151	0.000022	0.00132	0.00252
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	0.00059	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0043	0.0026	0.0021	0.0023	0.0012
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	0.00062	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2088282-6 Water 01-MAY-18 14:35 W2	L2088282-7 Water 01-MAY-18 15:00 MC1	L2088282-8 Water 01-MAY-18 DUP	L2088282-9 Water 30-APR-18 DUP	
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	0.0000084	0.0000088	0.0000097	0.0000079	
	Molybdenum (Mo)-Dissolved (mg/L)	0.000403	0.000365	0.000374	0.000304	
	Nickel (Ni)-Dissolved (mg/L)	0.00151	0.00122	0.00133	0.00103	
	Phosphorus (P)-Dissolved (mg/L)	0.059	<0.050	<0.050	0.051	
	Potassium (K)-Dissolved (mg/L)	1.82	1.74	1.82	2.46	
	Selenium (Se)-Dissolved (mg/L)	0.000082	0.000082	0.000104	0.000129	
	Silicon (Si)-Dissolved (mg/L)	3.15	3.11	3.25	3.96	
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Sodium (Na)-Dissolved (mg/L)	3.10	3.10	3.14	3.11	
	Strontium (Sr)-Dissolved (mg/L)	0.119	0.117	0.121	0.0669	
	Sulfur (S)-Dissolved (mg/L)	1.82	1.67	2.04	1.18	
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Dissolved (mg/L)	0.00219	0.00114	0.00225	0.00040	
	Uranium (U)-Dissolved (mg/L)	0.000139	0.000112	0.000146	0.000021	
	Vanadium (V)-Dissolved (mg/L)	0.00061	0.00055	0.00060	<0.00050	
	Zinc (Zn)-Dissolved (mg/L)	0.0035	0.0029	0.0030	0.0018	
	Zirconium (Zr)-Dissolved (mg/L)	0.00044	0.00037	0.00041	<0.00030	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Laboratory Control Sample	Sulfur (S)-Dissolved	MES	L2088282-1, -2, -3, -4, -6, -7, -8
Matrix Spike	Dissolved Organic Carbon	MS-B	L2088282-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2088282-1, -2, -3, -4, -6, -7, -8
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2088282-1, -2, -3, -4, -6, -7, -8
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2088282-1, -2, -3, -4, -6, -7, -8
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2088282-1, -2, -3, -4, -6, -7, -8
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2088282-1, -2, -3, -4, -6, -7, -8
Matrix Spike	Barium (Ba)-Total	MS-B	L2088282-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Boron (B)-Total	MS-B	L2088282-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L2088282-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Cobalt (Co)-Total	MS-B	L2088282-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Iron (Fe)-Total	MS-B	L2088282-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Lithium (Li)-Total	MS-B	L2088282-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2088282-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Total	MS-B	L2088282-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Nickel (Ni)-Total	MS-B	L2088282-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Total	MS-B	L2088282-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L2088282-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sulfur (S)-Total	MS-B	L2088282-1, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Reference Information

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 µm), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
----------------------------	---------------------

VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
----	---

Reference Information

Chain of Custody Numbers:

2018-05-02 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lw - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

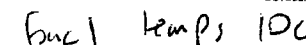
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.





Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 08-MAY-18
Report Date: 22-MAY-18 16:00 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2091095
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-05-08 A
Legal Site Desc:

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2091095-1 Water 07-MAY-18 15:10 W62	L2091095-2 Water 07-MAY-18 15:40 W35	L2091095-3 Water 07-MAY-18 16:05 W45	L2091095-4 Water 07-MAY-18 16:35 W15	L2091095-5 Water 07-MAY-18 DUP
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	1110	83.6	3190	211	3170
	Hardness (as CaCO3) (mg/L)	554	49.1	1410	106	1530
	pH (pH)	8.46	7.52	8.07	7.73	8.06
	Total Suspended Solids (mg/L)	35.3	56.3	38.5	8.3	33.5
	TDS (Calculated) (mg/L)	784	45.7	2680	126	2800
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	254	34.2	115	55.0	115
	Alkalinity, Carbonate (as CaCO3) (mg/L)	17.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	271	34.2	115	55.0	115
	Ammonia, Total (as N) (mg/L)	0.0230	0.0182	6.05	0.0304	5.97
	Chloride (Cl) (mg/L)	18.1	<0.50	34	0.90	36
	Nitrate and Nitrite (as N) (mg/L)	26.6	0.180	23.8	3.08	25.0
	Nitrate (as N) (mg/L)	26.5	0.179	19.2	3.00	20.2
	Nitrite (as N) (mg/L)	0.0786	0.0012	4.56	0.0784	4.81
	Sulfate (SO4) (mg/L)	255	3.37	1740	34.5	1800
	Anion Sum (meq/L)	13.1	0.77	41.1	2.06	42.5
	Cation Sum (meq/L)	12.6	1.11	36.9	2.38	39.7
	Cation - Anion Balance (%)	-2.3	18.5	-5.5	7.2	-3.4
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	11.2	41.8	81.3	47.7	80.9
Total Metals	Aluminum (Al)-Total (mg/L)	1.14	0.626	0.615	0.304	0.482
	Antimony (Sb)-Total (mg/L)	0.00019	<0.00010	0.00070	<0.00010	0.00066
	Arsenic (As)-Total (mg/L)	0.00127	0.00049	0.00054	0.00043	0.00048
	Barium (Ba)-Total (mg/L)	0.131	0.0444	0.151	0.0466	0.148
	Beryllium (Be)-Total (mg/L)	0.000058	0.000040	<0.000040 ^{DLA}	0.000027	<0.000040 ^{DLA}
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.00010 ^{DLA}	<0.000050	<0.00010 ^{DLA}
	Boron (B)-Total (mg/L)	0.036	<0.010	0.306	<0.010	0.303
	Cadmium (Cd)-Total (mg/L)	0.0000486	0.0000206	<0.00015 ^{DLM}	0.0000221	<0.00014 ^{DLM}
	Calcium (Ca)-Total (mg/L)	157	14.4	504	29.6	494
	Chromium (Cr)-Total (mg/L)	0.00188	0.00062	0.00055	0.00068	0.00055
	Cobalt (Co)-Total (mg/L)	0.00093	0.00048	0.00344	0.00058	0.00354
	Copper (Cu)-Total (mg/L)	0.0872	0.0923	0.304	0.0423	0.343
	Iron (Fe)-Total (mg/L)	1.89	1.19	1.55	0.542	1.27
	Lead (Pb)-Total (mg/L)	0.000724	0.000329	0.00064	0.000123	0.00050
	Lithium (Li)-Total (mg/L)	0.0045	<0.0010	0.0265	<0.0010	0.0261
	Magnesium (Mg)-Total (mg/L)	42.9	3.76	87.8	8.00	89.4
	Manganese (Mn)-Total (mg/L)	0.0767	0.0450	1.91	0.155	1.95

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2091095-1 Water 07-MAY-18 15:10 W62	L2091095-2 Water 07-MAY-18 15:40 W35	L2091095-3 Water 07-MAY-18 16:05 W45	L2091095-4 Water 07-MAY-18 16:35 W15	L2091095-5 Water 07-MAY-18 DUP
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	0.0000079	0.0000058	<0.0000050	0.0000092	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.0131	0.000480	0.109	0.00129	0.108
	Nickel (Ni)-Total (mg/L)	0.00258	0.00162	0.0058	0.00124	0.0058
	Phosphorus (P)-Total (mg/L)	0.067	0.077	<0.10 ^{DLA}	0.067	<0.10 ^{DLA}
	Potassium (K)-Total (mg/L)	6.14	1.62	70.2	2.56	70.8
	Selenium (Se)-Total (mg/L)	0.0118	0.000151	0.00934	0.00160	0.00953
	Silicon (Si)-Total (mg/L)	8.08	3.90	4.29	3.12	3.84
	Silver (Ag)-Total (mg/L)	0.000033	0.000025	0.000071	0.000012	0.000064
	Sodium (Na)-Total (mg/L)	30.4	1.91	181	3.96	183
	Strontium (Sr)-Total (mg/L)	2.06	0.0787	6.93	0.331	6.73
	Sulfur (S)-Total (mg/L)	86.2	1.89	646	13.5	649
	Thallium (Tl)-Total (mg/L)	0.000016	<0.000010	<0.000020 ^{DLA}	<0.000010	<0.000020 ^{DLA}
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00020 ^{DLA}	<0.00010	<0.00020 ^{DLA}
	Titanium (Ti)-Total (mg/L)	0.0489	0.0277	0.0383	0.00777	0.0309
	Uranium (U)-Total (mg/L)	0.00478	0.000046	0.00866	0.000554	0.00883
	Vanadium (V)-Total (mg/L)	0.00421	0.00272	0.0029	0.00134	0.0025
	Zinc (Zn)-Total (mg/L)	0.0308	0.0059	0.0099	0.0045	0.0069
	Zirconium (Zr)-Total (mg/L)	0.00057	<0.00030	<0.00030	0.00035	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0108	0.0554	0.0112	0.164	0.0131
	Antimony (Sb)-Dissolved (mg/L)	0.00010	<0.00010	0.00057	<0.00010	0.00058
	Arsenic (As)-Dissolved (mg/L)	0.00058	0.00028	0.00034	0.00033	0.00034
	Barium (Ba)-Dissolved (mg/L)	0.112	0.0318	0.123	0.0426	0.133
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000040 ^{DLA}	<0.000020	<0.000040 ^{DLA}
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.00010 ^{DLA}	<0.000050	<0.00010 ^{DLA}
	Boron (B)-Dissolved (mg/L)	0.035	<0.010	0.288	<0.010	0.295
	Cadmium (Cd)-Dissolved (mg/L)	0.0000192	0.0000070	<0.000055 ^{DLM}	0.0000151	<0.000055 ^{DLM}
	Calcium (Ca)-Dissolved (mg/L)	151	14.1	442	29.7	482
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00025	<0.00020 ^{DLA}	0.00027	<0.00020 ^{DLA}
	Cobalt (Co)-Dissolved (mg/L)	0.00014	<0.00010	0.00259	0.00045	0.00275
	Copper (Cu)-Dissolved (mg/L)	0.0428	0.0251	0.00544	0.0336	0.00571
	Iron (Fe)-Dissolved (mg/L)	0.027	0.124	0.085	0.269	0.027
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.00010 ^{DLA}	0.000071	<0.00010 ^{DLA}
	Lithium (Li)-Dissolved (mg/L)	0.0042	<0.0010	0.0274	<0.0010	0.0287
	Magnesium (Mg)-Dissolved (mg/L)	43.2	3.38	74.2	7.69	79.6
	Manganese (Mn)-Dissolved (mg/L)	0.0332	0.00936	1.65	0.151	1.77

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2091095-1 Water 07-MAY-18 15:10 W62	L2091095-2 Water 07-MAY-18 15:40 W35	L2091095-3 Water 07-MAY-18 16:05 W45	L2091095-4 Water 07-MAY-18 16:35 W15	L2091095-5 Water 07-MAY-18 DUP
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	0.0000063	0.0000107	<0.0000050	0.0000122	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.0138	0.000378	0.0986	0.00130	0.105
	Nickel (Ni)-Dissolved (mg/L)	0.00074	0.00123	0.0045 ^{DLA}	0.00092	0.0044 ^{DLA}
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.10 ^{DLA}	<0.050	<0.10 ^{DLA}
	Potassium (K)-Dissolved (mg/L)	6.28	1.45	59.3	2.59	65.5
	Selenium (Se)-Dissolved (mg/L)	0.0115	0.000102	0.00766	0.00135	0.00791
	Silicon (Si)-Dissolved (mg/L)	5.59	2.67	2.66 ^{DLA}	2.64	2.78 ^{DLA}
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000020	<0.000010	<0.000020 ^{DLA}
	Sodium (Na)-Dissolved (mg/L)	30.2	1.85	154	3.74	160
	Strontium (Sr)-Dissolved (mg/L)	1.95	0.0722	5.75	0.323	6.31
	Sulfur (S)-Dissolved (mg/L)	82.9	1.07	590	11.2	645 ^{DLA}
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000020 ^{DLA}	<0.000010	<0.000020 ^{DLA}
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010 ^{DLM}	<0.00020 ^{DLA}	<0.00010	<0.00020 ^{DLA}
	Titanium (Ti)-Dissolved (mg/L)	0.00143	<0.0012	<0.00060 ^{DLA}	0.00335	<0.00060 ^{DLA}
	Uranium (U)-Dissolved (mg/L)	0.00437	0.000030	0.00754 ^{DLA}	0.000482	0.00779 ^{DLA}
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.0010	0.00067	<0.0010 ^{DLA}
	Zinc (Zn)-Dissolved (mg/L)	0.0138	0.0014	0.0044	0.0033	0.0032
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	0.00033	<0.00030	0.00045	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Dissolved Organic Carbon	MS-B	L2091095-1, -2, -3, -4, -5
Matrix Spike	Dissolved Organic Carbon	MS-B	L2091095-1, -2, -3, -4, -5
Matrix Spike	Aluminum (Al)-Total	MS-B	L2091095-1, -2, -3, -4, -5
Matrix Spike	Barium (Ba)-Total	MS-B	L2091095-1, -2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Total	MS-B	L2091095-1, -2, -3, -4, -5
Matrix Spike	Copper (Cu)-Total	MS-B	L2091095-1, -2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2091095-1, -2, -3, -4, -5
Matrix Spike	Manganese (Mn)-Total	MS-B	L2091095-1, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Total	MS-B	L2091095-1, -2, -3, -4, -5

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			

Reference Information

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
----------------------------	---------------------

VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
----	---

Chain of Custody Numbers:

2018-05-08 A

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lw - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.





Minto Explorations Ltd.
ATTN: Minto Environment
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Vancouver BC V6B 0M3

Date Received: 09-MAY-18
Report Date: 22-MAY-18 19:22 (MT)
Version: FINAL

Client Phone: 604-759-0860

Certificate of Analysis

Lab Work Order #: L2091932
Project P.O. #: 229096 (WUL)
Job Reference:
C of C Numbers: 2018-05 09 A
Legal Site Desc:

Shane Stack
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2091932-1 Water 08-MAY-18 08:30 W3	L2091932-2 Water 08-MAY-18 09:20 W17	L2091932-3 Water 08-MAY-18 10:00 W8A	L2091932-4 Water 08-MAY-18 10:55 W12	L2091932-5 Water 08-MAY-18 14:55 MC1
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	361	521	1140	1900	123
	Hardness (as CaCO3) (mg/L)	192	262	583	942	66.8
	pH (pH)	8.20	8.36	8.16	8.07	7.75
	Total Suspended Solids (mg/L)	<3.0	87.0	42.8	42.8	4.2
	Total Dissolved Solids (mg/L)	278	333	866	1550	159
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	149	209	325	138	52.4
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	4.4	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Phenolphthalein (as CaCO3) (mg/L)	<2.0	2.2	<2.0	<2.0	<2.0
	Alkalinity, Total (as CaCO3) (mg/L)	149	213	325	138	52.4
	Ammonia, Total (as N) (mg/L)	0.0162	0.0103	0.193	2.78	0.0119
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.25 ^{DLDS}	<0.50 ^{DLDS}	<0.050
	Chloride (Cl) (mg/L)	3.11	7.20	9.8	22.0	0.93
	Fluoride (F) (mg/L)	0.355	0.343	0.59	1.48	0.138
	Nitrate (as N) (mg/L)	0.0785	0.0937	9.77	12.0	<0.0050
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	0.292	3.16	<0.0010
	Sulfate (SO4) (mg/L)	34.5	56.6	285	891	6.18
	Anion Sum (meq/L)	3.80	5.67	13.5	23.1	1.21
	Cation Sum (meq/L)	4.42	5.96	13.5	24.0	1.54
	Cation - Anion Balance (%)	7.5	2.5	0.2	1.9	12.0
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	31.2	9.98			32.7
Total Metals	Aluminum (Al)-Total (mg/L)	0.0693	0.191	0.672	0.515	0.0937
	Antimony (Sb)-Total (mg/L)	<0.00010	0.00014	0.00049	0.00034	<0.00010
	Arsenic (As)-Total (mg/L)	0.00049	0.00061	0.00123	0.00058	0.00060
	Barium (Ba)-Total (mg/L)	0.0604	0.0904	0.148	0.0906	0.0353
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.015	0.024	0.033	0.163	<0.010
	Cadmium (Cd)-Total (mg/L)	0.0000139	0.0000239	0.000527	0.000133	0.0000129
	Calcium (Ca)-Total (mg/L)	40.9	69.8	164	284	17.3
	Chromium (Cr)-Total (mg/L)	0.00041	0.00034	0.00155	0.00044	0.00057
	Cobalt (Co)-Total (mg/L)	0.00012	0.00039	0.00175	0.00196	0.00017
	Copper (Cu)-Total (mg/L)	0.0263	0.0450	0.373	0.135	0.0121
	Iron (Fe)-Total (mg/L)	0.152	1.20	3.52	0.752	0.230
	Lead (Pb)-Total (mg/L)	<0.000050	0.00133	0.00112	0.000314	<0.000050
	Lithium (Li)-Total (mg/L)	0.0024	0.0019	0.0043	0.0143	<0.0010
	Magnesium (Mg)-Total (mg/L)	21.2	23.2	44.4	57.5	6.17

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2091932-6 Water 08-MAY-18 15:31 W16	L2091932-8 Water 08-MAY-18 DUP			
Grouping	Analyte						
WATER							
Physical Tests	Conductivity (uS/cm)		198	362			
	Hardness (as CaCO3) (mg/L)		96.2	179			
	pH (pH)		7.79	8.13			
	Total Suspended Solids (mg/L)		19.0	5.6			
	Total Dissolved Solids (mg/L)		193	298			
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)		67.0	148			
	Alkalinity, Carbonate (as CaCO3) (mg/L)		<1.0	<1.0			
	Alkalinity, Hydroxide (as CaCO3) (mg/L)		<1.0	<1.0			
	Alkalinity, Phenolphthalein (as CaCO3) (mg/L)		<2.0	<2.0			
	Alkalinity, Total (as CaCO3) (mg/L)		67.0	148			
	Ammonia, Total (as N) (mg/L)		0.0162	0.0167			
	Bromide (Br) (mg/L)		<0.050	<0.050			
	Chloride (Cl) (mg/L)		3.01	3.14			
	Fluoride (F) (mg/L)		0.150	0.357			
	Nitrate (as N) (mg/L)		0.389	0.0882			
	Nitrite (as N) (mg/L)		0.0054	<0.0010			
	Sulfate (SO4) (mg/L)		24.0	34.5			
	Anion Sum (meq/L)		1.96	3.80			
	Cation Sum (meq/L)		2.21	4.16			
	Cation - Anion Balance (%)		5.9	4.5			
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)		27.1	31.5			
Total Metals	Aluminum (Al)-Total (mg/L)		0.551	0.116			
	Antimony (Sb)-Total (mg/L)		<0.00010	<0.00010			
	Arsenic (As)-Total (mg/L)		0.00063	0.00051			
	Barium (Ba)-Total (mg/L)		0.0553	0.0620			
	Bismuth (Bi)-Total (mg/L)		<0.000050	<0.000050			
	Boron (B)-Total (mg/L)		<0.010	0.015			
	Cadmium (Cd)-Total (mg/L)		0.0000363	0.0000173			
	Calcium (Ca)-Total (mg/L)		25.6	41.4			
	Chromium (Cr)-Total (mg/L)		0.00064	0.00044			
	Cobalt (Co)-Total (mg/L)		0.00040	0.00016			
	Copper (Cu)-Total (mg/L)		0.103	0.0350			
	Iron (Fe)-Total (mg/L)		0.925	0.233			
	Lead (Pb)-Total (mg/L)		0.000333	0.000062			
	Lithium (Li)-Total (mg/L)		0.0011	0.0025			
	Magnesium (Mg)-Total (mg/L)		7.95	21.6			

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ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2091932-1 Water 08-MAY-18 08:30 W3	L2091932-2 Water 08-MAY-18 09:20 W17	L2091932-3 Water 08-MAY-18 10:00 W8A	L2091932-4 Water 08-MAY-18 10:55 W12	L2091932-5 Water 08-MAY-18 14:55 MC1
Grouping	Analyte						
WATER							
Total Metals	Manganese (Mn)-Total (mg/L)	0.0799	0.447	1.99	1.14	0.0299	
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050			<0.0000050	
	Molybdenum (Mo)-Total (mg/L)	0.00303	0.00620	0.0120	0.0566	0.000495	
	Nickel (Ni)-Total (mg/L)	0.00222	0.00150	0.00293	0.00331	0.00206	
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	0.120	<0.050	0.064	
	Potassium (K)-Total (mg/L)	2.13	4.12	7.26	36.5	1.39	
	Selenium (Se)-Total (mg/L)	0.000262	0.000377	0.00786	0.00783	0.000135	
	Silicon (Si)-Total (mg/L)	5.55	6.43	7.77	4.47	3.90	
	Silver (Ag)-Total (mg/L)	<0.000010	0.000023	0.000101	0.000041	<0.000010	
	Sodium (Na)-Total (mg/L)	12.8	16.0	40.4	101	3.97	
	Strontium (Sr)-Total (mg/L)	0.485	0.751	1.92	4.54	0.131	
	Sulfur (S)-Total (mg/L)	12.3	20.0	98.5	338	2.14	
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	0.000011	<0.000010	<0.000010	
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	0.00016	<0.00010	<0.00010	
	Titanium (Ti)-Total (mg/L)	0.00209	0.00957	0.0347	0.0249	0.00239	
	Uranium (U)-Total (mg/L)	0.00177	0.00285	0.00332	0.00606	0.000234	
	Vanadium (V)-Total (mg/L)	0.00070	0.00127	0.00505	0.00193	0.00097	
	Zinc (Zn)-Total (mg/L)	<0.0030	0.0244	0.292	0.0076	0.0034	
	Zirconium (Zr)-Total (mg/L)	0.00046	<0.00030	0.00060	<0.00030	0.00037	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0538	0.0029	0.0090	0.0430	0.0500	
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	0.00012	0.00033	<0.00010	
	Arsenic (As)-Dissolved (mg/L)	0.00035	0.00038	0.00051	0.00039	0.00047	
	Barium (Ba)-Dissolved (mg/L)	0.0606	0.0769	0.117	0.0791	0.0317	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	0.015	0.024	0.033	0.165	<0.010	
	Cadmium (Cd)-Dissolved (mg/L)	0.0000128	0.0000056	0.000457	0.000130	0.0000094	
	Calcium (Ca)-Dissolved (mg/L)	43.4	69.3	165	289	17.5	
	Chromium (Cr)-Dissolved (mg/L)	0.00033	0.00011	0.00028	0.00035	0.00040	
	Cobalt (Co)-Dissolved (mg/L)	0.00011	0.00012	0.00118	0.00160	0.00012	
	Copper (Cu)-Dissolved (mg/L)	0.0241	0.0102	0.133	0.0641	0.00988	
	Iron (Fe)-Dissolved (mg/L)	0.122	0.049	0.197	0.084	0.157	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	0.000090	0.00208	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.0019	0.0010	0.0040	0.0171	<0.0010	
	Magnesium (Mg)-Dissolved (mg/L)	20.3	21.5	41.3	53.7	5.60	
	Manganese (Mn)-Dissolved (mg/L)	0.0754	0.122	1.68	0.967	0.0182	

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ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2091932-6 Water 08-MAY-18 15:31 W16	L2091932-8 Water 08-MAY-18 DUP			
Grouping	Analyte						
WATER							
Total Metals	Manganese (Mn)-Total (mg/L)	0.150	0.0889				
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050				
	Molybdenum (Mo)-Total (mg/L)	0.00163	0.00295				
	Nickel (Ni)-Total (mg/L)	0.00142	0.00221				
	Phosphorus (P)-Total (mg/L)	0.064	<0.050				
	Potassium (K)-Total (mg/L)	1.97	2.18				
	Selenium (Se)-Total (mg/L)	0.000489	0.000259				
	Silicon (Si)-Total (mg/L)	3.77	5.75				
	Silver (Ag)-Total (mg/L)	0.000028	<0.000010				
	Sodium (Na)-Total (mg/L)	5.31	13.0				
	Strontium (Sr)-Total (mg/L)	0.223	0.490				
	Sulfur (S)-Total (mg/L)	8.25	12.5				
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010				
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010				
	Titanium (Ti)-Total (mg/L)	0.0248	0.00522				
	Uranium (U)-Total (mg/L)	0.000527	0.00179				
	Vanadium (V)-Total (mg/L)	0.00236	0.00091				
	Zinc (Zn)-Total (mg/L)	0.0070	0.0032				
	Zirconium (Zr)-Total (mg/L)	<0.00030	0.00045				
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD				
	Dissolved Metals Filtration Location	FIELD	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	0.0485	0.0572				
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010				
	Arsenic (As)-Dissolved (mg/L)	0.00039	0.00035				
	Barium (Ba)-Dissolved (mg/L)	0.0482	0.0589				
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050				
	Boron (B)-Dissolved (mg/L)	<0.010	0.015				
	Cadmium (Cd)-Dissolved (mg/L)	0.0000303	0.0000085				
	Calcium (Ca)-Dissolved (mg/L)	27.0	40.0				
	Chromium (Cr)-Dissolved (mg/L)	0.00024	0.00035				
	Cobalt (Co)-Dissolved (mg/L)	0.00015	0.00011				
	Copper (Cu)-Dissolved (mg/L)	0.0574	0.0237				
	Iron (Fe)-Dissolved (mg/L)	0.209	0.122				
	Lead (Pb)-Dissolved (mg/L)	0.000056	<0.000050				
	Lithium (Li)-Dissolved (mg/L)	<0.0010	0.0018				
	Magnesium (Mg)-Dissolved (mg/L)	6.96	19.3				
	Manganese (Mn)-Dissolved (mg/L)	0.115	0.0724				

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2091932-1 Water 08-MAY-18 08:30 W3	L2091932-2 Water 08-MAY-18 09:20 W17	L2091932-3 Water 08-MAY-18 10:00 W8A	L2091932-4 Water 08-MAY-18 10:55 W12	L2091932-5 Water 08-MAY-18 14:55 MC1
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	0.0000068	<0.0000050	<0.0000050	<0.0000050	0.0000095
	Molybdenum (Mo)-Dissolved (mg/L)	0.00280	0.00598	0.0124	0.0553	0.000584
	Nickel (Ni)-Dissolved (mg/L)	0.00194	0.00088	0.00161	0.00305	0.00165
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	2.27	4.21	7.01	35.6	1.38
	Selenium (Se)-Dissolved (mg/L)	0.000216	0.000301	0.00789	0.00719	0.000150
	Silicon (Si)-Dissolved (mg/L)	5.01	5.36	5.82	3.26	3.45
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	0.000019	0.000011	<0.000010
	Sodium (Na)-Dissolved (mg/L)	11.8	14.2	36.8	91.9	3.53
	Strontium (Sr)-Dissolved (mg/L)	0.525	0.777	2.07	4.82	0.137
	Sulfur (S)-Dissolved (mg/L)	10.9	18.5	93.3	335	2.00
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.0012 ^{DLM}	<0.00030	<0.00054 ^{DLM}	<0.0024 ^{DLM}	<0.00093 ^{DLM}
	Uranium (U)-Dissolved (mg/L)	0.00165	0.00263	0.00296	0.00579	0.000204
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	0.00063	<0.00050	0.00056
	Zinc (Zn)-Dissolved (mg/L)	0.0034	0.0036	0.145	0.0106	0.0012
	Zirconium (Zr)-Dissolved (mg/L)	0.00048	<0.00030	<0.00030	<0.00030	0.00040

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2091932-6 Water 08-MAY-18 15:31 W16	L2091932-8 Water 08-MAY-18 DUP			
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	0.0000059	0.0000082			
	Molybdenum (Mo)-Dissolved (mg/L)	0.00154	0.00290			
	Nickel (Ni)-Dissolved (mg/L)	0.00105	0.00195			
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050			
	Potassium (K)-Dissolved (mg/L)	1.83	2.18			
	Selenium (Se)-Dissolved (mg/L)	0.000370	0.000235			
	Silicon (Si)-Dissolved (mg/L)	2.61	5.02			
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010			
	Sodium (Na)-Dissolved (mg/L)	4.93	11.5			
	Strontium (Sr)-Dissolved (mg/L)	0.231	0.516			
	Sulfur (S)-Dissolved (mg/L)	7.81	11.2			
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010			
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010			
	Titanium (Ti)-Dissolved (mg/L)	0.00221	0.00142			
	Uranium (U)-Dissolved (mg/L)	0.000490	0.00167			
	Vanadium (V)-Dissolved (mg/L)	0.00054	<0.00050			
	Zinc (Zn)-Dissolved (mg/L)	0.0015	0.0048			
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	0.00052			

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Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Dissolved Organic Carbon	MS-B	L2091932-1, -2, -5, -6, -8
Matrix Spike	Dissolved Organic Carbon	MS-B	L2091932-1, -2, -5, -6, -8
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2091932-1, -2, -3, -4, -5, -6, -8
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2091932-1, -2, -3, -4, -5, -6, -8
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2091932-1, -2, -3, -4, -5, -6, -8
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2091932-1, -2, -3, -4, -5, -6, -8
Matrix Spike	Aluminum (Al)-Total	MS-B	L2091932-1, -2, -3, -4, -5, -6, -8
Matrix Spike	Barium (Ba)-Total	MS-B	L2091932-1, -2, -3, -4, -5, -6, -8
Matrix Spike	Calcium (Ca)-Total	MS-B	L2091932-1, -2, -3, -4, -5, -6, -8
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2091932-1, -2, -3, -4, -5, -6, -8
Matrix Spike	Manganese (Mn)-Total	MS-B	L2091932-1, -2, -3, -4, -5, -6, -8
Matrix Spike	Strontium (Sr)-Total	MS-B	L2091932-1, -2, -3, -4, -5, -6, -8
Matrix Spike	Sulfate (SO4)	MS-B	L2091932-1, -2, -3, -4, -5, -6, -8

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
BR-L-IC-N-VA	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
F-IC-N-VA	Water	Fluoride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			

Reference Information

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-VA Water Total Dissolved Solids by Gravimetric APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
----------------------------	---------------------

VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
----	---

Chain of Custody Numbers:

2018-05 09 A

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lw - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Report To Contact and company name below will appear on the final report		Report Format / Distribution		Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply													
Company: Minto Explorations Ltd.		Select Report Format: ☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)		Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply													
Contact: Minto Environment - Coordinator		Quality Control (QC) Report with Report ☒ YES ☐ NO		PRIORITY (Business Days) 4 day [P4] ☐ 3 day [P3] ☐ 2 day [P2] ☐				EMERGENCY 1 Business day [E1] ☐ Same Day, Weekend or Statutory holiday [E0] ☐									
Phone: 1-604-759-4659		☒ Compare Results to Criteria on Report - provide details below if box checked															
Company address below will appear on the final report		Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX															
Street: 2100-510 West Georgia St.		Email 1 or Fax minto_environment@mintomine.com		Date and Time Required for all E&P TATs:													
City/Province: Vancouver, British Columbia		Email 2		For tests that can not be performed according to the service level selected, you will be contacted.													
Postal Code: V6B 0M3		Email 3		Analysis Request													
Invoice To Same as Report To ☐ YES ☒ NO		Invoice Distribution		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below													
Copy of Invoice with Report ☐ YES ☒ NO		Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX															
Company: Minto Explorations Ltd.		Email 1 or Fax ap@mintomine.com															
Contact: Ruth Cayetano		Email 2															
Project Information		Oil and Gas Required Fields (client use)															
ALS Account # / Quote #:		AFE/Cost Center:		PO#													
Job #:		Major/Minor Code:		Routing Code:													
PO / AFE: 229096 (WUL)		Requisitioner:															
LSD:		Location:															
ALS Lab Work Order # (lab use only)		ALS Contact: Shane Stack		Sampler: CR													
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mm-yy)	Time (hh:mm)	Sample Type	pH / Conductivity / Alkalinity / Anions	Total Suspended Solids (TSS)	Total Dissolved Solids (TDS)	Total Metals (TM), Hardness	Dissolved Metals (DM) (filtered and preserved)	Total Mercury, Hardness	Dissolved Mercury [1] (Filtered + preserved)	Total Nutrients (Ammonia)	Dissolved Organic Carbon (DOC)	Number of Containers			
	W3	8-May-18	8:30	Water	R	R	R	R	R	R	R	R	R		7		
	W17	8-May-18	9:30	Water	R	R	R	R	R	R	R	R	R		7		
	W8A	8-May-18	10:00	Water	R	R	R	R	R	R	R	R	R		7		
	W12	8-May-18	10:55	Water	R	R	R	R	R	R	R	R	R		7		
	MC1	8-May-18	14:55	Water	R	R	R	R	R	R	R	R	R		7		
	W16	8-May-18	15:31	Water	R	R	R	R	R	R	R	R	R		7		
	STP-E	8-May-18	10:30	Water	R	R	R	R	R	R	R	R	R		7		
	DUP	8-May-18		Waste	R	R	R	R	R	R	R	R	R		7		
Drinking Water (DW) Samples¹ (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)															
Are samples taken from a Regulated DW System? ☐ YES ☒ NO																	
Are samples for human drinking water use? ☐ YES ☒ NO																	
SHIPMENT RELEASE (client use)					INITIAL SHIPMENT RECEPTION (lab use only)					SAMPLE CONDITION AS RECEIVED (lab use only)							
Released by: Corey Roberts					Date: 2018-05-09					Frozen ☐ SIF Observations Yes ☐ No ☐							
Time:					Received by: EHF					Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐							
Date: 2018-05-09					Time: 15:40					Cooling Initiated ☒							
Time: 15:40					Date: May 10					INITIAL COOLER TEMPERATURES °C					FINAL COOLER TEMPERATURES °C		
Date: May 10					Time: 1600					6.0					8.3, 9.4 6.4 10.7		
Time: 1600					Received by: CW												

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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YELLOW - CLIENT COPY

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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

See reverse



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 10-MAY-18
Report Date: 23-MAY-18 14:49 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2092684
Project P.O. #: 22100
Job Reference:
C of C Numbers: 2018-05-10 A
Legal Site Desc:

Shane Stack
Account Manager

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ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2092684-1 Water 08-MAY-18 11:30 SS24	L2092684-2 Water 09-MAY-18 14:00 SS33			
Grouping	Analyte						
WATER							
Physical Tests	Conductivity (uS/cm)		2390	555			
	Hardness (as CaCO3) (mg/L)		1210	257			
	pH (pH)		8.01	8.23			
	Total Suspended Solids (mg/L)			49.0			
	TDS (Calculated) (mg/L)		2130	359			
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)		122	142			
	Alkalinity, Carbonate (as CaCO3) (mg/L)		<1.0	<1.0			
	Alkalinity, Hydroxide (as CaCO3) (mg/L)		<1.0	<1.0			
	Alkalinity, Total (as CaCO3) (mg/L)		122	142			
	Ammonia, Total (as N) (mg/L)		2.62	0.0941			
	Chloride (Cl) (mg/L)		44	2.91			
	Nitrate and Nitrite (as N) (mg/L)		25.7	14.8			
	Nitrate (as N) (mg/L)		22.1	14.8			
	Nitrite (as N) (mg/L)		3.64	0.0520			
	Sulfate (SO4) (mg/L)		1330	89.7			
	Anion Sum (meq/L)		33.3	5.85			
	Cation Sum (meq/L)		29.5	6.10			
	Cation - Anion Balance (%)		-6.1	2.1			
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)		59.3				
Total Metals	Aluminum (Al)-Total (mg/L)		10.4				
	Antimony (Sb)-Total (mg/L)		0.00045				
	Arsenic (As)-Total (mg/L)		0.00324				
	Barium (Ba)-Total (mg/L)		0.260				
	Beryllium (Be)-Total (mg/L)		0.000330				
	Bismuth (Bi)-Total (mg/L)		0.00087				
	Boron (B)-Total (mg/L)		0.186				
	Cadmium (Cd)-Total (mg/L)		0.00103				
	Calcium (Ca)-Total (mg/L)		376				
	Chromium (Cr)-Total (mg/L)		0.00543				
	Cobalt (Co)-Total (mg/L)		0.00756				
	Copper (Cu)-Total (mg/L)		6.75				
	Iron (Fe)-Total (mg/L)		21.5				
	Lead (Pb)-Total (mg/L)		0.00615				
	Lithium (Li)-Total (mg/L)		0.0237				
	Magnesium (Mg)-Total (mg/L)		73.0				
	Manganese (Mn)-Total (mg/L)		1.38				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2092684-1 Water 08-MAY-18 11:30 SS24	L2092684-2 Water 09-MAY-18 14:00 SS33			
Grouping	Analyte						
WATER							
Total Metals	Mercury (Hg)-Total (mg/L)		^{DLM} <0.00010				
	Molybdenum (Mo)-Total (mg/L)		0.0624				
	Nickel (Ni)-Total (mg/L)		0.0054				
	Phosphorus (P)-Total (mg/L)		0.39				
	Potassium (K)-Total (mg/L)		27.7				
	Selenium (Se)-Total (mg/L)		0.0119				
	Silicon (Si)-Total (mg/L)		22.8				
	Silver (Ag)-Total (mg/L)		0.00403				
	Sodium (Na)-Total (mg/L)		110				
	Strontium (Sr)-Total (mg/L)		7.56				
	Sulfur (S)-Total (mg/L)		462				
	Thallium (Tl)-Total (mg/L)		0.000120				
	Tin (Sn)-Total (mg/L)		0.00056				
	Titanium (Ti)-Total (mg/L)		0.688				
	Uranium (U)-Total (mg/L)		0.00457				
	Vanadium (V)-Total (mg/L)		0.0426				
	Zinc (Zn)-Total (mg/L)		0.104				
	Zirconium (Zr)-Total (mg/L)		0.00072				
Dissolved Metals	Dissolved Mercury Filtration Location		FIELD	FIELD			
	Dissolved Metals Filtration Location		FIELD	FIELD			
	Aluminum (Al)-Dissolved (mg/L)		0.0046	0.0107			
	Antimony (Sb)-Dissolved (mg/L)		0.00037	0.00013			
	Arsenic (As)-Dissolved (mg/L)		0.00044	0.00034			
	Barium (Ba)-Dissolved (mg/L)		0.0657	0.0408			
	Beryllium (Be)-Dissolved (mg/L)		^{DLA} <0.000040	0.000022			
	Bismuth (Bi)-Dissolved (mg/L)		^{DLA} <0.00010	<0.000050			
	Boron (B)-Dissolved (mg/L)		0.190	0.036			
	Cadmium (Cd)-Dissolved (mg/L)		0.000237	0.000194			
	Calcium (Ca)-Dissolved (mg/L)		383	73.2			
	Chromium (Cr)-Dissolved (mg/L)		^{DLA} <0.00020	<0.00010			
	Cobalt (Co)-Dissolved (mg/L)		0.00103	0.00017			
	Copper (Cu)-Dissolved (mg/L)		0.146	0.323			
	Iron (Fe)-Dissolved (mg/L)		^{DLA} <0.020	0.047			
	Lead (Pb)-Dissolved (mg/L)		^{DLA} <0.00010	<0.000050			
	Lithium (Li)-Dissolved (mg/L)		0.0186	0.0022			
	Magnesium (Mg)-Dissolved (mg/L)		62.6	18.1			
	Manganese (Mn)-Dissolved (mg/L)		0.856	0.147			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2092684-1 Water 08-MAY-18 11:30 SS24	L2092684-2 Water 09-MAY-18 14:00 SS33			
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050			
	Molybdenum (Mo)-Dissolved (mg/L)	0.0575	0.0110			
	Nickel (Ni)-Dissolved (mg/L)	0.0017	<0.00050			
	Phosphorus (P)-Dissolved (mg/L)	<0.10 ^{DLA}	<0.050			
	Potassium (K)-Dissolved (mg/L)	22.9	4.36			
	Selenium (Se)-Dissolved (mg/L)	0.00888	0.00909			
	Silicon (Si)-Dissolved (mg/L)	3.21	3.83			
	Silver (Ag)-Dissolved (mg/L)	<0.000020 ^{DLA}	0.000030			
	Sodium (Na)-Dissolved (mg/L)	101	18.8			
	Strontium (Sr)-Dissolved (mg/L)	6.26	1.77			
	Sulfur (S)-Dissolved (mg/L)	465	29.6			
	Thallium (Tl)-Dissolved (mg/L)	<0.000020 ^{DLA}	<0.000010			
	Tin (Sn)-Dissolved (mg/L)	<0.00020 ^{DLA}	<0.00010			
	Titanium (Ti)-Dissolved (mg/L)	<0.00060 ^{DLA}	<0.00090 ^{DLM}			
	Uranium (U)-Dissolved (mg/L)	0.00362	0.00207			
	Vanadium (V)-Dissolved (mg/L)	<0.0010 ^{DLA}	<0.00050			
	Zinc (Zn)-Dissolved (mg/L)	0.0078	0.0049			
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Alkalinity, Total (as CaCO ₃)	B	L2092684-1, -2
Method Blank	Arsenic (As)-Total	MB-LOR	L2092684-1
Method Blank	Zirconium (Zr)-Total	MB-LOR	L2092684-1
Matrix Spike	Dissolved Organic Carbon	MS-B	L2092684-1
Matrix Spike	Dissolved Organic Carbon	MS-B	L2092684-1

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
DLA	Detection Limit adjusted for required dilution
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are			

Reference Information

included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
----------------------------	---------------------

VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
----	---

Chain of Custody Numbers:

2018-05-10 A

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lw - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

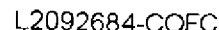
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Canada Toll Free: 1 800 668 9878

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COC Number: 2018-05-10 A

Page 1 of 1

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1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.



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ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 16-MAY-18
Report Date: 31-MAY-18 16:56 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2095920

Project P.O. #: 229096

Job Reference:

C of C Numbers: 2018-05-16 A 1 of 2, 2018-05-16 A 2 of 2

Legal Site Desc:

Shane Stack
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2095920-1 Water 12-MAY-18 09:55 W55	L2095920-2 Water 12-MAY-18 10:25 W14	L2095920-3 Water 12-MAY-18 11:00 W30	L2095920-4 Water 12-MAY-18 13:15 W10	L2095920-5 Water 14-MAY-18 09:00 W17
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	184	3410	411	50.6	511
	Hardness (as CaCO3) (mg/L)	108	1710	195	131	260
	pH (pH)	7.98	8.04	8.27	7.00	8.39
	Total Suspended Solids (mg/L)	17.7	15.3	<3.0	<3.0	<3.0
	TDS (Calculated) (mg/L)	105	3030	246	68.3	301
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	86.2	86.4	124	20.4	211
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	7.2
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	86.2	86.4	124	20.4	218
	Ammonia, Total (as N) (mg/L)	0.0474	12.3	0.0272	0.0152	0.0114
	Bromide (Br) (mg/L)	<0.050	<1.0	<0.050	<0.050	<0.050
	Chloride (Cl) (mg/L)	0.66	28	1.39	<0.50	6.86
	Fluoride (F) (mg/L)	0.165	2.24	0.465	0.046	0.374
	Nitrate and Nitrite (as N) (mg/L)	0.383	43.2	3.07	<0.0051	0.104
	Nitrate (as N) (mg/L)	0.378	40.0	3.01	<0.0050	0.104
	Nitrite (as N) (mg/L)	0.0057	3.14	0.0538	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	7.26	1870	76.7	<0.30	54.1
	Anion Sum (meq/L)	1.93	44.7	4.36	0.41	5.71
	Cation Sum (meq/L)	2.38	43.8	4.43	2.95	5.94
	Cation - Anion Balance (%)	10.4	-0.9	0.8	75.6	2.0
	Organic / Inorganic Carbon					9.14
Total Metals	Aluminum (Al)-Total (mg/L)	0.292		0.171	0.383	3.73
	Antimony (Sb)-Total (mg/L)	0.00012		0.00013	<0.00010	0.00031
	Arsenic (As)-Total (mg/L)	0.00102		0.00070	0.00042	0.00265
	Barium (Ba)-Total (mg/L)	0.0600		0.0630	0.0731	0.451
	Beryllium (Be)-Total (mg/L)	0.000046		<0.000020	0.000025	0.000141
	Bismuth (Bi)-Total (mg/L)	<0.000050		<0.000050	<0.000050	0.000086
	Boron (B)-Total (mg/L)	<0.017		0.019	<0.010	0.026
	Cadmium (Cd)-Total (mg/L)	0.0000489		0.0000201	0.0000278	0.000387
	Calcium (Ca)-Total (mg/L)	29.9		46.0	11.6	66.4
	Chromium (Cr)-Total (mg/L)	0.00053		0.00031	0.00066	0.00433
	Cobalt (Co)-Total (mg/L)	0.00051		0.00021	0.00046	0.00559
	Copper (Cu)-Total (mg/L)	0.126		0.0451	0.0431	0.572
	Iron (Fe)-Total (mg/L)	0.538		0.321	0.436	23.8
	Lead (Pb)-Total (mg/L)	0.000219		0.000127	0.000057	0.0206
	Lithium (Li)-Total (mg/L)	0.0013		0.0024	<0.0010	0.0036

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2095920-6 Water 14-MAY-18 09:35 W8A	L2095920-7 Water 14-MAY-18 14:10 W16	L2095920-8 Water 14-MAY-18 15:15 W33S	L2095920-9 Water 15-MAY-18 08:10 MC1	L2095920-10 Water 15-MAY-18 08:50 W2
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	1220	339	109	191	194
	Hardness (as CaCO3) (mg/L)	621	169	63.6	99.2	100
	pH (pH)	8.13	8.20	7.75	8.12	8.17
	Total Suspended Solids (mg/L)	45.1	13.5	<3.0	<3.0	<3.0
	TDS (Calculated) (mg/L)	831	198	60.4	107	108
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	385	125	48.3	89.7	91.1
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	385	125	48.3	89.7	91.1
	Ammonia, Total (as N) (mg/L)	0.181	0.0161	0.0199	0.0085	0.0102
	Bromide (Br) (mg/L)	<0.25 ^{DLDS}	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl) (mg/L)	9.9	5.16	<0.50	1.18	1.25
	Fluoride (F) (mg/L)	0.65	0.209	0.082	0.248	0.245
	Nitrate and Nitrite (as N) (mg/L)	8.63	0.722	0.162	<0.0051	<0.0051
	Nitrate (as N) (mg/L)	8.42	0.717	0.157	<0.0050	<0.0050
	Nitrite (as N) (mg/L)	0.214	0.0049	0.0053	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	285	43.8	4.69	10.5	10.8
	Anion Sum (meq/L)	14.5	3.62	1.08	2.06	2.09
	Cation Sum (meq/L)	14.4	3.85	1.42	2.28	2.29
	Cation - Anion Balance (%)	-0.6	3.1	13.5	5.1	4.5
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)		21.8		23.6	22.2
Total Metals	Aluminum (Al)-Total (mg/L)	0.553	0.838	0.146	0.0487	0.0566
	Antimony (Sb)-Total (mg/L)	0.00017	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00093	0.00068	0.00047	0.00064	0.00062
	Barium (Ba)-Total (mg/L)	0.141	0.0768	0.0340	0.0463	0.0414
	Beryllium (Be)-Total (mg/L)	0.000045	0.000046	0.000027	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.035	0.015	<0.010	<0.010	<0.010
	Cadmium (Cd)-Total (mg/L)	0.000523	0.0000281	0.0000166	0.0000116	0.0000113
	Calcium (Ca)-Total (mg/L)	175	42.4	17.3	23.6	24.2
	Chromium (Cr)-Total (mg/L)	0.00116	0.00082	0.00052	0.00051	0.00048
	Cobalt (Co)-Total (mg/L)	0.00147	0.00066	0.00020	0.00020	0.00018
	Copper (Cu)-Total (mg/L)	0.296	0.0731	0.0328	0.00618	0.00578
	Iron (Fe)-Total (mg/L)	2.01	1.50	0.290	0.236	0.235
	Lead (Pb)-Total (mg/L)	0.000396	0.000326	0.000053	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	0.0043	0.0016	<0.0010	<0.0010	<0.0010

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2095920-11 Water 15-MAY-18 09:55 W3	L2095920-12 Water 15-MAY-18 10:30 W7	L2095920-13 Water 12-MAY-18 F-BL	L2095920-14 Water 14-MAY-18 DUP	L2095920-15 Water 14-MAY-18 10:15 W55
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	502	142	<2.0	508	173
	Hardness (as CaCO3) (mg/L)	252	74.7	<0.50	256	92.2
	pH (pH)	8.39	8.00	5.41	8.38	7.88
	Total Suspended Solids (mg/L)	8.9	20.7	<3.0	4.5	4.5
	TDS (Calculated) (mg/L)	293	77.4	<1.0	298	98.4
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	213	70.5	<1.0	210	66.3
	Alkalinity, Carbonate (as CaCO3) (mg/L)	7.4	<1.0	<1.0	6.6	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	221	70.5	<1.0	216	66.3
	Ammonia, Total (as N) (mg/L)	0.0126	0.0117	<0.0050	0.0082	0.0239
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl) (mg/L)	4.76	<0.50	<0.50	6.80	0.55
	Fluoride (F) (mg/L)	0.499	0.158	<0.020	0.373	0.132
	Nitrate and Nitrite (as N) (mg/L)	0.158	0.0104	<0.0051	0.103	1.67
	Nitrate (as N) (mg/L)	0.155	0.0104	<0.0050	0.103	1.66
	Nitrite (as N) (mg/L)	0.0022	<0.0010	<0.0010	<0.0010	0.0121
	Sulfate (SO4) (mg/L)	53.2	3.80	<0.30	54.2	12.5
	Anion Sum (meq/L)	5.69	1.50	<0.10	5.67	1.73
	Cation Sum (meq/L)	5.79	1.73	<0.10	5.84	2.06
	Cation - Anion Balance (%)	0.9	7.3	0.0	1.6	8.7
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	14.8	23.4	0.51	9.15	
Total Metals	Aluminum (Al)-Total (mg/L)	0.158	0.537	<0.0030	0.0117	0.268
	Antimony (Sb)-Total (mg/L)	0.00011	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00039	0.00084	<0.00010	0.00036	0.00062
	Barium (Ba)-Total (mg/L)	0.0660	0.0522	<0.00010	0.0752	0.0514
	Beryllium (Be)-Total (mg/L)	<0.000020	0.000033	<0.000020	<0.000020	0.000033
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.021	<0.010	<0.010	0.025	<0.010
	Cadmium (Cd)-Total (mg/L)	0.0000205	0.0000160	<0.0000050	0.0000059	0.0000223
	Calcium (Ca)-Total (mg/L)	53.1	19.2	<0.050	66.8	25.7
	Chromium (Cr)-Total (mg/L)	0.00027	0.00143	<0.00010	0.00013	0.00050
	Cobalt (Co)-Total (mg/L)	0.00016	0.00055	<0.00010	<0.00010	0.00021
	Copper (Cu)-Total (mg/L)	0.0367	0.00722	<0.00050	0.0104	0.102
	Iron (Fe)-Total (mg/L)	0.278	1.38	<0.010	0.071	0.467
	Lead (Pb)-Total (mg/L)	0.000055	0.000207	<0.000050	0.000068	0.000148
	Lithium (Li)-Total (mg/L)	0.0031	<0.0010	<0.0010	0.0018	<0.0010

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ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2095920-1 Water 12-MAY-18 09:55 W55	L2095920-2 Water 12-MAY-18 10:25 W14	L2095920-3 Water 12-MAY-18 11:00 W30	L2095920-4 Water 12-MAY-18 13:15 W10	L2095920-5 Water 14-MAY-18 09:00 W17
Grouping	Analyte						
WATER							
Total Metals	Magnesium (Mg)-Total (mg/L)	7.88			17.5	2.60	23.3
	Manganese (Mn)-Total (mg/L)	0.112			0.0761	0.124	9.62
	Mercury (Hg)-Total (mg/L)	0.0000115			0.0000054	0.0000071	0.0000055
	Molybdenum (Mo)-Total (mg/L)	0.00166			0.00763	0.000155	0.0127
	Nickel (Ni)-Total (mg/L)	0.00185			0.00069	0.00176	0.0121
	Phosphorus (P)-Total (mg/L)	0.169			<0.050	0.113	0.346
	Potassium (K)-Total (mg/L)	2.14			4.14	1.15	4.89
	Selenium (Se)-Total (mg/L)	0.000492			0.00478	0.000114	0.000576
	Silicon (Si)-Total (mg/L)	4.51			3.30	2.79	13.4
	Silver (Ag)-Total (mg/L)	0.000026			0.000020	0.000012	0.000214
	Sodium (Na)-Total (mg/L)	3.74			10.0	1.33	16.2
	Strontium (Sr)-Total (mg/L)	0.232			0.761	0.0731	0.811
	Sulfur (S)-Total (mg/L)	2.98			28.2	<0.50	20.6
	Thallium (Tl)-Total (mg/L)	<0.000010			<0.000010	<0.000010	0.000055
	Tin (Sn)-Total (mg/L)	<0.00010			<0.00010	<0.00010	0.00020
	Titanium (Ti)-Total (mg/L)	0.0114			0.00672	<0.0060 ^{DLM}	0.179
	Uranium (U)-Total (mg/L)	0.000142			0.00195	0.000034	0.00299
	Vanadium (V)-Total (mg/L)	0.00139			0.00106	0.00105	0.0158
	Zinc (Zn)-Total (mg/L)	0.0067			<0.0030	0.0108	0.347
	Zirconium (Zr)-Total (mg/L)	0.00058			<0.00030	0.00055	0.00071
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0577	0.0355	0.0065	0.102	0.0024	
	Antimony (Sb)-Dissolved (mg/L)	0.00011	0.00064	0.00012	<0.00010	<0.00010	
	Arsenic (As)-Dissolved (mg/L)	0.00084	0.00036	0.00046	0.00046	0.00042	
	Barium (Ba)-Dissolved (mg/L)	0.0520	0.177	0.0591	0.178 ^{DTC}	0.0744	
	Beryllium (Be)-Dissolved (mg/L)	0.000029	<0.000040 ^{DLA}	<0.000020	<0.000020	<0.000020	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.00010 ^{DLA}	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	<0.010	0.367 ^{DLM}	0.014	<0.010	0.023	
	Cadmium (Cd)-Dissolved (mg/L)	0.0000270	<0.000030	0.0000132	0.0000137 ^{DTC}	0.0000281	
	Calcium (Ca)-Dissolved (mg/L)	30.4	552	46.9	36.9	68.0	
	Chromium (Cr)-Dissolved (mg/L)	0.00040	<0.00020 ^{DLA}	<0.00010	0.00020	<0.00010	
	Cobalt (Co)-Dissolved (mg/L)	0.00035	<0.00020 ^{DLA}	<0.00010	0.00026	<0.00010	
	Copper (Cu)-Dissolved (mg/L)	0.0877	0.00454 ^{DLA}	0.0332	0.0261	0.00848	
	Iron (Fe)-Dissolved (mg/L)	0.174	<0.020 ^{DLA}	0.031	0.145	0.031	
	Lead (Pb)-Dissolved (mg/L)	0.000058	<0.00010 ^{DLA}	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.0012	0.0175	0.0022	<0.0010	0.0016	

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2095920-6	L2095920-7	L2095920-8	L2095920-9	L2095920-10
		Water	Water	Water	Water	Water
		14-MAY-18	14-MAY-18	14-MAY-18	15-MAY-18	15-MAY-18
		09:35	14:10	15:15	08:10	08:50
		W8A	W16	W33S	MC1	W2
Grouping	Analyte					
WATER						
Total Metals	Magnesium (Mg)-Total (mg/L)	47.0	13.2	4.64	8.83	8.50
	Manganese (Mn)-Total (mg/L)	2.18	0.191	0.0197	0.0456	0.0196
	Mercury (Hg)-Total (mg/L)	0.0000073	<0.0000050	0.0000069	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.0131	0.00214	0.000565	0.000846	0.000802
	Nickel (Ni)-Total (mg/L)	0.00199	0.00162	0.00186	0.00197	0.00180
	Phosphorus (P)-Total (mg/L)	0.133	0.072	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	7.52	2.54	0.80	1.25	1.26
	Selenium (Se)-Total (mg/L)	0.00672	0.000428	0.000162	0.000168	0.000132
	Silicon (Si)-Total (mg/L)	8.25	5.27	3.56	4.89	4.72
	Silver (Ag)-Total (mg/L)	0.000070	0.000018	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	44.2	9.32	2.74	6.05	5.84
	Strontium (Sr)-Total (mg/L)	2.20	0.397	0.0896	0.205	0.210
	Sulfur (S)-Total (mg/L)	114	15.9	2.05	3.88	4.22
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	0.0278	0.0448	0.00354	<0.0018	0.00247
	Uranium (U)-Total (mg/L)	0.00344	0.000969	0.000037	0.000608	0.000588
	Vanadium (V)-Total (mg/L)	0.00368	0.00339	0.00076	0.00099	0.00091
	Zinc (Zn)-Total (mg/L)	0.0998	0.0069	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	0.00039	0.00035	0.00044	0.00033	0.00031
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0075	0.0289	0.0525	0.0255	0.0241
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00052	0.00037	0.00033	0.00056	0.00054
	Barium (Ba)-Dissolved (mg/L)	0.121	0.0677	0.0305	0.0437	0.0414
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.030	0.013	<0.010	<0.010	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	0.000439	0.0000218	0.0000144	0.0000069	0.0000084
	Calcium (Ca)-Dissolved (mg/L)	174	44.6	17.8	24.8	25.8
	Chromium (Cr)-Dissolved (mg/L)	0.00028	0.00018	0.00040	0.00039	0.00033
	Cobalt (Co)-Dissolved (mg/L)	0.00101	0.00013	0.00011	0.00020	0.00014
	Copper (Cu)-Dissolved (mg/L)	0.118	0.0464	0.0253	0.00599	0.00570
	Iron (Fe)-Dissolved (mg/L)	0.287	0.165	0.124	0.173	0.153
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0039	0.0011	<0.0010	<0.0010	<0.0010

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2095920-11 Water 15-MAY-18 09:55 W3	L2095920-12 Water 15-MAY-18 10:30 W7	L2095920-13 Water 12-MAY-18 F-BL	L2095920-14 Water 14-MAY-18 DUP	L2095920-15 Water 14-MAY-18 10:15 W55
Grouping	Analyte					
WATER						
Total Metals	Magnesium (Mg)-Total (mg/L)	26.0	7.03	<0.10	21.0	7.09
	Manganese (Mn)-Total (mg/L)	0.140	0.0746	<0.00010 ^{DTMF}	0.0996	0.0197
	Mercury (Hg)-Total (mg/L)	<0.0000050	0.0000067	<0.0000050	<0.0000050	0.0000087
	Molybdenum (Mo)-Total (mg/L)	0.00447	0.000731	<0.000050	0.00633	0.00145
	Nickel (Ni)-Total (mg/L)	0.00155	0.00267	<0.00050	0.00081	0.00166
	Phosphorus (P)-Total (mg/L)	<0.050	0.088	<0.050	<0.050	0.065
	Potassium (K)-Total (mg/L)	2.37	0.79	<0.10	3.84	1.80
	Selenium (Se)-Total (mg/L)	0.000266	0.000148	<0.000050	0.000314	0.000297
	Silicon (Si)-Total (mg/L)	6.35	5.73	<0.10	5.81	4.22
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	0.000013
	Sodium (Na)-Total (mg/L)	16.5	4.64	<0.050	15.5	4.09
	Strontium (Sr)-Total (mg/L)	0.695	0.155	<0.00020	0.691	0.206
	Sulfur (S)-Total (mg/L)	19.7	1.45	<0.50	20.8	5.10
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010 ^{DLM}	<0.00010
	Titanium (Ti)-Total (mg/L)	0.00634	0.0200	<0.00030	<0.00060	0.0102
	Uranium (U)-Total (mg/L)	0.00273	0.000440	<0.000010	0.00255	0.000183
	Vanadium (V)-Total (mg/L)	0.00087	0.00283	<0.00050	<0.00050	0.00129
	Zinc (Zn)-Total (mg/L)	<0.0030	0.0031	<0.0030	<0.0030	0.0034
	Zirconium (Zr)-Total (mg/L)	<0.00030	0.00048	<0.00030	<0.00030	0.00042
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD ^{RRV}	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0213	0.0389	0.0047 ^{RRV}	0.0024	0.0353
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00032	0.00061	<0.00010 ^{RRV}	0.00038	0.00049
	Barium (Ba)-Dissolved (mg/L)	0.0673	0.0417	0.00019	0.0748	0.0425
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.019	<0.010	<0.010	0.022	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	0.0000095	0.0000075	<0.0000050	<0.0000050	0.0000175
	Calcium (Ca)-Dissolved (mg/L)	55.2	18.5	<0.050	67.0	26.0
	Chromium (Cr)-Dissolved (mg/L)	0.00011	0.00041	<0.00010	<0.00010	0.00037
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00024	<0.00010 ^{RRV}	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.0104	0.00671	0.00056	0.00823	0.0826
	Iron (Fe)-Dissolved (mg/L)	0.069	0.601	<0.010	0.027	0.096
	Lead (Pb)-Dissolved (mg/L)	0.000080	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0029	<0.0010	<0.0010	0.0016	<0.0010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2095920-1 Water 12-MAY-18 09:55 W55	L2095920-2 Water 12-MAY-18 10:25 W14	L2095920-3 Water 12-MAY-18 11:00 W30	L2095920-4 Water 12-MAY-18 13:15 W10	L2095920-5 Water 14-MAY-18 09:00 W17
Grouping	Analyte					
WATER						
Dissolved Metals	Magnesium (Mg)-Dissolved (mg/L)	7.83	79.4	18.8	9.39 ^{DTC}	22.0
	Manganese (Mn)-Dissolved (mg/L)	0.0876	0.468	0.0482	0.268 ^{DTC}	0.0646
	Mercury (Hg)-Dissolved (mg/L)	0.0000083	<0.000050 ^{DLM}	<0.0000050	0.0000082	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00155	0.103	0.00724	0.000218	0.00610
	Nickel (Ni)-Dissolved (mg/L)	0.00154	0.0027	<0.00050	0.00063	0.00073
	Phosphorus (P)-Dissolved (mg/L)	0.077	<0.10 ^{DLA}	<0.050	0.062	<0.050
	Potassium (K)-Dissolved (mg/L)	1.93	94.7	4.15	5.01 ^{DTC}	3.79
	Selenium (Se)-Dissolved (mg/L)	0.000491	0.00788	0.00481	0.000092	0.000323
	Silicon (Si)-Dissolved (mg/L)	3.90	1.65 ^{DLA}	2.72	7.82 ^{DTC}	5.05
	Silver (Ag)-Dissolved (mg/L)	0.000014	<0.000020 ^{DLA}	0.000012	<0.000010 ^{DTC}	<0.000010
	Sodium (Na)-Dissolved (mg/L)	3.31	148	9.83	4.15 ^{DTC}	14.6
	Strontium (Sr)-Dissolved (mg/L)	0.239	6.05	0.735	0.244 ^{DTC}	0.728
	Sulfur (S)-Dissolved (mg/L)	2.82	766	25.3	0.64	17.6
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000020 ^{DLA}	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00020 ^{DLA}	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00272	<0.00060 ^{DLA}	0.00068	0.00089	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.000120	0.00553 ^{DLA}	0.00175	0.000045	0.00240
	Vanadium (V)-Dissolved (mg/L)	0.00053	<0.0010 ^{DLA}	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0047	<0.0020 ^{DLA}	<0.0010	0.0048	0.0017
	Zirconium (Zr)-Dissolved (mg/L)	0.00063	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2095920-6 Water 14-MAY-18 09:35 W8A	L2095920-7 Water 14-MAY-18 14:10 W16	L2095920-8 Water 14-MAY-18 15:15 W33S	L2095920-9 Water 15-MAY-18 08:10 MC1	L2095920-10 Water 15-MAY-18 08:50 W2
Grouping	Analyte					
WATER						
Dissolved Metals	Magnesium (Mg)-Dissolved (mg/L)	45.5	13.9	4.66	9.05	8.74
	Manganese (Mn)-Dissolved (mg/L)	1.98	0.145	0.0103	0.0373	0.0123
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.0121	0.00207	0.000564	0.000791	0.000798
	Nickel (Ni)-Dissolved (mg/L)	0.00126	0.00109	0.00163	0.00168	0.00164
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	6.84	2.29	0.74	1.21	1.21
	Selenium (Se)-Dissolved (mg/L)	0.00636	0.000464	0.000121	0.000156	0.000147
	Silicon (Si)-Dissolved (mg/L)	6.06	3.30	3.03	4.34	4.28
	Silver (Ag)-Dissolved (mg/L)	0.000014	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	38.2	9.11	2.53	5.74	5.55
	Strontium (Sr)-Dissolved (mg/L)	2.11	0.407	0.0937	0.219	0.220
	Sulfur (S)-Dissolved (mg/L)	96.6	14.3	1.74	3.57	3.56
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00056	0.00127	0.00129	0.00088	0.00111
	Uranium (U)-Dissolved (mg/L)	0.00312	0.000879	0.000032	0.000567	0.000561
	Vanadium (V)-Dissolved (mg/L)	0.00080	<0.00050	<0.00050	0.00083	0.00074
	Zinc (Zn)-Dissolved (mg/L)	0.0467	0.0024	0.0014	0.0070	0.0010
	Zirconium (Zr)-Dissolved (mg/L)	0.00031	<0.00030	0.00047	0.00038	0.00036

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2095920-11 Water 15-MAY-18 09:55 W3	L2095920-12 Water 15-MAY-18 10:30 W7	L2095920-13 Water 12-MAY-18 F-BL	L2095920-14 Water 14-MAY-18 DUP	L2095920-15 Water 14-MAY-18 10:15 W55
Grouping	Analyte					
WATER						
Dissolved Metals	Magnesium (Mg)-Dissolved (mg/L)	27.7	6.91	<0.10 ^{RRV}	21.6	6.64
	Manganese (Mn)-Dissolved (mg/L)	0.106	0.0422	0.00033	0.0575	0.00731
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	0.0000076
	Molybdenum (Mo)-Dissolved (mg/L)	0.00429	0.000699	<0.000050	0.00598	0.00134
	Nickel (Ni)-Dissolved (mg/L)	0.00140	0.00174	<0.00050	0.00070	0.00137
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	2.23	0.70	<0.10	3.81	1.56
	Selenium (Se)-Dissolved (mg/L)	0.000305	0.000137	<0.000050	0.000338	0.000323
	Silicon (Si)-Dissolved (mg/L)	5.44	4.26	<0.050	5.27	3.30
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	15.7	4.22	<0.050	14.4	3.69
	Strontium (Sr)-Dissolved (mg/L)	0.703	0.157	<0.00020	0.710	0.208
	Sulfur (S)-Dissolved (mg/L)	15.9	1.37	<0.50	18.0	4.37
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00079	0.00131	0.00040 ^{RRV}	<0.00030	0.00163
	Uranium (U)-Dissolved (mg/L)	0.00262	0.000375	<0.000010	0.00234	0.000174
	Vanadium (V)-Dissolved (mg/L)	<0.00050	0.00128	<0.00050	<0.00050	0.00053
	Zinc (Zn)-Dissolved (mg/L)	0.0029	<0.0010	<0.0010	0.0026	0.0016
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	0.00048	<0.00030	<0.00030	0.00046

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Aluminum (Al)-Total	MB-LOR	L2095920-13, -4
Laboratory Control Sample	Aluminum (Al)-Total	MES	L2095920-13, -4
Laboratory Control Sample	Boron (B)-Total	MES	L2095920-1, -10, -11, -12, -13, -14, -15, -3, -5, -6, -7, -8, -9
Laboratory Control Sample	Iron (Fe)-Total	MES	L2095920-1, -10, -11, -12, -13, -14, -15, -3, -5, -6, -7, -8, -9
Matrix Spike	Dissolved Organic Carbon	MS-B	L2095920-10, -11, -12, -13, -14, -5, -7, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2095920-1, -10, -11, -12, -13, -14, -15, -2, -3, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2095920-4
Matrix Spike	Boron (B)-Dissolved	MS-B	L2095920-1, -10, -11, -12, -13, -14, -15, -2, -3, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2095920-1, -10, -11, -12, -13, -14, -15, -2, -3, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2095920-4
Matrix Spike	Copper (Cu)-Dissolved	MS-B	L2095920-1, -10, -11, -12, -13, -14, -15, -2, -3, -5, -6, -7, -8, -9
Matrix Spike	Copper (Cu)-Dissolved	MS-B	L2095920-4
Matrix Spike	Lithium (Li)-Dissolved	MS-B	L2095920-1, -10, -11, -12, -13, -14, -15, -2, -3, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2095920-1, -10, -11, -12, -13, -14, -15, -2, -3, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2095920-4
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2095920-1, -10, -11, -12, -13, -14, -15, -2, -3, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2095920-4
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2095920-1, -10, -11, -12, -13, -14, -15, -2, -3, -5, -6, -7, -8, -9
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2095920-4
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2095920-1, -10, -11, -12, -13, -14, -15, -2, -3, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2095920-4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2095920-1, -10, -11, -12, -13, -14, -15, -2, -3, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2095920-4
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2095920-1, -10, -11, -12, -13, -14, -15, -2, -3, -5, -6, -7, -8, -9
Matrix Spike	Boron (B)-Total	MS-B	L2095920-13
Matrix Spike	Calcium (Ca)-Total	MS-B	L2095920-13
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2095920-13
Matrix Spike	Manganese (Mn)-Total	MS-B	L2095920-13
Matrix Spike	Sodium (Na)-Total	MS-B	L2095920-13
Matrix Spike	Strontium (Sr)-Total	MS-B	L2095920-13
Matrix Spike	Sulfur (S)-Total	MS-B	L2095920-13
Matrix Spike	Uranium (U)-Total	MS-B	L2095920-13

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLAI	Detection limit raised due to low level analytical interference or background.
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DTC	Dissolved concentration exceeds total. Results were confirmed by re-analysis.
DTMF	Dissolved concentration exceeds total for field-filtered metals sample. Metallic contaminants may have been introduced to dissolved sample during field filtration.
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter

Reference Information

MS-B Scan (considered acceptable as per OMOE & CCME).
 Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
 RRV Reported Result Verified By Repeat Analysis

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
BR-L-IC-N-VA	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
F-IC-N-VA	Water	Fluoride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			

Reference Information

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)
 Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
 This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)
 Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)
 Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value
 This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode
 It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)
 Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)
 This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
 The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC
 This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-05-16 A 1 of 2 2018-05-16 A 2 of 2

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com



L2095920-COFC

COC Number: 2018-05-16 A

Page 2 of 2

Report To		Report Format / Distribution		Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply													
Company:	Minto Explorations Ltd.	Select Report Format:	☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)	Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply													
Contact:	Minto Environment - Coordinator	Quality Control (QC) Report with Report	☒ YES ☐ NO	PRIORITY (Business Days)	4 day [P4] ☐				1 Business day [E1] ☐				EMERGENCY				
Phone:	1-804-759-4659	☒ Compare Results to Criteria on Report - provide details below if box checked	3 day [P3] ☐				Same Day, Weekend or Statutory holiday [E0] ☐										
Company address below will appear on the final report		Select Distribution:	☒ EMAIL ☐ MAIL ☐ FAX		2 day [P2] ☐												
Street:	2100-510 West Georgia St.	Email 1 or Fax	minto_environment@mintomine.com	Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm													
City/Province:	Vancouver, British Columbia	Email 2		For tests that can not be performed according to the service level selected, you will be contacted.													
Postal Code:	V6B 0M3	Email 3		Analysis Request													
Invoice To	Same as Report To ☐ YES ☒ NO	Invoice Distribution		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below													
	Copy of Invoice with Report ☐ YES ☒ NO	Select Invoice Distribution:	☒ EMAIL ☐ MAIL ☐ FAX														
Company:	Minto Explorations Ltd.	Email 1 or Fax	ap@mintomine.com														
Contact:	Ruth Cayetano	Email 2															
Project Information		Oil and Gas Required Fields (client use)															
ALS Account # / Quote #:		AFE/Cost Center:	PO#														
Job #:		Major/Minor Code:	Routing Code:														
PO / AFE:	229098 (WUL)	Requisitioner:															
LSD:		Location:															
ALS Lab Work Order # (lab use only)		ALS Contact:	Shane Stack	Sampler:	CR/CP/EB												
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	pH / Conductivity / Alkalinity / Anions	Total Suspended Solids (TSS)	Total Dissolved Solids (TDS)	Total Metals (TM), Hardness	Dissolved Metals (DM) (Filtered and preserved)	Total Mercury, Hardness	Dissolved Mercury [1] (Filtered + preserved)	Total Nutrients (Ammonia)	Dissolved Organic Carbon (DOC)	Number of Containers			
	W3	15-May-18	9:55	Water	R	R	R	R	R	R	R	R	R		7		
	W7	15-May-18	10:30	Water	R	R	R	R	R	R	R	R	R		7		
	F-BL	12-May-18		Water	R	R	R	R	R	R	R	R	R		7		
	Dup	14-May-18		Water	R	R	R	R	R	R	R	R	R		7		
	W55	14-May-18	10:15	Water	R	R	R	R	R	R	R	R	R		6		
Drinking Water (DW) Samples ¹ (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)			SAMPLE CONDITION AS RECEIVED (lab use only)												
Are samples taken from a Regulated DW System? ☐ YES ☒ NO					Frozen ☐ SIF Observations Yes ☐ No ☐												
Are samples for human drinking water use? ☐ YES ☒ NO					Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐												
					Cooling Initiated ☒												
					INITIAL COOLER TEMPERATURES °C 7.0 FINAL COOLER TEMPERATURES °C 10												
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)												
Released by:	Corey Roberts	Date:	2018-05-16	Time:	Received by:	L21HF	Date:	16 May 2018	Time:	15:52	Received by:	L1A	Date:	5/17	Time:	2:20p	

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

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L2095920-COFC

COC Number: 2018-05-16 A

Page 1 of 2

Report To Contact and company name below will appear on the final report		Report Format / Distribution				Select Service Level - Please confirm all E&P TATs with your AM - surcharges will apply															
Company: Minto Explorations Ltd.		Select Report Format: ☒ PDF ☐ EXCEL ☒ EDO (DIGITAL)				Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply															
Contact: Minto Environment - Coordinator		Quality Control (QC) Report with Report ☒ YES ☐ NO				PRIORITY (Business Days)															
Phone: 1-604-759-4659		☒ Compare Results to Criteria on Report - provide details below if box checked				EMERGENCY															
Company address below will appear on the final report		Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX				4 day [P4] ☐ 1 Business day [E1] ☐															
Street: 2100-510 West Georgia St.		Email 1 or Fax minto_environment@mintomine.com				3 day [P3] ☐ Same Day, Weekend or ☐															
City/Province: Vancouver, British Columbia		Email 2				2 day [P2] ☐ Statutory holiday [E0] ☐															
Postal Code: V6B 0M3		Email 3				Date and Time Required for all E&P TATs: dd-mm-yy hh:mm															
Invoice To: Same as Report To ☐ YES ☒ NO		Invoice Distribution				Analysis Request															
Copy of Invoice with Report ☐ YES ☒ NO		Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX				Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below															
Company: Minto Explorations Ltd.		Email 1 or Fax ap@mintomine.com																			
Contact: Ruth Cayetano		Email 2																			
Project Information		Oil and Gas Required Fields (client use)																			
ALS Account # / Quote #:		AFE/Cost Center:		PO#																	
Job #:		Major/Minor Code:		Routing Code:																	
PO / AFE: 229096 (WUL)		Requisitioner:																			
LSD:		Location:																			
ALS Lab Work Order # (lab use only)		ALS Contact: Shane Stack		Sampler: CR/CP/EB/DF																	
ALS Sample # (lab use only)		Sample Identification and/or Coordinates (This description will appear on the report)		Date (dd-mm-yy)		Time (hh:mm)		Sample Type													
W55				12-May-18		9:55		Water													
W14				12-May-18		10:25		Water													
W30				12-May-18		11:00		Water													
W10				12-May-18		13:15		Water													
W17				14-May-18		9:00		Water													
W8A				14-May-18		9:35		Water													
W16				14-May-18		14:10		Water													
W33S				14-May-18		15:15		Water													
MC1				15-May-18		8:10		Water													
W2				15-May-18		8:50		Water													
Drinking Water (DW) Samples¹ (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)				SAMPLE CONDITION AS RECEIVED (lab use only)															
Are samples taken from a Regulated DW System? ☐ YES ☒ NO						Frozen ☐ SIF Observations Yes ☐ No ☐															
Are samples for human drinking water use? ☐ YES ☒ NO						Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐															
						Cooling Initiated ☒															
						INITIAL COOLER TEMPERATURES °C: 7.0 FINAL COOLER TEMPERATURES °C: 10															
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)				FINAL SHIPMENT RECEPTION (lab use only)															
Released by: Corey Roberts		Date: 2018-05-16		Time:		Received by: [Signature]		Date: 16 May 2018		Time: 15:50		Received by: [Signature]		Date: 5/17		Time: [Signature]					

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1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 23-MAY-18
Report Date: 05-JUN-18 18:28 (MT)
Version: FINAL REV. 2

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2098844

Project P.O. #: 22100

Job Reference:

C of C Numbers: 2018-05-23 A 1 of 2, 2018-05-23 A 2 of 2

Legal Site Desc:

Comments: 5-JUN-2018 Please note, this report has been revised to amend the sampling time on sample 4.

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2098844-1 Water 17-MAY-18 09:30 SS100	L2098844-2 Water 17-MAY-18 10:15 SS32	L2098844-3 Water 18-MAY-18 14:20 SS33	L2098844-4 Water 18-MAY-18 14:40 SS5	L2098844-5 Water 18-MAY-18 14:50 SS6
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	1080	197	455	1230	1110
	Hardness (as CaCO3) (mg/L)	529	91.4	196	553	486
	pH (pH)	8.43	8.21	8.25	8.33	8.32
	Total Suspended Solids (mg/L)	5.5	<3.0	30.1	9.5	<3.0
	TDS (Calculated) (mg/L)	739	106	280	872	780
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	263	99.8	127	177	170
	Alkalinity, Carbonate (as CaCO3) (mg/L)	15.0	<1.0	<1.0	5.0	4.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	278	99.8	127	182	174
	Ammonia, Total (as N) (mg/L)	0.0058	<0.0050	0.0284	0.0684	0.0309
	Chloride (Cl) (mg/L)	18.7	<1.0	2.0	8.0	7.1
	Nitrate and Nitrite (as N) (mg/L)	20.7	0.321	10.7	50.9	44.2
	Nitrate (as N) (mg/L)	20.6	0.321	10.7	50.8	44.2
	Nitrite (as N) (mg/L)	0.0751	<0.0010	0.0110	0.0305	0.0284
	Sulfate (SO4) (mg/L)	242	6.2	65.6	289	261
	Anion Sum (meq/L)	12.6	2.16	4.75	13.5	12.3
	Cation Sum (meq/L)	12.0	2.00	4.65	12.8	11.3
	Cation - Anion Balance (%)	-2.6	-3.8	-1.1	-2.7	-4.4
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0047	<0.0010	0.0102	0.0165	0.0038
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00014	0.00015
	Arsenic (As)-Dissolved (mg/L)	0.00044	0.00013	0.00033	0.00037	0.00031
	Barium (Ba)-Dissolved (mg/L)	0.112	0.0175	0.0436	0.0581	0.0516
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	0.000022	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.033	<0.010	0.030	0.050	0.046
	Cadmium (Cd)-Dissolved (mg/L)	0.0000204	<0.0000050	0.0000874	0.000107	0.0000930
	Calcium (Ca)-Dissolved (mg/L)	145	28.8	56.7	159	140
	Chromium (Cr)-Dissolved (mg/L)	0.00010	<0.00010	0.00011	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	0.00012	<0.00010	0.00012	0.00013	0.00014
	Copper (Cu)-Dissolved (mg/L)	0.0443	0.00045	0.338	0.144	0.152
	Iron (Fe)-Dissolved (mg/L)	0.037	<0.010	0.044	0.039	<0.010
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0040	<0.0010	0.0019	0.0049	0.0047
	Magnesium (Mg)-Dissolved (mg/L)	40.8	4.74	13.3	37.5	33.0
	Manganese (Mn)-Dissolved (mg/L)	0.0334	<0.00010	0.0398	0.119	0.0544

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2098844-6 Water 18-MAY-18 15:00 SS7	L2098844-7 Water 18-MAY-18 15:10 SS8	L2098844-8 Water 19-MAY-18 10:15 SS101	L2098844-9 Water 19-MAY-18 11:10 SS39	L2098844-10 Water 19-MAY-18 13:30 W32
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	1030	1370	40.0	585	1250
	Hardness (as CaCO3) (mg/L)	432	642	16.8	284	619
	pH (pH)	8.45	8.38	7.45	8.38	8.14
	Total Suspended Solids (mg/L)	<3.0	3.1	12.1	3.5	5.1
	TDS (Calculated) (mg/L)	707	1020	20.6	368	854
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	206	182	16.7	174	244
	Alkalinity, Carbonate (as CaCO3) (mg/L)	13.0	8.6	<1.0	6.6	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	219	190	16.7	180	244
	Ammonia, Total (as N) (mg/L)	0.0678	0.121	0.0128	0.0051	0.0297
	Chloride (Cl) (mg/L)	5.9	8.9	<1.0 ^[U]	2.0	3.5
	Nitrate and Nitrite (as N) (mg/L)	36.0	52.1	0.214	9.43	35.6
	Nitrate (as N) (mg/L)	35.9	52.0	0.205	9.41	35.6
	Nitrite (as N) (mg/L)	0.110	0.125	0.0085	0.0191	0.0293
	Sulfate (SO4) (mg/L)	214	384	1.7	100	294
	Anion Sum (meq/L)	11.6	15.8	0.39	6.43	13.6
	Cation Sum (meq/L)	10.4	14.8	0.40	6.36	13.6
	Cation - Anion Balance (%)	-5.4	-3.3	1.3	-0.6	-0.1
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0031	0.0023	0.0532	0.0055	0.0077
	Antimony (Sb)-Dissolved (mg/L)	0.00022	0.00028	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00038	0.00037	0.00013	0.00035	0.00023
	Barium (Ba)-Dissolved (mg/L)	0.0595	0.0641	0.0168	0.0982	0.0757
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.052	0.051	<0.010	0.018	0.035
	Cadmium (Cd)-Dissolved (mg/L)	0.000125	0.000164	<0.0000050	0.0000240	0.0000389
	Calcium (Ca)-Dissolved (mg/L)	123	188	5.59	76.4	180
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	0.00017	0.00015	0.00012	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.173	0.118	0.00962	0.0513	0.0497
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	0.047	0.047	0.016
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0045	0.0057	<0.0010	0.0028	0.0032
	Magnesium (Mg)-Dissolved (mg/L)	30.4	42.1	0.70	22.7	41.1
	Manganese (Mn)-Dissolved (mg/L)	0.129	0.181	0.0241	0.0861	0.0485

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2098844-11 Water 19-MAY-18 13:45 SS58	L2098844-12 Water 19-MAY-18 14:00 SS31	L2098844-13 Water 19-MAY-18 14:10 SS13	L2098844-14 Water 19-MAY-18 DUP	
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	1070	882	922	579	
	Hardness (as CaCO3) (mg/L)	551	454	464	285	
	pH (pH)	8.34	8.26	8.43	8.36	
	Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0	<3.0	
	TDS (Calculated) (mg/L)	719	599	629	368	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	307	264	247	173	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	7.8	<1.0	13.4	5.0	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Total (as CaCO3) (mg/L)	315	264	260	178	
	Ammonia, Total (as N) (mg/L)	0.0669	0.122	0.0422	<0.0050	
	Chloride (Cl) (mg/L)	3.4	2.5	2.3	1.9	
	Nitrate and Nitrite (as N) (mg/L)	29.2	19.3	22.9	9.42	
	Nitrate (as N) (mg/L)	29.2	19.1	22.9	9.40	
	Nitrite (as N) (mg/L)	0.0306	0.276	0.0600	0.0189	
	Sulfate (SO4) (mg/L)	180	169	178	99.9	
	Anion Sum (meq/L)	12.2	10.3	10.6	6.39	
	Cation Sum (meq/L)	11.8	9.79	10.0	6.37	
	Cation - Anion Balance (%)	-1.8	-2.4	-2.9	-0.2	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0031	0.0152	0.0053	0.0056	
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Arsenic (As)-Dissolved (mg/L)	0.00035	0.00038	0.00029	0.00036	
	Barium (Ba)-Dissolved (mg/L)	0.136	0.101	0.0515	0.0983	
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	0.023	0.014	0.022	0.018	
	Cadmium (Cd)-Dissolved (mg/L)	0.0000124	0.0000351	0.0000709	0.0000228	
	Calcium (Ca)-Dissolved (mg/L)	161	137	146	78.1	
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00150	0.00028	<0.00010	
	Copper (Cu)-Dissolved (mg/L)	0.0291	0.0570	0.0882	0.0501	
	Iron (Fe)-Dissolved (mg/L)	<0.010	0.035	0.015	0.051	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.0031	0.0024	0.0027	0.0027	
	Magnesium (Mg)-Dissolved (mg/L)	36.4	27.0	23.9	21.9	
	Manganese (Mn)-Dissolved (mg/L)	0.0249	0.664	0.207	0.0845	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2098844-1 Water 17-MAY-18 09:30 SS100	L2098844-2 Water 17-MAY-18 10:15 SS32	L2098844-3 Water 18-MAY-18 14:20 SS33	L2098844-4 Water 18-MAY-18 14:40 SS5	L2098844-5 Water 18-MAY-18 14:50 SS6
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	0.0000107	0.0000053	0.0000059
	Molybdenum (Mo)-Dissolved (mg/L)	0.0152	0.00290	0.0112	0.0103	0.00893
	Nickel (Ni)-Dissolved (mg/L)	0.00056	<0.00050	<0.00050	<0.00050	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	6.23	1.21	3.53	7.05	5.69
	Selenium (Se)-Dissolved (mg/L)	0.00981	0.000154	0.00719	0.0340	0.0284
	Silicon (Si)-Dissolved (mg/L)	5.71	5.86	3.67	5.78	5.69
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	0.000046	0.000034	0.000039
	Sodium (Na)-Dissolved (mg/L)	28.6	3.37	14.1	36.3	31.9
	Strontium (Sr)-Dissolved (mg/L)	2.17	0.152	1.45	3.27	2.84
	Sulfur (S)-Dissolved (mg/L)	82.2	1.88	22.0	102	88.0
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00036	<0.00030	0.00100	0.00076	0.00031
	Uranium (U)-Dissolved (mg/L)	0.00493	0.000361	0.00173	0.00802	0.00693
	Vanadium (V)-Dissolved (mg/L)	<0.00050	0.00061	0.00056	0.00052	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0020	<0.0010	<0.0010	0.0016	0.0014
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2098844-6 Water 18-MAY-18 15:00 SS7	L2098844-7 Water 18-MAY-18 15:10 SS8	L2098844-8 Water 19-MAY-18 10:15 SS101	L2098844-9 Water 19-MAY-18 11:10 SS39	L2098844-10 Water 19-MAY-18 13:30 W32
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	0.0000078	0.0000054	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.0102	0.0125	0.00129	0.00671	0.0113
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	6.33	7.36	0.74	4.22	5.58
	Selenium (Se)-Dissolved (mg/L)	0.0224	0.0401	0.000103	0.00552	0.0174
	Silicon (Si)-Dissolved (mg/L)	5.68	5.69	0.707	4.15	6.10
	Silver (Ag)-Dissolved (mg/L)	0.000015	0.000016	<0.000010	0.000013	<0.000010
	Sodium (Na)-Dissolved (mg/L)	36.5	40.2	0.713	12.9	25.5
	Strontium (Sr)-Dissolved (mg/L)	2.73	3.50	0.0279	1.26	2.82
	Sulfur (S)-Dissolved (mg/L)	73.2	133	0.50	33.6	99.2
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	0.00267	0.00048	0.00130
	Uranium (U)-Dissolved (mg/L)	0.00439	0.00566	0.000046	0.00232	0.00450
	Vanadium (V)-Dissolved (mg/L)	0.00056	0.00052	<0.00050	<0.00050	0.00058
	Zinc (Zn)-Dissolved (mg/L)	0.0017	0.0016	<0.0010	0.0014	0.0012
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2098844-11 Water 19-MAY-18 13:45 SS58	L2098844-12 Water 19-MAY-18 14:00 SS31	L2098844-13 Water 19-MAY-18 14:10 SS13	L2098844-14 Water 19-MAY-18 DUP	
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	0.0000092	<0.0000050	
	Molybdenum (Mo)-Dissolved (mg/L)	0.00786	0.00739	0.00755	0.00660	
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Potassium (K)-Dissolved (mg/L)	7.36	6.04	6.89	4.11	
	Selenium (Se)-Dissolved (mg/L)	0.0106	0.00776	0.00865	0.00529	
	Silicon (Si)-Dissolved (mg/L)	6.19	5.22	5.45	4.20	
	Silver (Ag)-Dissolved (mg/L)	0.000012	0.000011	<0.000010	0.000011	
	Sodium (Na)-Dissolved (mg/L)	13.6	12.0	13.3	12.8	
	Strontium (Sr)-Dissolved (mg/L)	1.57	1.12	1.25	1.28	
	Sulfur (S)-Dissolved (mg/L)	61.0	57.1	58.5	34.0	
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	0.00105	<0.00030	0.00056	
	Uranium (U)-Dissolved (mg/L)	0.00508	0.00462	0.00406	0.00233	
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	0.00072	<0.00050	
	Zinc (Zn)-Dissolved (mg/L)	0.0011	0.0022	0.0017	0.0015	
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2098844-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2098844-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Copper (Cu)-Dissolved	MS-B	L2098844-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2098844-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2098844-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2098844-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2098844-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2098844-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2098844-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Uranium (U)-Dissolved	MS-B	L2098844-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sulfate (SO4)	MS-B	L2098844-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
[U]	The analyte was not detected above the EDL.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BR-L-IC-N-WR	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
CL-L-IC-N-WR	Water	Chloride in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
F-IC-N-WR	Water	Fluoride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction			

Reference Information

with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = \frac{[\text{Cation Sum} - \text{Anion Sum}]}{[\text{Cation Sum} + \text{Anion Sum}]}$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-WR Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-05-23 A 1 of 2 2018-05-23 A 2 of 2

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lw - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

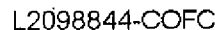
Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

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Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 23-MAY-18
Report Date: 05-JUN-18 15:14 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2098857
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-05-23 B
Legal Site Desc:

Shane Stack
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2098857-1 Water 21-MAY-18 09:20 W17	L2098857-2 Water 21-MAY-18 09:50 W16	L2098857-3 Water 21-MAY-18 13:50 MC1	L2098857-4 Water 21-MAY-18 14:45 C4	L2098857-5 Water 21-MAY-18 15:10 W46
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	480	366	234	165	229
	Hardness (as CaCO3) (mg/L)	234	177	112	83.5	112
	pH (pH)	8.44	8.26	8.29	8.14	8.27
	Total Suspended Solids (mg/L)	17.4	4.4	<3.0	3.4	<3.0
	TDS (Calculated) (mg/L)	283	215	131	91.3	129
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	199	135	114	78.4	110
	Alkalinity, Carbonate (as CaCO3) (mg/L)	9.2	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	208	135	114	78.4	110
	Ammonia, Total (as N) (mg/L)	0.0057	0.0123	0.0076	0.0126	0.0072
	Chloride (Cl) (mg/L)	6.5	5.5	1.3	<1.0 ^{DLDS}	1.3
	Nitrate and Nitrite (as N) (mg/L)	0.081	0.900	<0.025	<0.025 ^[U]	<0.025 ^[U]
	Nitrate (as N) (mg/L)	0.081	0.892	<0.025 ^[U]	<0.025 ^[U]	<0.025 ^[U]
	Nitrite (as N) (mg/L)	<0.0010	0.0085	<0.0010	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	51.6	48.6	14.2	9.0	14.4
	Anion Sum (meq/L)	5.42	3.94	2.60	1.76	2.54
	Cation Sum (meq/L)	5.41	4.07	2.61	1.92	2.59
	Cation - Anion Balance (%)	-0.1	1.6	0.0	4.5	1.0
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	9.79	20.0	14.0	17.3	11.5
Total Metals	Aluminum (Al)-Total (mg/L)	0.0478	0.111	0.107	0.0273	0.0595
	Antimony (Sb)-Total (mg/L)	0.00012	0.00010	0.00010	0.00014	<0.00010
	Arsenic (As)-Total (mg/L)	0.00044	0.00044	0.00067	0.00055	0.00046
	Barium (Ba)-Total (mg/L)	0.0877	0.0706	0.0510	0.0425	0.0488
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.026	0.016	<0.010	<0.010	<0.010
	Cadmium (Cd)-Total (mg/L)	0.0000270	0.0000131	0.0000053	0.0000103	<0.0000050
	Calcium (Ca)-Total (mg/L)	63.5	48.1	28.8	21.9	27.9
	Chromium (Cr)-Total (mg/L)	0.00020	0.00027	0.00052	0.00047	0.00028
	Cobalt (Co)-Total (mg/L)	0.00020	0.00016	0.00023	0.00015	0.00014
	Copper (Cu)-Total (mg/L)	0.0233	0.0509	0.00436	0.00259	0.00458
	Iron (Fe)-Total (mg/L)	1.41	0.307	0.270	0.168	0.180
	Lead (Pb)-Total (mg/L)	0.000505	0.000095	0.000092	<0.000050	0.000070
	Lithium (Li)-Total (mg/L)	0.0018	0.0013	0.0012	<0.0010	0.0011
	Magnesium (Mg)-Total (mg/L)	21.0	15.1	11.3	7.20	11.4
	Manganese (Mn)-Total (mg/L)	0.312	0.150	0.0916	0.0236	0.0304

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2098857-6 Water 21-MAY-18 15:30 W6	L2098857-7 Water 22-MAY-18 08:50 W3	L2098857-8 Water 22-MAY-18 14:00 W2	L2098857-9 Water 22-MAY-18 DUP	L2098857-10 Water 21-MAY-18 DUP
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	123	513	242	244	162
	Hardness (as CaCO3) (mg/L)	65.6	257	126	121	79.5
	pH (pH)	8.04	8.44	8.22	8.23	8.03
	Total Suspended Solids (mg/L)	<3.0	<3.0	3.1	<3.0	<3.0
	TDS (Calculated) (mg/L)	66.0	304	140	140	87.3
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	62.8	217	117	121	74.5
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	11.4	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	62.8	228	117	121	74.5
	Ammonia, Total (as N) (mg/L)	0.0130	0.0100	0.0053	<0.0050	0.0121
	Chloride (Cl) (mg/L)	<1.0 ^[U]	5.2	1.4	1.5	<1.0 ^[U]
	Nitrate and Nitrite (as N) (mg/L)	<0.025	0.129	<0.025	<0.025	<0.025
	Nitrate (as N) (mg/L)	<0.025 ^[U]	0.129	<0.025 ^[U]	<0.025 ^[U]	<0.025 ^[U]
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	1.1	55.4	15.7	15.7	9.1
	Anion Sum (meq/L)	1.28	5.86	2.71	2.78	1.68
	Cation Sum (meq/L)	1.48	6.00	2.92	2.80	1.83
	Cation - Anion Balance (%)	7.4	1.1	3.7	0.4	4.4
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	21.0	8.21	12.7	12.9	17.4
Total Metals	Aluminum (Al)-Total (mg/L)	0.0476	0.0188	0.0166	0.0223	0.0245
	Antimony (Sb)-Total (mg/L)	0.00011	<0.00010	<0.00010	<0.00010	0.00011
	Arsenic (As)-Total (mg/L)	0.00054	0.00029	0.00052	0.00053	0.00056
	Barium (Ba)-Total (mg/L)	0.0337	0.0697	0.0490	0.0486	0.0424
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	<0.010	0.024	<0.010	<0.010	<0.010
	Cadmium (Cd)-Total (mg/L)	0.0000077	0.0000143	<0.0000050	<0.0000050	<0.0000050
	Calcium (Ca)-Total (mg/L)	18.4	58.2	31.2	30.7	21.5
	Chromium (Cr)-Total (mg/L)	0.00037	0.00012	0.00023	0.00027	0.00043
	Cobalt (Co)-Total (mg/L)	0.00013	<0.00010	<0.00010	<0.00010	0.00013
	Copper (Cu)-Total (mg/L)	0.00288	0.00535	0.00351	0.00347	0.00255
	Iron (Fe)-Total (mg/L)	0.138	0.052	0.085	0.096	0.152
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	<0.0010	0.0034	0.0013	0.0012	<0.0010
	Magnesium (Mg)-Total (mg/L)	5.06	30.3	11.8	11.8	7.11
	Manganese (Mn)-Total (mg/L)	0.00933	0.120	0.00757	0.00867	0.0225

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2098857-1 Water 21-MAY-18 09:20 W17	L2098857-2 Water 21-MAY-18 09:50 W16	L2098857-3 Water 21-MAY-18 13:50 MC1	L2098857-4 Water 21-MAY-18 14:45 C4	L2098857-5 Water 21-MAY-18 15:10 W46
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.00564	0.00243	0.00114	0.000727	0.00128
	Nickel (Ni)-Total (mg/L)	0.00111	0.00104	0.00152	0.00205	0.00117
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	3.70	2.46	1.39	0.94	1.29
	Selenium (Se)-Total (mg/L)	0.000329	0.000571	0.000181	0.000100	0.000162
	Silicon (Si)-Total (mg/L)	5.96	4.18	5.23	5.17	4.84
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	14.5	9.98	7.36	4.81	7.13
	Strontium (Sr)-Total (mg/L)	0.682	0.447	0.275	0.144	0.278
	Sulfur (S)-Total (mg/L)	19.4	17.9	5.26	3.38	5.20
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	0.00196	<0.0048 ^{DLM}	0.00443	0.00101	0.00245
	Uranium (U)-Total (mg/L)	0.00230	0.00102	0.000943	0.000312	0.000989
	Vanadium (V)-Total (mg/L)	0.00074	0.00082	0.00124	0.00058	0.00109
	Zinc (Zn)-Total (mg/L)	0.0244	<0.0030	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	<0.00030	0.00032	<0.00030	0.00033	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0021	0.0203	0.0140	0.0141	0.0122
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00037	0.00038	0.00058	0.00050	0.00043
	Barium (Ba)-Dissolved (mg/L)	0.0725	0.0742	0.0511	0.0469	0.0486
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.024	0.015	<0.010	<0.010	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	0.0000071	0.0000180	0.0000077	<0.0000050	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	61.7	48.4	28.0	22.2	27.3
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00013	0.00015	0.00035	0.00015
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00012	0.00015	0.00012	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.0113	0.0453	0.00400	0.00252	0.00409
	Iron (Fe)-Dissolved (mg/L)	0.026	0.127	0.098	0.103	0.078
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0017	0.0012	0.0011	<0.0010	0.0010
	Magnesium (Mg)-Dissolved (mg/L)	19.4	13.7	10.2	6.83	10.5
	Manganese (Mn)-Dissolved (mg/L)	0.0566	0.136	0.0776	0.0207	0.0238

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2098857-6 Water 21-MAY-18 15:30 W6	L2098857-7 Water 22-MAY-18 08:50 W3	L2098857-8 Water 22-MAY-18 14:00 W2	L2098857-9 Water 22-MAY-18 DUP	L2098857-10 Water 21-MAY-18 DUP
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.000401	0.00519	0.00122	0.00119	0.000715
	Nickel (Ni)-Total (mg/L)	0.00196	0.00110	0.00115	0.00112	0.00202
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	0.68	2.38	1.49	1.47	0.95
	Selenium (Se)-Total (mg/L)	0.000102	0.000293	0.000131	0.000119	0.000120
	Silicon (Si)-Total (mg/L)	5.30	6.44	4.85	4.72	4.94
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	3.19	18.0	7.67	7.63	4.85
	Strontium (Sr)-Total (mg/L)	0.0792	0.751	0.294	0.288	0.141
	Sulfur (S)-Total (mg/L)	0.59	20.9	5.62	5.66	3.25
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	0.00161	<0.00060 ^{DLM}	0.00067	0.00081	0.00087
	Uranium (U)-Total (mg/L)	0.000078	0.00300	0.00104	0.00102	0.000303
	Vanadium (V)-Total (mg/L)	0.00085	0.00051	0.00083	0.00085	0.00059
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	0.00032
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0165	0.0067	0.0118	0.0090	0.0138
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00049	0.00030	0.00051	0.00050	0.00048
	Barium (Ba)-Dissolved (mg/L)	0.0348	0.0710	0.0530	0.0516	0.0432
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	<0.010	0.021	<0.010	<0.010	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	0.0000073	0.0000069	0.0000066	0.0000068	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	18.2	57.3	31.4	30.8	21.2
	Chromium (Cr)-Dissolved (mg/L)	0.00029	<0.00010	0.00019	0.00022	0.00036
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	0.00012
	Copper (Cu)-Dissolved (mg/L)	0.00294	0.00473	0.00350	0.00323	0.00255
	Iron (Fe)-Dissolved (mg/L)	0.069	0.039	0.064	0.059	0.097
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	<0.0010	0.0032	0.0012	0.0012	<0.0010
	Magnesium (Mg)-Dissolved (mg/L)	4.92	27.7	11.5	10.7	6.49
	Manganese (Mn)-Dissolved (mg/L)	0.00396	0.117	0.00437	0.00381	0.0195

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2098857-1 Water 21-MAY-18 09:20 W17	L2098857-2 Water 21-MAY-18 09:50 W16	L2098857-3 Water 21-MAY-18 13:50 MC1	L2098857-4 Water 21-MAY-18 14:45 C4	L2098857-5 Water 21-MAY-18 15:10 W46
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00635	0.00216	0.00106	0.000665	0.00119
	Nickel (Ni)-Dissolved (mg/L)	0.00056	0.00085	0.00110	0.00195	0.00089
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	3.68	2.52	1.41	0.99	1.30
	Selenium (Se)-Dissolved (mg/L)	0.000382	0.000550	0.000134	0.000119	0.000114
	Silicon (Si)-Dissolved (mg/L)	5.30	3.53	4.49	4.62	4.52
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	14.7	10.2	7.43	5.04	7.33
	Strontium (Sr)-Dissolved (mg/L)	0.689	0.447	0.274	0.149	0.275
	Sulfur (S)-Dissolved (mg/L)	18.5	16.0	4.55	3.11	4.82
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	0.00084	0.00082	<0.00054 ^{DLM}	0.00046
	Uranium (U)-Dissolved (mg/L)	0.00213	0.000955	0.000914	0.000286	0.000975
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	0.00087	<0.00050	0.00078
	Zinc (Zn)-Dissolved (mg/L)	0.0014	<0.0010	<0.0010	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	0.00034	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2098857-6 Water 21-MAY-18 15:30 W6	L2098857-7 Water 22-MAY-18 08:50 W3	L2098857-8 Water 22-MAY-18 14:00 W2	L2098857-9 Water 22-MAY-18 DUP	L2098857-10 Water 21-MAY-18 DUP
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.000354	0.00474	0.00114	0.00107	0.000663
	Nickel (Ni)-Dissolved (mg/L)	0.00176	0.00092	0.00103	0.00098	0.00183
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	0.71	2.39	1.56	1.48	0.96
	Selenium (Se)-Dissolved (mg/L)	0.000101	0.000272	0.000100	0.000119	0.000072
	Silicon (Si)-Dissolved (mg/L)	4.79	5.63	4.55	4.47	4.60
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	3.34	18.1	8.23	7.76	4.84
	Strontium (Sr)-Dissolved (mg/L)	0.0802	0.768	0.326	0.300	0.144
	Sulfur (S)-Dissolved (mg/L)	<0.50	17.7	4.97	4.96	2.95
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00072 ^{DLM}	<0.00030	0.00046	0.00037	<0.00060 ^{DLM}
	Uranium (U)-Dissolved (mg/L)	0.000081	0.00285	0.00102	0.000958	0.000281
	Vanadium (V)-Dissolved (mg/L)	0.00069	<0.00050	0.00075	0.00070	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	0.00033

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Cadmium (Cd)-Total	MB-LOR	L2098857-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Method Blank	Uranium (U)-Total	MB-LOR	L2098857-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Dissolved Organic Carbon	MS-B	L2098857-6
Matrix Spike	Dissolved Organic Carbon	MS-B	L2098857-6
Matrix Spike	Dissolved Organic Carbon	MS-B	L2098857-1, -2, -3, -4, -5, -7, -8
Matrix Spike	Dissolved Organic Carbon	MS-B	L2098857-10, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2098857-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2098857-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Copper (Cu)-Dissolved	MS-B	L2098857-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2098857-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2098857-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2098857-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2098857-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2098857-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Uranium (U)-Dissolved	MS-B	L2098857-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Total	MS-B	L2098857-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L2098857-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Copper (Cu)-Total	MS-B	L2098857-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2098857-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Total	MS-B	L2098857-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Total	MS-B	L2098857-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L2098857-1, -10, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
[U]	The analyte was not detected above the EDL.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-L-IC-N-WR	Water	Chloride in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

Reference Information

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-SCREEN-VA Water Conductivity Screen (Internal Use Only) APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 µm), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-WR Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

Reference Information

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-05-23 B

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

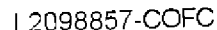
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Canada Toll Free: 1 800 668 9878

www.alsglobal.com



COC Number: 2018-05-23 B

Page 4 of 4

Report To			Report Format / Distribution			Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply																						
Contact and company name below will appear on the final report			Select Report Format: ☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)			Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply																						
Company: Minto Explorations Ltd.			Quality Control (QC) Report with Report ☒ YES ☐ NO			PRIORITY (Business Days)		4 day [P4] ☐				EMERGENCY		1 Business day [E1] ☐														
Contact: Minto Environment - Coordinator			☒ Compare Results to Criteria on Report - provide details below if box checked					3 day [P3] ☐						Same Day, Weekend or Statutory holiday [E0] ☐														
Phone: 1-604-759-4659			Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX					2 day [P2] ☐																				
Company address below will appear on the final report			Email 1 or Fax minto_environment@mintomine.com			Date and Time Required for all E&P TATs: dd-mm-yy hh:mm																						
Street: 2100-510 West Georgia St.			Email 2			For tests that can not be performed according to the service level selected, you will be contacted.																						
City/Province: Vancouver, British Columbia			Email 3			Analysis Request																						
Postal Code: V6B 0M3			Invoice Distribution			Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below																						
Invoice To: Same as Report To ☐ YES ☒ NO			Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX																									
Copy of Invoice with Report ☐ YES ☒ NO			Email 1 or Fax ap@mintomine.com																									
Company: Minto Explorations Ltd.			Email 2																									
Contact: Ruth Cayetano			Oil and Gas Required Fields (client use)																									
Project Information			AFE/Cost Center: PO#																									
ALS Account # / Quote #:			Major/Minor Code: Routing Code:																									
Job #:			Requisitioner:																									
PO / AFE: 229096 (WUL)			Location:																									
LSD:			ALS Contact: Shane Stack			Sampler: SR/CP																						
ALS Lab Work Order # (lab use only)																												
ALS Sample # (lab use only)			Sample Identification and/or Coordinates (This description will appear on the report)			Date (dd-mm-yy)			Time (hh:mm)			Sample Type																
W17						21-May-18			9:20 ✓			Water																
W16						21-May-18			9:50 ✓			Water																
MC1						21-May-18			13:50 ✓			Water																
C4						21-May-18			14:45 ✓			Water																
W46						21-May-18			15:10 ✓			Water																
W6						21-May-18			15:30 ✓			Water																
W3						22-May-18			8:50 ✓			Water																
W2						22-May-18			14:00 ✓			Water																
Dup						22-May-18			✓			Water																
Dup						21-May-18			✓			Water																
Drinking Water (DW) Samples ¹ (client use)			Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)			SAMPLE CONDITION AS RECEIVED (lab use only)																						
Are samples taken from a Regulated DW System? ☐ YES ☒ NO						Frozen ☐ SIF Observations Yes ☐ No ☐																						
Are samples for human drinking water use? ☐ YES ☒ NO						Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐																						
						Cooling Initiated ☒																						
						INITIAL COOLER TEMPERATURES °C 5.0 FINAL COOLER TEMPERATURES °C 12																						
SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)																						
Released by: Shaun Roberts			Date: 2018-05-23			Time: 12:00			Received by: EHF			Date: 23 May 2018			Time: 11:45			Received by: HA			Date: 5/24			Time: 2:54				

REFER TO BACK PAGE FOR AIS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 EDITION



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 30-MAY-18
Report Date: 12-JUN-18 17:52 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2103810
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-05-30 B
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2103810-1 Water 26-MAY-18 10:50 MN	L2103810-2 Water 26-MAY-18 12:00 UG1	L2103810-3 Water 26-MAY-18 10:45 MN-0.2	L2103810-4 Water 26-MAY-18 11:45 MN-1.5	L2103810-5 Water 26-MAY-18 14:55 MN-4.5
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	398	1930	71.2	93.0	181
	Hardness (as CaCO3) (mg/L)		1080	36.8	50.4	94.1
	pH (pH)	8.07	7.98	7.58	7.87	8.14
	Total Suspended Solids (mg/L)	3.4	293	395	6.6	<3.0
	TDS (Calculated) (mg/L)	259	1710	41.3	52.3	102
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	64.5	170	26.7	48.1	87.6
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	64.5	170	26.7	48.1	87.6
	Ammonia, Total (as N) (mg/L)	0.209	6.20	0.0059	0.0067	0.0082
	Chloride (Cl) (mg/L)	1.17	16.3	0.20	0.21	0.54
	Nitrate and Nitrite (as N) (mg/L)	15.8	10.7	<0.0051 ^{HTA}	0.0144 ^{HTA}	<0.0051
	Nitrate (as N) (mg/L)	15.7	10.1	<0.0050 ^{HTA}	0.0144 ^{HTA}	<0.0050
	Nitrite (as N) (mg/L)	0.0550	0.614	<0.0010	<0.0010 ^{HTA}	<0.0010
	Sulfate (SO4) (mg/L)	70.2	1010	8.62	1.94	9.64
	Anion Sum (meq/L)	3.91	25.6	0.72	1.01	1.97
	Cation Sum (meq/L)	4.02	27.1	0.90	1.16	2.14
	Cation - Anion Balance (%)	1.4	2.8	11.2	7.1	4.3
				20.4	19.7	15.0
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)					
Total Metals	Aluminum (Al)-Total (mg/L)		3.74	0.0643	0.0801	0.0262
	Antimony (Sb)-Total (mg/L)		0.00040	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)		0.00201	0.00038	0.00035	0.00039
	Barium (Ba)-Total (mg/L)		0.106	0.0287	0.0317	0.0413
	Beryllium (Be)-Total (mg/L)		0.000137	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)		0.000074	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)		0.402	<0.010	<0.010	<0.010
	Cadmium (Cd)-Total (mg/L)		0.000173	<0.0000050	0.0000055	0.0000064
	Calcium (Ca)-Total (mg/L)		360	9.34	13.4	24.9
	Chromium (Cr)-Total (mg/L)		0.00183	0.00039	0.00047	0.00021
	Cobalt (Co)-Total (mg/L)		0.00338	0.00011	0.00016	<0.00010
	Copper (Cu)-Total (mg/L)		0.609	0.00272	0.00627	0.00165
	Iron (Fe)-Total (mg/L)		6.97	0.183	0.194	0.067
	Lead (Pb)-Total (mg/L)		0.00448	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)		0.0146	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)-Total (mg/L)		41.5	3.04	3.99	6.49
	Manganese (Mn)-Total (mg/L)		0.295	0.00662	0.0139	0.00528

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2103810-6 Water 26-MAY-18 16:20 MN-0.5	L2103810-7 Water 26-MAY-18 17:00 MN-2.5	L2103810-8 Water 28-MAY-18 08:30 W17	L2103810-9 Water 26-MAY-18 DUP 1	L2103810-10 Water 26-MAY-18 DUP 3
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	157	120	451	573	74.1
	Hardness (as CaCO3) (mg/L)	82.3	63.1	238		37.3
	pH (pH)	8.07	7.99	8.50	8.14	7.57
	Total Suspended Solids (mg/L)	15.4	45.8	3.6	779	4.0
	TDS (Calculated) (mg/L)	88.2	65.4	279	398	41.3
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	74.5	60.8	188	94.7	26.3
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	12.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	74.5	60.8	200	94.7	26.3
	Ammonia, Total (as N) (mg/L)	0.0074	0.0097	<0.0050	0.248	0.0080
	Chloride (Cl) (mg/L)	0.38	0.51	6.38	3.27	0.20
	Nitrate and Nitrite (as N) (mg/L)	<0.0051	<0.0051	0.111	25.8	<0.0051
	Nitrate (as N) (mg/L)	<0.0050	<0.0050	0.111	25.7	<0.0050
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	0.0639	<0.0010
	Sulfate (SO4) (mg/L)	8.31	2.19	52.3	101	8.64
	Anion Sum (meq/L)	1.67	1.28	5.27	5.93	0.71
	Cation Sum (meq/L)	1.87	1.43	5.49	6.19	0.91
	Cation - Anion Balance (%)	5.7	5.8	2.1	2.2	12.4
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	12.4	15.4	9.53		20.5
Total Metals	Aluminum (Al)-Total (mg/L)	0.207	0.465	0.0064		0.0663
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010		<0.00010
	Arsenic (As)-Total (mg/L)	0.00181	0.00061	0.00034		0.00041
	Barium (Ba)-Total (mg/L)	0.0399	0.0365	0.0642		0.0287
	Beryllium (Be)-Total (mg/L)	<0.000020	0.000022	<0.000020		<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050		<0.000050
	Boron (B)-Total (mg/L)	<0.010	<0.010	0.023		<0.010
	Cadmium (Cd)-Total (mg/L)	0.0000120	0.0000097	<0.0000050		<0.0000050
	Calcium (Ca)-Total (mg/L)	21.7	16.7	60.3		9.20
	Chromium (Cr)-Total (mg/L)	0.00043	0.00095	<0.00010		0.00037
	Cobalt (Co)-Total (mg/L)	0.00023	0.00040	<0.00010		0.00011
	Copper (Cu)-Total (mg/L)	0.00146	0.00280	0.00756		0.00273
	Iron (Fe)-Total (mg/L)	0.333	0.739	<0.010		0.216
	Lead (Pb)-Total (mg/L)	0.000108	0.000225	<0.000050		<0.000050
	Lithium (Li)-Total (mg/L)	<0.0010	<0.0010	0.0016		<0.0010
	Magnesium (Mg)-Total (mg/L)	5.38	5.00	18.5		3.09
	Manganese (Mn)-Total (mg/L)	0.0720	0.0464	0.00651		0.00724

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2103810-11 Water 28-MAY-18 08:50 W16	L2103810-12 Water 28-MAY-18 10:30 W55	L2103810-13 Water 28-MAY-18 15:10 MC1	L2103810-14 Water 29-MAY-18 09:00 W3	L2103810-15 Water 29-MAY-18 14:30 W2
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	362	552	276	513	262
	Hardness (as CaCO3) (mg/L)	192	248	130	256	131
	pH (pH)	8.31	8.31	8.34	8.53	8.29
	Total Suspended Solids (mg/L)	4.8	11.8	16.6	3.0	<3.0
	TDS (Calculated) (mg/L)	224	362	154	309	150
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	131	118	129	219	126
	Alkalinity, Carbonate (as CaCO3) (mg/L)	3.0	3.4	3.8	16.4	1.6
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	134	121	133	235	128
	Ammonia, Total (as N) (mg/L)	0.0103	0.0819	0.0063	0.0078	<0.0050
	Chloride (Cl) (mg/L)	5.53	1.73	1.49	5.25	1.47
	Nitrate and Nitrite (as N) (mg/L)	1.17	21.1	<0.0051	0.135	<0.0051
	Nitrate (as N) (mg/L)	1.16	20.9	<0.0050	0.135	<0.0050
	Nitrite (as N) (mg/L)	0.0111	0.144	<0.0010	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	52.3	89.7	18.1	56.7	17.3
	Anion Sum (meq/L)	4.01	5.85	3.08	6.04	2.95
	Cation Sum (meq/L)	4.40	5.72	3.00	5.97	3.01
	Cation - Anion Balance (%)	4.7	-1.1	-1.2	-0.5	1.0
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	20.3	23.1	10.3	6.82	10.6
Total Metals	Aluminum (Al)-Total (mg/L)	0.0967	0.518	0.240	0.0261	0.0173
	Antimony (Sb)-Total (mg/L)	<0.00010	0.00012	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00043	0.00064	0.00070	0.00036	0.00053
	Barium (Ba)-Total (mg/L)	0.0692	0.120	0.0624	0.0694	0.0513
	Beryllium (Be)-Total (mg/L)	<0.000020	0.000034	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.015	0.057	<0.010	0.023	<0.010
	Cadmium (Cd)-Total (mg/L)	0.0000225	0.0000206	0.0000145	0.0000094	0.0000056
	Calcium (Ca)-Total (mg/L)	48.0	70.9	34.5	57.8	33.1
	Chromium (Cr)-Total (mg/L)	0.00022	0.00058	0.00061	<0.00010	0.00020
	Cobalt (Co)-Total (mg/L)	0.00013	0.00031	0.00029	<0.00010	<0.00010
	Copper (Cu)-Total (mg/L)	0.0464	0.0938	0.00349	0.00466	0.00278
	Iron (Fe)-Total (mg/L)	0.234	0.780	0.429	0.045	0.073
	Lead (Pb)-Total (mg/L)	0.000069	0.000277	0.000123	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	0.0012	0.0019	0.0015	0.0031	0.0013
	Magnesium (Mg)-Total (mg/L)	14.7	20.5	13.1	28.4	12.0
	Manganese (Mn)-Total (mg/L)	0.117	0.0312	0.107	0.137	0.00572

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2103810-16 Water 29-MAY-18 DUP				
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	514				
	Hardness (as CaCO3) (mg/L)	258				
	pH (pH)	8.54				
	Total Suspended Solids (mg/L)	<3.0				
	TDS (Calculated) (mg/L)	308				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	216				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	16.8				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Total (as CaCO3) (mg/L)	232				
	Ammonia, Total (as N) (mg/L)	0.0073				
	Chloride (Cl) (mg/L)	5.26				
	Nitrate and Nitrite (as N) (mg/L)	0.133				
	Nitrate (as N) (mg/L)	0.133				
	Nitrite (as N) (mg/L)	<0.0010				
	Sulfate (SO4) (mg/L)	56.7				
	Anion Sum (meq/L)	5.98				
	Cation Sum (meq/L)	6.04				
	Cation - Anion Balance (%)	0.5				
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	6.91				
Total Metals	Aluminum (Al)-Total (mg/L)	0.0066				
	Antimony (Sb)-Total (mg/L)	<0.00010				
	Arsenic (As)-Total (mg/L)	0.00033				
	Barium (Ba)-Total (mg/L)	0.0685				
	Beryllium (Be)-Total (mg/L)	<0.000020				
	Bismuth (Bi)-Total (mg/L)	<0.000050				
	Boron (B)-Total (mg/L)	0.023				
	Cadmium (Cd)-Total (mg/L)	0.0000087				
	Calcium (Ca)-Total (mg/L)	57.4				
	Chromium (Cr)-Total (mg/L)	<0.00010				
	Cobalt (Co)-Total (mg/L)	<0.00010				
	Copper (Cu)-Total (mg/L)	0.00445				
	Iron (Fe)-Total (mg/L)	0.047				
	Lead (Pb)-Total (mg/L)	<0.000050				
	Lithium (Li)-Total (mg/L)	0.0031				
	Magnesium (Mg)-Total (mg/L)	28.2				
	Manganese (Mn)-Total (mg/L)	0.137				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2103810-1 Water 26-MAY-18 10:50 MN	L2103810-2 Water 26-MAY-18 12:00 UG1	L2103810-3 Water 26-MAY-18 10:45 MN-0.2	L2103810-4 Water 26-MAY-18 11:45 MN-1.5	L2103810-5 Water 26-MAY-18 14:55 MN-4.5
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)		0.0000093	0.0000064	0.0000072	0.0000098
	Molybdenum (Mo)-Total (mg/L)		0.0223	0.000241	0.000284	0.00100
	Nickel (Ni)-Total (mg/L)		0.00443	0.00122	0.00109	0.00097
	Phosphorus (P)-Total (mg/L)		0.131	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)		9.29	0.39	0.59	1.10
	Selenium (Se)-Total (mg/L)		0.000646	<0.000050	0.000098	0.000153
	Silicon (Si)-Total (mg/L)		13.6	3.76	4.61	4.44
	Silver (Ag)-Total (mg/L)		0.000372	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)		106	2.95	2.82	4.98
	Strontium (Sr)-Total (mg/L)		7.12	0.0560	0.0662	0.190
	Sulfur (S)-Total (mg/L)		373	2.32	<0.50	2.74
	Thallium (Tl)-Total (mg/L)		0.000051	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)		0.00021	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)		0.259	0.00082	0.00178	0.00078
	Uranium (U)-Total (mg/L)		0.00766	0.000021	0.000033	0.000497
	Vanadium (V)-Total (mg/L)		0.0140	0.00054	0.00068	0.00078
	Zinc (Zn)-Total (mg/L)		0.0374	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)		<0.00030	0.00041	0.00041	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0018	0.0122	0.0713	0.0595	0.0115
	Antimony (Sb)-Dissolved (mg/L)	0.00014	0.00040	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00041	0.00156	0.00034	0.00031	0.00038
	Barium (Ba)-Dissolved (mg/L)	0.0288	0.0319	0.0295	0.0320	0.0440
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.059	0.372	<0.010	<0.010	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	0.0000610	0.0000151	<0.0000050	<0.0000050	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	50.1	363	9.39	13.3	26.0
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	0.00039	0.00043	0.00021
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00126	0.00012	0.00013	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.0199	0.00641	0.00283	0.00622	0.00174
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	0.225	0.126	0.046
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0036	0.0123	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)-Dissolved (mg/L)	7.67	42.0	3.24	4.19	7.10
	Manganese (Mn)-Dissolved (mg/L)	0.0213	0.107	0.00768	0.00955	0.00291

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2103810-6 Water 26-MAY-18 16:20 MN-0.5	L2103810-7 Water 26-MAY-18 17:00 MN-2.5	L2103810-8 Water 28-MAY-18 08:30 W17	L2103810-9 Water 26-MAY-18 DUP 1	L2103810-10 Water 26-MAY-18 DUP 3
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	0.0000105	0.0000102	0.0000082		0.0000087
	Molybdenum (Mo)-Total (mg/L)	0.000756	0.000562	0.00665		0.000217
	Nickel (Ni)-Total (mg/L)	0.00100	0.00180	0.00063		0.00129
	Phosphorus (P)-Total (mg/L)	<0.050	0.060	<0.050		<0.050
	Potassium (K)-Total (mg/L)	1.08	0.86	3.41		0.39
	Selenium (Se)-Total (mg/L)	0.000151	0.000087	0.000347		<0.000050
	Silicon (Si)-Total (mg/L)	3.87	4.80	4.92		3.77
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010		<0.000010
	Sodium (Na)-Total (mg/L)	4.04	3.21	13.9		2.98
	Strontium (Sr)-Total (mg/L)	0.188	0.0788	0.686		0.0566
	Sulfur (S)-Total (mg/L)	2.39	<0.50	17.3		2.34
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010		<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010		<0.00010
	Titanium (Ti)-Total (mg/L)	0.00903	0.0240	<0.00030		0.00096
	Uranium (U)-Total (mg/L)	0.000404	0.000093	0.00210		0.000023
	Vanadium (V)-Total (mg/L)	0.00132	0.00221	0.00059		0.00059
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030		<0.0030
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030		0.00042
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0102	0.0178	0.0020	0.0036	0.0713
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00021	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00034	0.00034	0.00035	0.00041	0.00037
	Barium (Ba)-Dissolved (mg/L)	0.0396	0.0287	0.0676	0.0444	0.0300
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	<0.010	<0.010	0.022	0.108	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	0.0000070	<0.0000050	<0.0000050	0.000102	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	23.1	16.9	61.6	76.3	9.38
	Chromium (Cr)-Dissolved (mg/L)	0.00012	0.00018	<0.00010	<0.00010	0.00041
	Cobalt (Co)-Dissolved (mg/L)	0.00011	<0.00010	<0.00010	0.00013	0.00012
	Copper (Cu)-Dissolved (mg/L)	0.00111	0.00234	0.00791	0.0508	0.00286
	Iron (Fe)-Dissolved (mg/L)	0.065	0.047	<0.010	<0.010	0.197
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	0.00101	<0.000050
	Lithium (Li)-Dissolved (mg/L)	<0.0010	<0.0010	0.0017	0.0062	<0.0010
	Magnesium (Mg)-Dissolved (mg/L)	5.98	5.08	20.4	11.5	3.37
Manganese (Mn)-Dissolved (mg/L)	0.0708	0.0178	0.00361	0.0629	0.00709	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2103810-11 Water 28-MAY-18 08:50 W16	L2103810-12 Water 28-MAY-18 10:30 W55	L2103810-13 Water 28-MAY-18 15:10 MC1	L2103810-14 Water 29-MAY-18 09:00 W3	L2103810-15 Water 29-MAY-18 14:30 W2
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	0.0000057	0.0000076	0.0000094	0.0000067	0.0000066
	Molybdenum (Mo)-Total (mg/L)	0.00251	0.00246	0.00148	0.00513	0.00137
	Nickel (Ni)-Total (mg/L)	0.00099	0.00140	0.00144	0.00104	0.00100
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	2.53	3.04	1.51	2.32	1.37
	Selenium (Se)-Total (mg/L)	0.000692	0.000800	0.000239	0.000254	0.000148
	Silicon (Si)-Total (mg/L)	3.49	5.00	5.20	5.59	4.70
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000015 ^{DLAI}	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	10.5	15.9	9.10	18.2	8.23
	Strontium (Sr)-Total (mg/L)	0.471	0.671	0.371	0.779	0.343
	Sulfur (S)-Total (mg/L)	17.6	32.6	5.61	19.0	5.20
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	0.00453	0.0288	0.0103	<0.00030	<0.00093 ^{DLM}
	Uranium (U)-Total (mg/L)	0.00103	0.000894	0.00145	0.00301	0.00128
	Vanadium (V)-Total (mg/L)	0.00087	0.00254	0.00184	0.00060	0.00095
	Zinc (Zn)-Total (mg/L)	<0.0030	0.0035	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	<0.00030	0.00041	<0.00030	<0.00030	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0141	0.0150	0.0079	0.0037	0.0080
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00040	0.00052	0.00051	0.00027	0.00047
	Barium (Ba)-Dissolved (mg/L)	0.0702	0.107	0.0524	0.0698	0.0516
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.014	0.050	<0.010	0.023	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	0.0000149	0.0000160	0.0000069	0.0000052	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	50.7	65.8	32.3	56.4	32.8
	Chromium (Cr)-Dissolved (mg/L)	0.00015	0.00029	0.00018	<0.00010	0.00020
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	0.00013	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.0441	0.0659	0.00251	0.00445	0.00316
	Iron (Fe)-Dissolved (mg/L)	0.078	0.052	0.070	0.037	0.044
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0012	0.0016	0.0013	0.0031	0.0013
	Magnesium (Mg)-Dissolved (mg/L)	16.0	20.3	11.9	28.0	11.8
Manganese (Mn)-Dissolved (mg/L)	0.0520	0.00677	0.0787	0.136	0.00276	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID				
		L2103810-16 Water 29-MAY-18 DUP				
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	0.0000095				
	Molybdenum (Mo)-Total (mg/L)	0.00514				
	Nickel (Ni)-Total (mg/L)	0.00101				
	Phosphorus (P)-Total (mg/L)	<0.050				
	Potassium (K)-Total (mg/L)	2.29				
	Selenium (Se)-Total (mg/L)	0.000332				
	Silicon (Si)-Total (mg/L)	5.52				
	Silver (Ag)-Total (mg/L)	<0.000010				
	Sodium (Na)-Total (mg/L)	18.0				
	Strontium (Sr)-Total (mg/L)	0.769				
	Sulfur (S)-Total (mg/L)	18.9				
	Thallium (Tl)-Total (mg/L)	<0.000010				
	Tin (Sn)-Total (mg/L)	<0.00010				
	Titanium (Ti)-Total (mg/L)	0.00042				
	Uranium (U)-Total (mg/L)	0.00300				
	Vanadium (V)-Total (mg/L)	0.00057				
	Zinc (Zn)-Total (mg/L)	<0.0030				
	Zirconium (Zr)-Total (mg/L)	<0.00030				
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD				
	Dissolved Metals Filtration Location	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	0.0028				
	Antimony (Sb)-Dissolved (mg/L)	<0.00010				
	Arsenic (As)-Dissolved (mg/L)	0.00026				
	Barium (Ba)-Dissolved (mg/L)	0.0708				
	Beryllium (Be)-Dissolved (mg/L)	<0.000020				
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050				
	Boron (B)-Dissolved (mg/L)	0.023				
	Cadmium (Cd)-Dissolved (mg/L)	0.0000059				
	Calcium (Ca)-Dissolved (mg/L)	56.2				
	Chromium (Cr)-Dissolved (mg/L)	<0.00010				
	Cobalt (Co)-Dissolved (mg/L)	0.00010				
	Copper (Cu)-Dissolved (mg/L)	0.00437				
	Iron (Fe)-Dissolved (mg/L)	0.037				
	Lead (Pb)-Dissolved (mg/L)	<0.000050				
	Lithium (Li)-Dissolved (mg/L)	0.0032				
	Magnesium (Mg)-Dissolved (mg/L)	28.7				
	Manganese (Mn)-Dissolved (mg/L)	0.139				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2103810-1 Water 26-MAY-18 10:50 MN	L2103810-2 Water 26-MAY-18 12:00 UG1	L2103810-3 Water 26-MAY-18 10:45 MN-0.2	L2103810-4 Water 26-MAY-18 11:45 MN-1.5	L2103810-5 Water 26-MAY-18 14:55 MN-4.5
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.0176	0.0227	0.000243	0.000264	0.000932
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	0.00339	0.00130	0.00108	0.00104
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	3.07	8.45	0.47	0.66	1.23
	Selenium (Se)-Dissolved (mg/L)	0.0119	0.000510	0.000060	0.000087	0.000194
	Silicon (Si)-Dissolved (mg/L)	2.15	7.40	3.98	4.84	4.68
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	18.3	111	3.03	2.86	5.22
	Strontium (Sr)-Dissolved (mg/L)	1.24	7.05	0.0569	0.0642	0.191
	Sulfur (S)-Dissolved (mg/L)	22.4	371	2.88	0.75	3.01
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	0.000011	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	0.00085	0.00080	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.000719	0.00755	0.000028	0.000034	0.000505
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	0.00055
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	0.0015	<0.0010	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	0.00040	0.00042	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2103810-6 Water 26-MAY-18 16:20 MN-0.5	L2103810-7 Water 26-MAY-18 17:00 MN-2.5	L2103810-8 Water 28-MAY-18 08:30 W17	L2103810-9 Water 26-MAY-18 DUP 1	L2103810-10 Water 26-MAY-18 DUP 3
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.000772	0.000570	0.00646	0.0262	0.000232
	Nickel (Ni)-Dissolved (mg/L)	0.00077	0.00120	0.00063	<0.00050	0.00133
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	1.23	0.90	3.73	4.35	0.48
	Selenium (Se)-Dissolved (mg/L)	0.000197	0.000076	0.000404	0.0192	0.000089
	Silicon (Si)-Dissolved (mg/L)	3.79	4.47	5.37	2.81	3.98
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	4.39	3.28	14.8	30.0	3.12
	Strontium (Sr)-Dissolved (mg/L)	0.193	0.0775	0.694	1.94	0.0553
	Sulfur (S)-Dissolved (mg/L)	2.66	0.78	17.1	33.6	3.01
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00034	0.00069	<0.00030	<0.00030	0.00079
	Uranium (U)-Dissolved (mg/L)	0.000407	0.000072	0.00215	0.00108	0.000024
	Vanadium (V)-Dissolved (mg/L)	0.00057	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	0.0061	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	0.00041

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2103810-11 Water 28-MAY-18 08:50 W16	L2103810-12 Water 28-MAY-18 10:30 W55	L2103810-13 Water 28-MAY-18 15:10 MC1	L2103810-14 Water 29-MAY-18 09:00 W3	L2103810-15 Water 29-MAY-18 14:30 W2
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00232	0.00221	0.00148	0.00499	0.00136
	Nickel (Ni)-Dissolved (mg/L)	0.00099	0.00113	0.00087	0.00096	0.00094
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	2.71	3.00	1.45	2.48	1.51
	Selenium (Se)-Dissolved (mg/L)	0.000678	0.000985	0.000145	0.000236	0.000124
	Silicon (Si)-Dissolved (mg/L)	3.48	4.11	4.93	5.96	4.87
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	10.9	15.6	8.40	18.1	8.30
	Strontium (Sr)-Dissolved (mg/L)	0.477	0.603	0.343	0.757	0.333
	Sulfur (S)-Dissolved (mg/L)	17.6	29.1	6.43	20.4	6.21
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00032	0.00086	0.00043	<0.00030	0.00034
	Uranium (U)-Dissolved (mg/L)	0.00108	0.000835	0.00145	0.00316	0.00132
	Vanadium (V)-Dissolved (mg/L)	<0.00050	0.00069	0.00091	<0.00050	0.00072
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	0.0040	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	0.00032	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2103810-16 Water 29-MAY-18 DUP				
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050				
	Molybdenum (Mo)-Dissolved (mg/L)	0.00508				
	Nickel (Ni)-Dissolved (mg/L)	0.00097				
	Phosphorus (P)-Dissolved (mg/L)	<0.050				
	Potassium (K)-Dissolved (mg/L)	2.55				
	Selenium (Se)-Dissolved (mg/L)	0.000323				
	Silicon (Si)-Dissolved (mg/L)	5.99				
	Silver (Ag)-Dissolved (mg/L)	<0.000010				
	Sodium (Na)-Dissolved (mg/L)	18.6				
	Strontium (Sr)-Dissolved (mg/L)	0.756				
	Sulfur (S)-Dissolved (mg/L)	20.0				
	Thallium (Tl)-Dissolved (mg/L)	<0.000010				
	Tin (Sn)-Dissolved (mg/L)	<0.00010				
	Titanium (Ti)-Dissolved (mg/L)	<0.00030				
	Uranium (U)-Dissolved (mg/L)	0.00315				
	Vanadium (V)-Dissolved (mg/L)	<0.00050				
	Zinc (Zn)-Dissolved (mg/L)	<0.0010				
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Sulfur (S)-Total	B	L2103810-10, -11, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Dissolved Organic Carbon	MS-B	L2103810-10, -11, -12, -13, -14, -15, -16, -3, -4, -5, -6, -7, -8
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2103810-13, -14, -15, -16
Matrix Spike	Boron (B)-Dissolved	MS-B	L2103810-13, -14, -15, -16
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2103810-13, -14, -15, -16
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2103810-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Cobalt (Co)-Dissolved	MS-B	L2103810-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Lithium (Li)-Dissolved	MS-B	L2103810-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2103810-13, -14, -15, -16
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2103810-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2103810-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Nickel (Ni)-Dissolved	MS-B	L2103810-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2103810-13, -14, -15, -16
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2103810-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Selenium (Se)-Dissolved	MS-B	L2103810-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2103810-13, -14, -15, -16
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2103810-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2103810-13, -14, -15, -16
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2103810-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2103810-13, -14, -15, -16
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2103810-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Uranium (U)-Dissolved	MS-B	L2103810-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Aluminum (Al)-Total	MS-B	L2103810-10, -11, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Barium (Ba)-Total	MS-B	L2103810-10, -11, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Boron (B)-Total	MS-B	L2103810-10, -11, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Calcium (Ca)-Total	MS-B	L2103810-10, -11, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Copper (Cu)-Total	MS-B	L2103810-10, -11, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Iron (Fe)-Total	MS-B	L2103810-10, -11, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2103810-10, -11, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Manganese (Mn)-Total	MS-B	L2103810-10, -11, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Molybdenum (Mo)-Total	MS-B	L2103810-10, -11, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Potassium (K)-Total	MS-B	L2103810-10, -11, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Silicon (Si)-Total	MS-B	L2103810-10, -11, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Sodium (Na)-Total	MS-B	L2103810-10, -11, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Strontium (Sr)-Total	MS-B	L2103810-10, -11, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Sulfur (S)-Total	MS-B	L2103810-10, -11, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Titanium (Ti)-Total	MS-B	L2103810-10, -11, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Uranium (U)-Total	MS-B	L2103810-10, -11, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8

Qualifiers for Individual Parameters Listed:

Qualifier	Description
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Reference Information

B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
DLAI	Detection limit raised due to low level analytical interference or background.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
HTA	Analytical holding time was exceeded.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-L-IC-N-WR	Water	Chloride in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Reference Information

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NO2-L-IC-N-WR	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-WR	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
SO4-IC-WR	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)
This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".			
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.			
TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.			
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-05-30 B

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



ALS Environmental

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L2103810-COFC

Page of

2018-05-30 B (1 of 2)

Report To Contact and company name below will appear on the final report			Report Format / Distribution			Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply																																																	
Company: Minto Explorations Ltd.			Select Report Format: ☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)			Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply																																																	
Contact: Minto Environment - Coordinator			Quality Control (QC) Report with Report ☒ YES ☐ NO			PRIORITY (Business Day)				EMERGENCY																																													
Phone: 1-604-759-4659			☒ Compare Results to Criteria on Report - provide details below if box checked			4 day [P4] ☐				3 day [P3] ☐				1 Business day [E1] ☐																																									
Company address below will appear on the final report			Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX			2 day [P2] ☐				Same Day, Weekend or Statutory holiday [E0] ☐																																													
Street: 2100-510 West Georgia St.			Email 1 or Fax: minto_environment@mintomine.com			Date and Time Required for all E&P TATs: dd-mm-yy hh:mm																																																	
City/Province: Vancouver, British Columbia			Email 2			For tests that can not be performed according to the service level selected, you will be contacted.																																																	
Postal Code: V6B 0M3			Email 3			Analysis Request																																																	
Invoice To: Same as Report To ☐ YES ☒ NO			Invoice Distribution			Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below																																																	
Copy of Invoice with Report ☐ YES ☒ NO			Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX																																																				
Company: Minto Explorations Ltd.			Email 1 or Fax: ap@mintomine.com																																																				
Contact: Ruth Cayetano			Email 2																																																				
Project Information			Oil and Gas Required Fields (client use)																																																				
ALS Account # / Quote #:			AFE/Cost Center:			PO#																																																	
Job #:			Major/Minor Code:			Routing Code:																																																	
PO / AFE: 229096 (WUL)			Requisitioner:																																																				
LSD:			Location:																																																				
ALS Lab Work Order # (lab use only)			ALS Contact: Shane Stack		Sampler: SR/CH/CP																																																		
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)		Date (dd-mm-yy)	Time (hh:mm)	Sample Type	<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td colspan="2">pH / Conductivity / Alkalinity / Anions</td> <td colspan="2">Total Suspended Solids (TSS)</td> <td colspan="2">Total Dissolved Solids (TDS)</td> <td colspan="2">Total Metals (Tm), Hardness</td> <td colspan="2">Dissolved Metals (DM) (filtered + preserved)</td> <td colspan="2">Total Mercury, Hardness</td> <td colspan="2">Dissolved Mercury [1] (Filtered + preserved)</td> <td colspan="2">Total Nutrients (Ammonia)</td> <td colspan="2">Dissolved Organic Carbon (DOC)</td> <td colspan="2" rowspan="2">Number of Containers</td> </tr> <tr> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> </table>												pH / Conductivity / Alkalinity / Anions		Total Suspended Solids (TSS)		Total Dissolved Solids (TDS)		Total Metals (Tm), Hardness		Dissolved Metals (DM) (filtered + preserved)		Total Mercury, Hardness		Dissolved Mercury [1] (Filtered + preserved)		Total Nutrients (Ammonia)		Dissolved Organic Carbon (DOC)		Number of Containers																			
																		pH / Conductivity / Alkalinity / Anions		Total Suspended Solids (TSS)		Total Dissolved Solids (TDS)		Total Metals (Tm), Hardness		Dissolved Metals (DM) (filtered + preserved)		Total Mercury, Hardness		Dissolved Mercury [1] (Filtered + preserved)		Total Nutrients (Ammonia)		Dissolved Organic Carbon (DOC)				Number of Containers																	
	MN		26-May-18	10:50	✓	Water	R	R	R		R		R	R						4																																			
	UG1		26-May-18	12:00	✓	Water	R	R	R	R	R	R	R	R	R					26																																			
	MN-0.2		26-May-18	10:45	✓	Water	R	R	R	R	R	R	R	R	R					7																																			
	MN-1.5		26-May-18	11:45	✓	Water	R	R	R	R	R	R	R	R	R					7																																			
	MN-4.5		26-May-18	14:55	✓	Water	R	R	R	R	R	R	R	R	R					7																																			
	MN-0.5		26-May-18	16:20	✓	Water	R	R	R	R	R	R	R	R	R					7																																			
	MN-2.5		26-May-18	17:00	✓	Water	R	R	R	R	R	R	R	R	R					7																																			
	W17		28-May-18	8:30	✓	Water	R	R	R	R	R	R	R	R	R					7																																			
	DUP 1		26-May-18		✓	Water	R	R	R		R		R	R						4																																			
	DUP 3		26-May-18		✓	Water	R	R	R	R	R	R	R	R	R					7																																			
Drinking Water (DW) Samples¹ (client use)			Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)			SAMPLE CONDITION AS RECEIVED (lab use only)																																																	
Are samples taken from a Regulated DW System? ☐ YES ☒ NO						Frozen ☐ SIF Observations Yes ☐ No ☐																																																	
Are samples for human drinking water use? ☐ YES ☒ NO						Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐																																																	
						Cooling Initiated ☒																																																	
						INITIAL COOLER TEMPERATURES °C: 8.0 FINAL COOLER TEMPERATURES °C: 10																																																	
SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)																																																	
Released by: Shaun Roberts		Date: 2018-05-30	Time: 10:00	Received by: EHF		Date: 30 May 2018	Time: 16:40	Received by: HA		Date: 6/1	Time: 12:34																																												

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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OCTOBER 2016 PRINT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

[illegible]

REFER TO BACK PAGE FOR AIS LOCATIONS AND SAMPLING INFORMATION

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OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 05-JUN-18
Report Date: 19-JUN-18 14:32 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2106485
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-06-04 B
Legal Site Desc:

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2106485-1 Water 04-JUN-18 08:30 W15	L2106485-2 Water 04-JUN-18 09:00 W35	L2106485-3 Water 04-JUN-18 09:45 W55	L2106485-4 Water 04-JUN-18 10:45 W12	L2106485-5 Water 04-JUN-18 13:35 W45
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	469	272	245	2240	3370
	Hardness (as CaCO3) (mg/L)	238	127	124	1120	1720
	pH (pH)	8.27	8.18	8.09	8.13	7.95
	Total Suspended Solids (mg/L)	<3.0	17.3	<3.0	15.1	92.9
	TDS (Calculated) (mg/L)	290	160	146	1800	2910
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	140	93.8	84.3	143	111
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	140	93.8	84.3	143	111
	Ammonia, Total (as N) (mg/L)	0.0129	0.0331	0.0137	3.72	9.63
	Chloride (Cl) (mg/L)	1.37	1.57	1.75	24.1	27.6
	Nitrate and Nitrite (as N) (mg/L)	5.63	4.55	4.37	16.6	27.9
	Nitrate (as N) (mg/L)	5.62	4.52	4.36	12.7	24.6
	Nitrite (as N) (mg/L)	0.0166	0.0281	0.0098	3.96	3.31
	Sulfate (SO4) (mg/L)	83.8	27.2	22.6	1060	1830
	Anion Sum (meq/L)	4.99	2.81	2.52	26.8	43.0
	Cation Sum (meq/L)	5.26	2.98	2.81	28.5	43.5
	Cation - Anion Balance (%)	2.6	2.9	5.5	3.1	0.6
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	26.2	17.8			
Total Metals	Aluminum (Al)-Total (mg/L)	0.0386	0.728	0.0601	0.158	0.390
	Antimony (Sb)-Total (mg/L)	<0.00010	0.00020	0.00010	0.00042	0.00067
	Arsenic (As)-Total (mg/L)	0.00043	0.00056	0.00047	0.00049	0.00048
	Barium (Ba)-Total (mg/L)	0.0545	0.0585	0.0502	0.0809	0.133
	Beryllium (Be)-Total (mg/L)	<0.000020	0.000058	<0.000020	<0.000020	<0.000040 ^{DLA}
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.00010 ^{DLA}
	Boron (B)-Total (mg/L)	<0.010	0.016	0.017	0.214	0.419
	Cadmium (Cd)-Total (mg/L)	0.0000072	0.0000286	0.0000128	0.000129	<0.000090 ^{DLM}
	Calcium (Ca)-Total (mg/L)	62.7	33.0	31.3	324	550
	Chromium (Cr)-Total (mg/L)	0.00029	0.00065	0.00042	0.00025	0.00035
	Cobalt (Co)-Total (mg/L)	0.00016	0.00062	<0.00010	0.00126	0.00057
	Copper (Cu)-Total (mg/L)	0.0181	0.123	0.0556	0.0975	0.0203
	Iron (Fe)-Total (mg/L)	0.147	1.20	0.116	0.291	1.00
	Lead (Pb)-Total (mg/L)	<0.000050	0.000549	0.000061	0.000340	0.00054
	Lithium (Li)-Total (mg/L)	<0.0010	0.0019	0.0012	0.0154	0.0265
	Magnesium (Mg)-Total (mg/L)	18.2	10.1	9.44	61.9	95.6
	Manganese (Mn)-Total (mg/L)	0.0301	0.109	0.00398	0.968	0.899

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2106485-6 Water 04-JUN-18 14:15 W30	L2106485-7 Water 04-JUN-18 14:40 W33S	L2106485-8 Water 04-JUN-18 15:30 W14	L2106485-9 Water 04-JUN-18 DUP	L2106485-10 Water 04-JUN-18 T-BL
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	472	160	3480	160	<2.0 ^{HTC}
	Hardness (as CaCO3) (mg/L)	229	82.2		85.7	<0.50
	pH (pH)	8.37	7.94	8.04	7.93	5.45
	Total Suspended Solids (mg/L)	<3.0	11.7		3.7	
	TDS (Calculated) (mg/L)	289	90.6		91.3	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	149	62.3	98.8	61.3	<1.0
	Alkalinity, Carbonate (as CaCO3) (mg/L)	3.6	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	152	62.3	98.8	61.3	<1.0
	Ammonia, Total (as N) (mg/L)	0.026	0.0274	12.3	0.0346	
	Chloride (Cl) (mg/L)	1.56	<0.50	27.8	<0.50	<0.50
	Nitrate and Nitrite (as N) (mg/L)	1.71	1.82	37.2	1.79	<0.0051
	Nitrate (as N) (mg/L)	1.68	1.80	33.2	1.77	<0.0050
	Nitrite (as N) (mg/L)	0.0261	0.0180	3.99	0.0181	<0.0010
	Sulfate (SO4) (mg/L)	95.0	11.1	1880	11.0	<0.30
	Anion Sum (meq/L)	5.19	1.61	44.6	1.58	<0.10
	Cation Sum (meq/L)	5.23	1.87	43.6	1.95	<0.10
	Cation - Anion Balance (%)	0.4	7.7	-1.1	10.3	0.0
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)					
Total Metals	Aluminum (Al)-Total (mg/L)	0.0133	0.165		0.106	<0.0030
	Antimony (Sb)-Total (mg/L)	0.00015	<0.00010		<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00058	0.00045		0.00039	<0.00010
	Barium (Ba)-Total (mg/L)	0.0704	0.0437		0.0353	<0.00010
	Beryllium (Be)-Total (mg/L)	<0.000020	0.000023		0.000022	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050		<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.019	<0.010		<0.010	<0.010
	Cadmium (Cd)-Total (mg/L)	0.0000095	0.0000198		0.0000126	<0.0000050
	Calcium (Ca)-Total (mg/L)	54.2	22.6		22.3	<0.050
	Chromium (Cr)-Total (mg/L)	0.00015	0.00068		0.00057	<0.00010
	Cobalt (Co)-Total (mg/L)	<0.00010	0.00026		0.00014	<0.00010
	Copper (Cu)-Total (mg/L)	0.0284	0.0410		0.0280	<0.00050
	Iron (Fe)-Total (mg/L)	0.070	0.303		0.206	<0.010
	Lead (Pb)-Total (mg/L)	0.000064	0.000150		0.000077	<0.000050
	Lithium (Li)-Total (mg/L)	0.0029	<0.0010		<0.0010	<0.0010
	Magnesium (Mg)-Total (mg/L)	22.3	6.44		6.36	<0.10
	Manganese (Mn)-Total (mg/L)	0.0181	0.0383		0.0168	<0.00010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2106485-1 Water 04-JUN-18 08:30 W15	L2106485-2 Water 04-JUN-18 09:00 W35	L2106485-3 Water 04-JUN-18 09:45 W55	L2106485-4 Water 04-JUN-18 10:45 W12	L2106485-5 Water 04-JUN-18 13:35 W45
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	0.0000076	0.0000067	0.0000060	<0.00010 ^{DLM}
	Molybdenum (Mo)-Total (mg/L)	0.00254	0.00661	0.00139	0.0625	0.104
	Nickel (Ni)-Total (mg/L)	0.00102	0.00137	0.00135	0.00422	0.0097 ^{DLA}
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.10
	Potassium (K)-Total (mg/L)	2.77	2.24	1.39	43.1	86.1
	Selenium (Se)-Total (mg/L)	0.00220	0.000614	0.000451	0.00812	0.00905
	Silicon (Si)-Total (mg/L)	3.93	5.07	4.60	3.61	3.44
	Silver (Ag)-Total (mg/L)	<0.000010	0.000018	<0.000010	<0.000020 ^{DLM}	<0.000020 ^{DLA}
	Sodium (Na)-Total (mg/L)	9.53	8.15	6.21	107	152
	Strontium (Sr)-Total (mg/L)	0.584	0.302	0.275	4.97	7.16
	Sulfur (S)-Total (mg/L)	29.7	9.38	7.92	407	694
	Thallium (Tl)-Total (mg/L)	<0.000010	0.000013	<0.000010	0.000015	0.000024 ^{DLA}
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020
	Titanium (Ti)-Total (mg/L)	0.00151	0.0231	0.00217	0.00529	0.0217
	Uranium (U)-Total (mg/L)	0.00155	0.00124	0.000230	0.00580	0.00532
	Vanadium (V)-Total (mg/L)	0.00073	0.00320	0.00068	0.00083	0.0016
	Zinc (Zn)-Total (mg/L)	<0.0030	0.0075	<0.0030	0.0107	0.0127
	Zirconium (Zr)-Total (mg/L)	0.00031	<0.00030	0.00035	<0.00030	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0305	0.0258	0.0268	0.0067	0.0174
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	0.00014	<0.00010	0.00037	0.00064
	Arsenic (As)-Dissolved (mg/L)	0.00042	0.00034	0.00045	0.00040	0.00038
	Barium (Ba)-Dissolved (mg/L)	0.0561	0.0426	0.0507	0.0868	0.127 ^{DLA}
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000040 ^{DLA}
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.00010
	Boron (B)-Dissolved (mg/L)	<0.010	0.015	0.016	0.200 ^{DLM}	0.389 ^{DLA}
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	0.0000131	0.0000082	<0.000080	<0.000010
	Calcium (Ca)-Dissolved (mg/L)	64.9	34.1	33.5	343	537 ^{DLA}
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00012	0.00027	<0.00010	<0.00020
	Cobalt (Co)-Dissolved (mg/L)	0.00017	0.00013	<0.00010	0.00122	0.00032
	Copper (Cu)-Dissolved (mg/L)	0.0173	0.0581	0.0548	0.0502	0.00558 ^{DLA}
	Iron (Fe)-Dissolved (mg/L)	0.132	0.039	0.061	0.034	<0.020 ^{DLA}
	Lead (Pb)-Dissolved (mg/L)	<0.000050	0.000081	<0.000050	0.000088	<0.00010 ^{DLA}
	Lithium (Li)-Dissolved (mg/L)	<0.0010	0.0017	0.0012	0.0153	0.0247
	Magnesium (Mg)-Dissolved (mg/L)	18.5	10.3	9.84	63.1	91.3
	Manganese (Mn)-Dissolved (mg/L)	0.0253	0.0567	0.00221	0.994	0.845

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2106485-6 Water 04-JUN-18 14:15 W30	L2106485-7 Water 04-JUN-18 14:40 W33S	L2106485-8 Water 04-JUN-18 15:30 W14	L2106485-9 Water 04-JUN-18 DUP	L2106485-10 Water 04-JUN-18 T-BL
Grouping	Analyte						
WATER							
Total Metals	Mercury (Hg)-Total (mg/L)	0.0000065	0.0000051			0.0000053	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.00828	0.000776			0.000797	<0.000050
	Nickel (Ni)-Total (mg/L)	<0.00050	0.00166			0.00159	<0.00050
	Phosphorus (P)-Total (mg/L)	<0.050	0.061			<0.050	<0.050
	Potassium (K)-Total (mg/L)	4.32	0.68			0.65	<0.10
	Selenium (Se)-Total (mg/L)	0.00372	0.000220			0.000213	<0.000050
	Silicon (Si)-Total (mg/L)	2.22	4.72			4.55	<0.10
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010			<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	12.0	4.47			4.48	<0.050
	Strontium (Sr)-Total (mg/L)	0.875	0.171			0.175	<0.00020
	Sulfur (S)-Total (mg/L)	32.2	4.07			4.11	<0.50
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010			<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010			<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	0.00059	0.00527			0.00306	<0.00030
	Uranium (U)-Total (mg/L)	0.00212	0.000073			0.000078	<0.000010
	Vanadium (V)-Total (mg/L)	0.00052	0.00109			0.00078	<0.00050
	Zinc (Zn)-Total (mg/L)	<0.0030	0.0031			<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	<0.00030	0.00046			0.00042	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD		FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD		FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0061	0.0411	0.0316		0.0389	
	Antimony (Sb)-Dissolved (mg/L)	0.00012	<0.00010	0.00074		<0.00010	
	Arsenic (As)-Dissolved (mg/L)	0.00055	0.00034	0.00037		0.00035	
	Barium (Ba)-Dissolved (mg/L)	0.0741	0.0343	0.184		0.0359	
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000040 ^{DLA}		<0.000020	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.00010 ^{DLA}		<0.000050	
	Boron (B)-Dissolved (mg/L)	0.017	<0.010	0.344 ^{DLA}		0.011	
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.000010 ^{DLA}		<0.0000050	
	Calcium (Ca)-Dissolved (mg/L)	55.0	22.1	536 ^{DLA}		23.3	
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00036	<0.00020 ^{DLA}		0.00043	
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	0.00028		<0.00010	
	Copper (Cu)-Dissolved (mg/L)	0.0276	0.0239	0.00849 ^{DLA}		0.0245	
	Iron (Fe)-Dissolved (mg/L)	0.045	0.079	<0.020 ^{DLA}		0.073	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.00010 ^{DLA}		<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.0026	<0.0010	0.0292		<0.0010	
	Magnesium (Mg)-Dissolved (mg/L)	22.3	6.54	91.9		6.65	
	Manganese (Mn)-Dissolved (mg/L)	0.0162	0.0104	0.577		0.0103	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2106485-1 Water 04-JUN-18 08:30 W15	L2106485-2 Water 04-JUN-18 09:00 W35	L2106485-3 Water 04-JUN-18 09:45 W55	L2106485-4 Water 04-JUN-18 10:45 W12	L2106485-5 Water 04-JUN-18 13:35 W45
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00233	0.00741	0.00128	0.0607	0.0961
	Nickel (Ni)-Dissolved (mg/L)	0.00102	0.00109	0.00131	0.00424	0.0088
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.10 ^{DLA}
	Potassium (K)-Dissolved (mg/L)	2.77	2.12	1.44	43.7	84.0
	Selenium (Se)-Dissolved (mg/L)	0.00186	0.000489	0.000445	0.00688	0.00844
	Silicon (Si)-Dissolved (mg/L)	3.72	3.56	4.30	3.16	2.61
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020 ^{DLA}
	Sodium (Na)-Dissolved (mg/L)	9.54	8.52	6.51	109	146
	Strontium (Sr)-Dissolved (mg/L)	0.587	0.309	0.286	5.27	6.80
	Sulfur (S)-Dissolved (mg/L)	26.7	8.38	6.76	378	705
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020 ^{DLA}
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020 ^{DLA}
	Titanium (Ti)-Dissolved (mg/L)	0.00107	0.00116	0.00119	<0.00060 ^{DLM}	<0.00060 ^{DLA}
	Uranium (U)-Dissolved (mg/L)	0.00140	0.00117	0.000210	0.00550	0.00487
	Vanadium (V)-Dissolved (mg/L)	0.00056	0.00057	<0.00050	<0.00050	<0.0010 ^{DLA}
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	0.0022	0.0011	0.0094	0.0033
	Zirconium (Zr)-Dissolved (mg/L)	0.00039	<0.00030	0.00036	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2106485-6 Water 04-JUN-18 14:15 W30	L2106485-7 Water 04-JUN-18 14:40 W33S	L2106485-8 Water 04-JUN-18 15:30 W14	L2106485-9 Water 04-JUN-18 DUP	L2106485-10 Water 04-JUN-18 T-BL
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Dissolved (mg/L)	0.00807	0.000785	0.106	0.000887	
	Nickel (Ni)-Dissolved (mg/L)	0.00054	0.00151	0.0069	0.00159	
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.10 ^{DLA}	<0.050	
	Potassium (K)-Dissolved (mg/L)	4.40	0.65	87.3	0.70	
	Selenium (Se)-Dissolved (mg/L)	0.00335	0.000192	0.00940	0.000225	
	Silicon (Si)-Dissolved (mg/L)	1.97	4.27	2.12	4.07	
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000020 ^{DLA}	<0.000010	
	Sodium (Na)-Dissolved (mg/L)	12.1	4.63	143	4.71	
	Strontium (Sr)-Dissolved (mg/L)	0.939	0.184	7.30	0.189	
	Sulfur (S)-Dissolved (mg/L)	31.1	3.70	725	4.91	
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000020 ^{DLA}	<0.000010	
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00020 ^{DLA}	<0.00010	
	Titanium (Ti)-Dissolved (mg/L)	0.00032	0.00149	<0.00060 ^{DLA}	0.00097	
	Uranium (U)-Dissolved (mg/L)	0.00206	0.000061	0.00629	0.000065	
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.0010 ^{DLA}	<0.00050	
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	0.0016	<0.0020 ^{DLA}	0.0019	
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	0.00041	<0.00030	0.00038	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Uranium (U)-Total	B	L2106485-1, -2, -3, -4, -5, -6, -7, -9
Matrix Spike	Dissolved Organic Carbon	MS-B	L2106485-1, -2
Matrix Spike	Barium (Ba)-Total	MS-B	L2106485-1, -10, -2, -3, -4, -5, -6, -7, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L2106485-1, -10, -2, -3, -4, -5, -6, -7, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2106485-1, -10, -2, -3, -4, -5, -6, -7, -9
Matrix Spike	Manganese (Mn)-Total	MS-B	L2106485-1, -10, -2, -3, -4, -5, -6, -7, -9
Matrix Spike	Sodium (Na)-Total	MS-B	L2106485-1, -10, -2, -3, -4, -5, -6, -7, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L2106485-1, -10, -2, -3, -4, -5, -6, -7, -9
Matrix Spike	Sulfur (S)-Total	MS-B	L2106485-1, -10, -2, -3, -4, -5, -6, -7, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
DLA	Detection Limit adjusted for required dilution
DLAI	Detection limit raised due to low level analytical interference or background.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
HTC	Hardness was calculated from Total Ca and/or Mg concentrations and may be biased high (dissolved Ca/Mg results unavailable).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-WR	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			

Reference Information

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-WR Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
----------------------------	---------------------

WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
----	---

VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
----	---

Chain of Custody Numbers:

2018-06-04 B

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lw - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Chain of Custody (COC) / Analytical Request Form



L2106485-COFC

Number: 2018-06-04 B

Page 1 of 1

Environmental

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

Report TO Contact and company name below will appear on the final report		Report Format / Distribution		Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply																	
Company: Minto Explorations Ltd.		Select Report Format: ☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)		Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply						1 Business day [E1] ☐											
Contact: Minto Environment - Coordinator		Quality Control (QC) Report with Report ☒ YES ☐ NO		4 day [P4] ☐						3 day [P3] ☐											
Phone: 1-604-759-4659		☒ Compare Results to Criteria on Report - provide details below if box checked		2 day [P2] ☐						Same Day, Weekend or Statutory holiday [E0] ☐											
Company address below will appear on the final report		Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX		Date and Time Required for all E&P TATs: dd-mm-yy hh:mm																	
Street: 2100-510 West Georgia St.		Email 1 or Fax: minto_environment@mintomine.com		For tests that can not be performed according to the service level selected, you will be contacted.																	
City/Province: Vancouver, British Columbia		Email 2		Analysis Request																	
Postal Code: V6B 0M3		Email 3		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below																	
Invoice To: Same as Report To ☐ YES ☒ NO		Invoice Distribution		Number of Containers																	
Copy of Invoice with Report ☐ YES ☒ NO		Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX																			
Company: Minto Explorations Ltd.		Email 1 or Fax: ap@mintomine.com																			
Contact: Ruth Cayetano		Email 2																			
Project Information		Oil and Gas Required Fields (client use)																			
ALS Account # / Quote #:		AFE/Cost Center:																			
Job #:		Major/Minor Code:																			
PO / AFE: 229096 (WUL)		Requisitioner:																			
LSD:		Location:																			
ALS Lab Work Order # (lab use only)		ALS Contact: Shane Stack		Sampler:																	
ALS Sample # (lab use only)		Sample Identification and/or Coordinates (This description will appear on the report)		Date (dd-mm-yy)		Time (hh:mm)		Sample Type													
W15				4-Jun-18		8:30		Water													
W35				4-Jun-18		9:00		Water													
W55				4-Jun-18		9:45		Water													
W12				4-Jun-18		10:45		Water													
W45				4-Jun-18		13:35		Water													
W30				4-Jun-18		14:15		Water													
W33S				4-Jun-18		14:40		Water													
W14				4-Jun-18		15:30		Water													
Dup				4-Jun-18				Water													
T-BL				4-Jun-18				Water													
Drinking Water (DW) Samples ¹ (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)		SAMPLE CONDITION AS RECEIVED (lab use only)																	
Are samples taken from a Regulated DW System? ☐ YES ☒ NO				Frozen ☐ SIF Observations Yes ☐ No ☐																	
Are samples for human drinking water use? ☐ YES ☒ NO				Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐																	
				Cooling Initiated ☒																	
				INITIAL COOLER TEMPERATURES °C: 8.0 FINAL COOLER TEMPERATURES °C: 6																	
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)		FINAL SHIPMENT RECEPTION (lab use only)																	
Released by: Corey Roberts		Date: 2018-06-04		Time:		Received by: [Signature]		Date: 5 Jun 2018		Time: 16:30		Received by: HA		Date: 6 Jun		Time: 12:00					

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

OCTOBER 2015 FRONT



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 06-JUN-18
Report Date: 21-JUN-18 13:55 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2107451
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-06-06 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2107451-1 Water 05-JUN-18 10:05 W3	L2107451-2 Water 05-JUN-18 10:30 W17	L2107451-3 Water 05-JUN-18 DUP	L2107451-4 Water 05-JUN-18 14:45 W2	L2107451-5 Water 05-JUN-18 15:50 MC1
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	485	470	468	257	247
	Hardness (as CaCO3) (mg/L)	237	228	225	123	119
	pH (pH)	8.49	8.43	8.46	8.26	8.24
	Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0	7.7	90.5
	TDS (Calculated) (mg/L)	277	274	270	139	137
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	198	187	182	116	116
	Alkalinity, Carbonate (as CaCO3) (mg/L)	11.2	8.4	10.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	209	195	192	116	116
	Ammonia, Total (as N) (mg/L)	0.0105	<0.0050	<0.0050	<0.0050	0.0117
	Chloride (Cl) (mg/L)	4.47	6.22	6.23	1.47	1.36
	Nitrate and Nitrite (as N) (mg/L)	0.117	0.137	0.137	0.0145	0.0235
	Nitrate (as N) (mg/L)	0.117	0.137	0.137	0.0145	0.0235
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	49.2	52.4	52.5	16.3	15.4
	Anion Sum (meq/L)	5.33	5.18	5.11	2.69	2.68
	Cation Sum (meq/L)	5.54	5.28	5.21	2.84	2.78
	Cation - Anion Balance (%)	1.9	0.9	1.0	2.7	1.8
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	13.5	9.99	10.3	15.1	14.4
Total Metals	Aluminum (Al)-Total (mg/L)	0.162	0.0073	0.0045	0.0905	1.57
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	0.00016
	Arsenic (As)-Total (mg/L)	0.00043	0.00037	0.00035	0.00064	0.00144
	Barium (Ba)-Total (mg/L)	0.0706	0.0656	0.0637	0.0516	0.0841
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	0.000068
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.022	0.024	0.025	<0.010	<0.010
	Cadmium (Cd)-Total (mg/L)	0.0000117	<0.0000050	<0.0000050	0.0000083	0.0000388
	Calcium (Ca)-Total (mg/L)	52.3	60.6	60.4	31.6	31.2
	Chromium (Cr)-Total (mg/L)	0.00034	0.00012	0.00013	0.00039	0.00300
	Cobalt (Co)-Total (mg/L)	0.00023	<0.00010	<0.00010	0.00015	0.00127
	Copper (Cu)-Total (mg/L)	0.0170	0.0106	0.00879	0.00363	0.00845
	Iron (Fe)-Total (mg/L)	0.311	<0.010	<0.010	0.261	2.58
	Lead (Pb)-Total (mg/L)	0.000064	0.000056	<0.000050	0.000064	0.000740
	Lithium (Li)-Total (mg/L)	0.0031	0.0017	0.0018	0.0013	0.0022
	Magnesium (Mg)-Total (mg/L)	25.1	18.5	18.4	11.0	11.2
	Manganese (Mn)-Total (mg/L)	0.142	0.00449	0.00464	0.0281	0.287

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID				
		L2107451-6 Water 05-JUN-18 16:30 W7				
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	181				
	Hardness (as CaCO3) (mg/L)	85.8				
	pH (pH)	8.14				
	Total Suspended Solids (mg/L)	28.7				
	TDS (Calculated) (mg/L)	96.4				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	90.2				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Total (as CaCO3) (mg/L)	90.2				
	Ammonia, Total (as N) (mg/L)	0.0101				
	Chloride (Cl) (mg/L)	<0.50				
	Nitrate and Nitrite (as N) (mg/L)	0.0218				
	Nitrate (as N) (mg/L)	0.0218				
	Nitrite (as N) (mg/L)	<0.0010				
	Sulfate (SO4) (mg/L)	6.12				
	Anion Sum (meq/L)	1.93				
	Cation Sum (meq/L)	2.00				
	Cation - Anion Balance (%)	1.8				
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	14.4				
Total Metals	Aluminum (Al)-Total (mg/L)	0.455				
	Antimony (Sb)-Total (mg/L)	0.00010				
	Arsenic (As)-Total (mg/L)	0.00064				
	Barium (Ba)-Total (mg/L)	0.0539				
	Beryllium (Be)-Total (mg/L)	0.000024				
	Bismuth (Bi)-Total (mg/L)	<0.000050				
	Boron (B)-Total (mg/L)	<0.010				
	Cadmium (Cd)-Total (mg/L)	0.0000131				
	Calcium (Ca)-Total (mg/L)	21.9				
	Chromium (Cr)-Total (mg/L)	0.00113				
	Cobalt (Co)-Total (mg/L)	0.00047				
	Copper (Cu)-Total (mg/L)	0.00316				
	Iron (Fe)-Total (mg/L)	0.795				
	Lead (Pb)-Total (mg/L)	0.000231				
	Lithium (Li)-Total (mg/L)	0.0010				
	Magnesium (Mg)-Total (mg/L)	7.75				
	Manganese (Mn)-Total (mg/L)	0.110				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID	L2107451-1	L2107451-2	L2107451-3	L2107451-4	L2107451-5
		Description	Water	Water	Water	Water	Water
		Sampled Date	05-JUN-18	05-JUN-18	05-JUN-18	05-JUN-18	05-JUN-18
		Sampled Time	10:05	10:30		14:45	15:50
		Client ID	W3	W17	DUP	W2	MC1
Grouping	Analyte						
WATER							
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.000025 ^{DLM}
	Molybdenum (Mo)-Total (mg/L)	0.00466	0.00696	0.00673	0.00135	0.00134	
	Nickel (Ni)-Total (mg/L)	0.00162	0.00063	0.00063	0.00149	0.00504	
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	0.119	
	Potassium (K)-Total (mg/L)	2.14	3.33	3.32	1.16	1.30	
	Selenium (Se)-Total (mg/L)	0.000336	0.000464	0.000440	0.000131	0.000217	
	Silicon (Si)-Total (mg/L)	6.40	5.62	5.59	5.25	7.97	
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020 ^{DLM}	
	Sodium (Na)-Total (mg/L)	15.9	13.8	13.6	7.78	7.59	
	Strontium (Sr)-Total (mg/L)	0.683	0.683	0.659	0.307	0.303	
	Sulfur (S)-Total (mg/L)	17.4	18.6	18.7	6.13	5.37	
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	0.000017	
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Total (mg/L)	0.0105	<0.00030	<0.00030	0.00388	0.0683	
	Uranium (U)-Total (mg/L)	0.00277	0.00220	0.00216	0.00121	0.00138	
	Vanadium (V)-Total (mg/L)	0.00121	<0.00050	<0.00050	0.00125	0.00583	
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	0.0070	
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	0.00036	0.00039	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0115	0.0031	0.0019	0.0152	0.0208	
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
	Arsenic (As)-Dissolved (mg/L)	0.00035	0.00034	0.00036	0.00058	0.00062	
	Barium (Ba)-Dissolved (mg/L)	0.0701	0.0691	0.0692	0.0527	0.0541	
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	0.020	0.022	0.021	<0.010	<0.010	
	Cadmium (Cd)-Dissolved (mg/L)	0.0000086	<0.0000050	<0.0000050	0.0000060	0.0000056	
	Calcium (Ca)-Dissolved (mg/L)	52.1	60.2	59.0	30.7	29.4	
	Chromium (Cr)-Dissolved (mg/L)	0.00014	<0.00010	<0.00010	0.00023	0.00020	
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	0.00019	
	Copper (Cu)-Dissolved (mg/L)	0.0102	0.00846	0.00834	0.00339	0.00445	
	Iron (Fe)-Dissolved (mg/L)	0.055	<0.010	<0.010	0.101	0.159	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.0029	0.0016	0.0016	0.0012	0.0011	
	Magnesium (Mg)-Dissolved (mg/L)	26.0	18.9	18.9	11.2	11.0	
	Manganese (Mn)-Dissolved (mg/L)	0.108	0.00418	0.00433	0.00974	0.150	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID				
		L2107451-6 Water 05-JUN-18 16:30 W7				
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	^{DLM} <0.000025				
	Molybdenum (Mo)-Total (mg/L)	0.00116				
	Nickel (Ni)-Total (mg/L)	0.00208				
	Phosphorus (P)-Total (mg/L)	<0.050				
	Potassium (K)-Total (mg/L)	0.75				
	Selenium (Se)-Total (mg/L)	0.000108				
	Silicon (Si)-Total (mg/L)	5.37				
	Silver (Ag)-Total (mg/L)	<0.000010				
	Sodium (Na)-Total (mg/L)	5.49				
	Strontium (Sr)-Total (mg/L)	0.220				
	Sulfur (S)-Total (mg/L)	2.02				
	Thallium (Tl)-Total (mg/L)	<0.000010				
	Tin (Sn)-Total (mg/L)	<0.000010				
	Titanium (Ti)-Total (mg/L)	0.0176				
	Uranium (U)-Total (mg/L)	0.000855				
	Vanadium (V)-Total (mg/L)	0.00237				
	Zinc (Zn)-Total (mg/L)	0.0056				
	Zirconium (Zr)-Total (mg/L)	0.00036				
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD				
	Dissolved Metals Filtration Location	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	0.0147				
	Antimony (Sb)-Dissolved (mg/L)	<0.00010				
	Arsenic (As)-Dissolved (mg/L)	0.00041				
	Barium (Ba)-Dissolved (mg/L)	0.0470				
	Beryllium (Be)-Dissolved (mg/L)	<0.000020				
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050				
	Boron (B)-Dissolved (mg/L)	<0.010				
	Cadmium (Cd)-Dissolved (mg/L)	0.0000058				
	Calcium (Ca)-Dissolved (mg/L)	21.1				
	Chromium (Cr)-Dissolved (mg/L)	0.00026				
	Cobalt (Co)-Dissolved (mg/L)	0.00016				
	Copper (Cu)-Dissolved (mg/L)	0.00300				
	Iron (Fe)-Dissolved (mg/L)	0.094				
	Lead (Pb)-Dissolved (mg/L)	<0.000050				
	Lithium (Li)-Dissolved (mg/L)	<0.0010				
	Magnesium (Mg)-Dissolved (mg/L)	8.01				
	Manganese (Mn)-Dissolved (mg/L)	0.0833				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2107451-1 Water 05-JUN-18 10:05 W3	L2107451-2 Water 05-JUN-18 10:30 W17	L2107451-3 Water 05-JUN-18 DUP	L2107451-4 Water 05-JUN-18 14:45 W2	L2107451-5 Water 05-JUN-18 15:50 MC1
Grouping	Analyte						
WATER							
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00444	0.00664	0.00652	0.00131	0.00128	0.00128
	Nickel (Ni)-Dissolved (mg/L)	0.00134	0.00059	0.00062	0.00134	0.00131	0.00131
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	2.23	3.57	3.51	1.27	1.22	1.22
	Selenium (Se)-Dissolved (mg/L)	0.000272	0.000428	0.000415	0.000146	0.000157	0.000157
	Silicon (Si)-Dissolved (mg/L)	5.32	4.91	4.94	4.55	4.47	4.47
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	16.9	14.4	14.4	8.13	8.16	8.16
	Strontium (Sr)-Dissolved (mg/L)	0.699	0.678	0.667	0.306	0.292	0.292
	Sulfur (S)-Dissolved (mg/L)	14.2	15.3	15.5	4.90	4.34	4.34
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00048	<0.00030	<0.00030	<0.00090 ^{DLM}	0.00172	0.00172
	Uranium (U)-Dissolved (mg/L)	0.00274	0.00214	0.00212	0.00117	0.00123	0.00123
	Vanadium (V)-Dissolved (mg/L)	0.00060	<0.00050	<0.00050	0.00087	0.00110	0.00110
	Zinc (Zn)-Dissolved (mg/L)	0.0012	<0.0010	0.0010	0.0021	0.0012	0.0012
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2107451-6 Water 05-JUN-18 16:30 W7				
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050				
	Molybdenum (Mo)-Dissolved (mg/L)	0.00115				
	Nickel (Ni)-Dissolved (mg/L)	0.00185				
	Phosphorus (P)-Dissolved (mg/L)	<0.050				
	Potassium (K)-Dissolved (mg/L)	0.77				
	Selenium (Se)-Dissolved (mg/L)	0.000129				
	Silicon (Si)-Dissolved (mg/L)	4.02				
	Silver (Ag)-Dissolved (mg/L)	<0.000010				
	Sodium (Na)-Dissolved (mg/L)	5.90				
	Strontium (Sr)-Dissolved (mg/L)	0.216				
	Sulfur (S)-Dissolved (mg/L)	1.76				
	Thallium (Tl)-Dissolved (mg/L)	<0.000010				
	Tin (Sn)-Dissolved (mg/L)	<0.00010				
	Titanium (Ti)-Dissolved (mg/L)	0.00064				
	Uranium (U)-Dissolved (mg/L)	0.000798				
	Vanadium (V)-Dissolved (mg/L)	0.00097				
	Zinc (Zn)-Dissolved (mg/L)	<0.0010				
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Dissolved Organic Carbon	MS-B	L2107451-1, -2, -3, -4, -5, -6
Matrix Spike	Dissolved Organic Carbon	MS-B	L2107451-1, -2, -3, -4, -5, -6
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2107451-1, -2, -3, -4, -5, -6
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2107451-1, -2, -3, -4, -5, -6
Matrix Spike	Copper (Cu)-Dissolved	MS-B	L2107451-1, -2, -3, -4, -5, -6
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2107451-1, -2, -3, -4, -5, -6
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2107451-1, -2, -3, -4, -5, -6
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2107451-1, -2, -3, -4, -5, -6
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2107451-1, -2, -3, -4, -5, -6
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2107451-1, -2, -3, -4, -5, -6
Matrix Spike	Uranium (U)-Dissolved	MS-B	L2107451-1, -2, -3, -4, -5, -6
Matrix Spike	Barium (Ba)-Total	MS-B	L2107451-1, -2, -3, -4, -5, -6
Matrix Spike	Calcium (Ca)-Total	MS-B	L2107451-1, -2, -3, -4, -5, -6
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2107451-1, -2, -3, -4, -5, -6
Matrix Spike	Sodium (Na)-Total	MS-B	L2107451-1, -2, -3, -4, -5, -6
Matrix Spike	Strontium (Sr)-Total	MS-B	L2107451-1, -2, -3, -4, -5, -6

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLAI	Detection limit raised due to low level analytical interference or background.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-WR	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)

Reference Information

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-WR Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
----------------------------	---------------------

WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
----	---

VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
----	---

Chain of Custody Numbers:

Reference Information

2018-06-06 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2107451-COFC

COC Number: 2018-06-06 A

Page 1 of 1

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[illegible]

REFER TO BACK PAGE FOR AIS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 08-JUN-18
Report Date: 26-JUN-18 13:05 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2109673
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-06-08 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

26-JUN-18 13:05 (MT)

Version: FINAL

Sample ID Description Sampled Date Sampled Time Client ID		L2109673-1 Water 06-JUN-18 15:00 W4	L2109673-2 Water 06-JUN-18 14:30 W5	L2109673-3 Water 07-JUN-18 10:25 W10	L2109673-4 Water 07-JUN-18 11:00 W62	L2109673-5 Water 07-JUN-18 F-BL
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	152	163	344	1030	<2.0
	Hardness (as CaCO3) (mg/L)	77.9	81.9	176	562	<0.50
	pH (pH)	8.02	8.04	8.24	8.44	5.38
	Total Suspended Solids (mg/L)	22.1	21.7	8.1	10.3	<3.0
	TDS (Calculated) (mg/L)	83.2	86.7	203	715	<1.0
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	68.3	70.9	142	262	<1.0
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	16.8	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	68.3	70.9	142	278	<1.0
	Ammonia, Total (as N) (mg/L)	0.0053	<0.0050	0.0367	0.0242	0.0055 ^{RRV}
	Chloride (Cl) (mg/L)	<0.50	<0.50	<0.50	17.1	<0.50
	Nitrate and Nitrite (as N) (mg/L)	0.0294	0.0259	8.56	10.6	<0.0051
	Nitrate (as N) (mg/L)	0.0294	0.0259	8.52	10.6	<0.0050
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	0.0391	0.0659	<0.0010
	Sulfate (SO4) (mg/L)	10.9	11.5	5.91	244	<0.30
	Anion Sum (meq/L)	1.59	1.66	3.57	11.9	<0.10
	Cation Sum (meq/L)	1.72	1.79	3.95	12.9	<0.10
	Cation - Anion Balance (%)	3.9	3.9	5.0	4.0	0.0
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	6.27	5.55			<0.50
Total Metals	Aluminum (Al)-Total (mg/L)	0.374	0.469	0.0759	0.115	<0.0030
	Antimony (Sb)-Total (mg/L)	0.00011	0.00012	<0.00010	0.00016	<0.00010
	Arsenic (As)-Total (mg/L)	0.00076	0.00084	0.00047	0.00078	<0.00010
	Barium (Ba)-Total (mg/L)	0.0448	0.0463	0.261	0.0885	<0.00010
	Beryllium (Be)-Total (mg/L)	0.000021	0.000028	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	<0.010	<0.010	0.015	0.037	<0.010
	Cadmium (Cd)-Total (mg/L)	0.0000159	0.0000184	0.0000117	0.0000360	<0.0000050
	Calcium (Ca)-Total (mg/L)	20.4	21.5	50.3	152	<0.050
	Chromium (Cr)-Total (mg/L)	0.00088	0.00102	0.00012	0.00035	<0.00010
	Cobalt (Co)-Total (mg/L)	0.00026	0.00032	0.00063	0.00021	<0.00010
	Copper (Cu)-Total (mg/L)	0.00266	0.00276	0.0209	0.0704	<0.00050
	Iron (Fe)-Total (mg/L)	0.514	0.641	3.82	0.227	<0.010
	Lead (Pb)-Total (mg/L)	0.000209	0.000235	0.000086	0.000109	<0.000050
	Lithium (Li)-Total (mg/L)	0.0013	0.0014	<0.0010	0.0041	<0.0010
	Magnesium (Mg)-Total (mg/L)	6.29	6.39	11.2	40.2	<0.10
	Manganese (Mn)-Total (mg/L)	0.0207	0.0268	0.671	0.0593	<0.00010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

26-JUN-18 13:05 (MT)

Version: FINAL

Sample ID Description Sampled Date Sampled Time Client ID		L2109673-1 Water 06-JUN-18 15:00 W4	L2109673-2 Water 06-JUN-18 14:30 W5	L2109673-3 Water 07-JUN-18 10:25 W10	L2109673-4 Water 07-JUN-18 11:00 W62	L2109673-5 Water 07-JUN-18 F-BL
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.000984	0.00107	0.00111	0.0111	<0.000050
	Nickel (Ni)-Total (mg/L)	0.00156	0.00183	0.00052	0.00113	<0.00050
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	0.113	<0.050	<0.050
	Potassium (K)-Total (mg/L)	0.86	0.91	2.96	7.33	<0.10
	Selenium (Se)-Total (mg/L)	0.000175	0.000155	0.000106	0.00406	<0.000050
	Silicon (Si)-Total (mg/L)	4.41	4.40	4.34	6.77	<0.10
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	0.000021	<0.000010
	Sodium (Na)-Total (mg/L)	3.11	2.91	7.07	33.0	<0.050
	Strontium (Sr)-Total (mg/L)	0.129	0.131	0.333	1.79	<0.00020
	Sulfur (S)-Total (mg/L)	3.66	3.93	2.22	90.8	<0.50
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	0.00012	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	0.0164	0.0217	0.00297	0.00539	<0.00030
	Uranium (U)-Total (mg/L)	0.00112	0.00110	0.000189	0.00467	<0.000010
	Vanadium (V)-Total (mg/L)	0.00158	0.00179	0.00087	0.00118	<0.00050
	Zinc (Zn)-Total (mg/L)	<0.0030	0.0031	0.0046	0.0233	<0.0030
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0264	0.0199	0.0086	0.0081	0.0019
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00011	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00047	0.00048	0.00030	0.00072	<0.00010
	Barium (Ba)-Dissolved (mg/L)	0.0413	0.0405	0.203	0.0877	<0.00010
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	<0.010	<0.010	0.014	0.035	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	0.0000068	0.0000078	<0.0000050	0.0000265	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	20.8	22.1	51.4	158	<0.050
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	0.00017	0.00013	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00165	0.00132	0.0105	0.0577	0.00024
	Iron (Fe)-Dissolved (mg/L)	0.049	0.051	0.663	0.040	<0.010
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0010	0.0010	<0.0010	0.0041	<0.0010
	Magnesium (Mg)-Dissolved (mg/L)	6.30	6.47	11.5	40.5	<0.10
Manganese (Mn)-Dissolved (mg/L)	0.00634	0.0102	0.191	0.0532	0.00014	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2109673-1 Water 06-JUN-18 15:00 W4	L2109673-2 Water 06-JUN-18 14:30 W5	L2109673-3 Water 07-JUN-18 10:25 W10	L2109673-4 Water 07-JUN-18 11:00 W62	L2109673-5 Water 07-JUN-18 F-BL
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.000959	0.000996	0.00111	0.0113	<0.000050
	Nickel (Ni)-Dissolved (mg/L)	0.00090	0.00070	<0.00050	0.00102	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	0.86	0.87	2.99	7.60	<0.10
	Selenium (Se)-Dissolved (mg/L)	0.000112	0.000172	0.000131	0.00438	<0.000050
	Silicon (Si)-Dissolved (mg/L)	3.70	3.55	3.97	6.36	<0.050
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	0.000011	<0.000010
	Sodium (Na)-Dissolved (mg/L)	3.18	2.98	7.35	33.3	<0.050
	Strontium (Sr)-Dissolved (mg/L)	0.135	0.134	0.340	1.86	<0.00020
	Sulfur (S)-Dissolved (mg/L)	3.36	3.82	1.95	83.7	<0.50
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00064	0.00065	0.00049	0.00077	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00109	0.00107	0.000182	0.00475	<0.000010
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	0.00060	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0015	0.0011	0.0010	0.0161	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Aluminum (Al)-Dissolved	DUP-H	L2109673-1, -2, -3, -4, -5
Duplicate	Titanium (Ti)-Dissolved	DUP-H	L2109673-1, -2, -3, -4, -5
Method Blank	Chromium (Cr)-Dissolved	MB-LOR	L2109673-1, -2, -3, -4, -5
Method Blank	Sulfur (S)-Dissolved	MB-LOR	L2109673-5
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2109673-1, -2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2109673-1, -2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2109673-1, -2, -3, -4, -5
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2109673-1, -2, -3, -4, -5
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2109673-1, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2109673-1, -2, -3, -4, -5
Matrix Spike	Aluminum (Al)-Total	MS-B	L2109673-1, -2, -3, -4, -5
Matrix Spike	Barium (Ba)-Total	MS-B	L2109673-1, -2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Total	MS-B	L2109673-1, -2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2109673-1, -2, -3, -4, -5
Matrix Spike	Manganese (Mn)-Total	MS-B	L2109673-1, -2, -3, -4, -5
Matrix Spike	Sodium (Na)-Total	MS-B	L2109673-1, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Total	MS-B	L2109673-1, -2, -3, -4, -5

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DUP-H	Duplicate results outside ALS DQO, due to sample heterogeneity.
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			

Reference Information

HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
SO4-IC-N-VA	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)
This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".			
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.			
TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.			
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-06-08 A

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com



L2109673-COFC

COC Number: 2018-06-08 A

Page 1 of 1

Report To		Report Format / Distribution		Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply																
Company:	Minto Explorations Ltd.	Select Report Format:	☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)	Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply																
Contact:	Minto Environment - Coordinator	Quality Control (QC) Report with Report	☒ YES ☐ NO	PRIORITY (Business Days)	4 day [P4] ☐				EMERGENCY	1 Business day [E1] ☐										
Phone:	1-804-759-4659	☒ Compare Results to Criteria on Report - provide details below if box checked	3 day [P3] ☐				Same Day, Weekend or Statutory holiday [E0] ☐													
Company address below will appear on the final report		Select Distribution:	☒ EMAIL ☐ MAIL ☐ FAX		2 day [P2] ☐															
Street:	2100-510 West Georgia St.	Email 1 or Fax	minto_environment@mintomine.com	Date and Time Required for all E&P TATs:				dd-mm-yy hh:mm												
City/Province:	Vancouver, British Columbia	Email 2		For tests that can not be performed according to the service level selected, you will be contacted.																
Postal Code:	V6B 0M3	Email 3		Analysis Request																
Invoice To	Same as Report To ☐ YES ☒ NO	Invoice Distribution		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below																
	Copy of Invoice with Report ☐ YES ☒ NO	Select Invoice Distribution:	☒ EMAIL ☐ MAIL ☐ FAX				P	F/P	P	F/P	P	F/P								
Company:	Minto Explorations Ltd.	Email 1 or Fax	ap@mintomine.com	pH / Conductivity / Alkalinity / Anions	Total Suspended Solids (TSS)	Total Dissolved Solids (TDS)	Total Metals (TM), Hardness	Dissolved Metals (DM) (Filtered and preserved)	Total Mercury, Hardness	Dissolved Mercury (1) (Filtered + preserved)	Total Nutrients (Ammonia)	Dissolved Organic Carbon (DOC)								
Contact:	Ruth Cayetano	Email 2																		
Project Information		Oil and Gas Required Fields (client use)																		
ALS Account # / Quote #:	AFE/Cost Center:	PO#																		
Job #:	Major/Minor Code:	Routing Code:																		
PO / AFE:	229096 (WUL)	Requisitioner:																		
LSD:		Location:																		
ALS Lab Work Order # (lab use only)		ALS Contact:	Shane Stack	Sampler:	CR															
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mm-yy)	Time (hh:mm)	Sample Type																
	W4	6-Jun-18	15:00	Water	R	R	R	R	R	R	R	R	R	R						7
	W5	6-Jun-18	14:30	Water	R	R	R	R	R	R	R	R	R	R						7
	W10	7-Jun-18	10:25	Water	R	R	R	R	R	R	R	R	R	R						6
	W62	7-Jun-18	11:00	Water	R	R	R	R	R	R	R	R	R	R						6
	F-BL	7-Jun-18		Water	R	R	R	R	R	R	R	R	R	R						7
Drinking Water (DW) Samples ¹ (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)		SAMPLE CONDITION AS RECEIVED (lab use only)																
Are samples taken from a Regulated DW System?				Frozen ☐ SIF Observations Yes ☐ No ☐																
Are samples for human drinking water use?				Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐																
				Cooling Initiated ☐																
				INITIAL COOLER TEMPERATURES °C 10.0 FINAL COOLER TEMPERATURES °C 6																
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)		FINAL SHIPMENT RECEPTION (lab use only)																
Released by: Corey Roberts	Date: 2018-06-08	Time:	Received by: EHF	Date: 8 June 2018	Time: 16:00	Received by: 1A	Date: 6/12	Time: 1:55 PM												

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 13-JUN-18
Report Date: 13-JUL-18 20:14 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2111705
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-06-13 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2111705-1 Water 10-JUN-18 09:00 W50	L2111705-2 Water 10-JUN-18 07:40 W16A	L2111705-3 Water 11-JUN-18 10:10 MN-0.2	L2111705-4 Water 11-JUN-18 14:15 MN-4.5	L2111705-5 Water 11-JUN-18 15:10 MN-0.5
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	406	412	74.3	185	197
	Hardness (as CaCO3) (mg/L)	196	201	36.1	88.3	96.9
	pH (pH)	8.25	8.31	7.44	8.08	8.12
	Total Suspended Solids (mg/L)	3.6	<3.0	<3.0	<3.0	14.6
	TDS (Calculated) (mg/L)	242	246	38.4	96.6	105
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	147	148	24.8	83.5	89.0
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	3.6	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	147	151	24.8	83.5	89.0
	Ammonia, Total (as N) (mg/L)	0.0118	0.0154	0.0101	<0.0050	0.0052
	Chloride (Cl) (mg/L)	5.11	5.08	<0.50	<0.50	<0.50
	Nitrate and Nitrite (as N) (mg/L)	1.75	1.81	0.0067	0.0243	<0.0051
	Nitrate (as N) (mg/L)	1.75	1.80	0.0067	0.0243	<0.0050
	Nitrite (as N) (mg/L)	0.0061	0.0109	<0.0010	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	58.8	58.4	7.24	9.42	10.8
	Anion Sum (meq/L)	4.43	4.51	0.65	1.87	2.00
	Cation Sum (meq/L)	4.50	4.58	0.89	2.01	2.20
	Cation - Anion Balance (%)	0.8	0.7	15.9	3.7	4.7
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	19.3	19.5	22.2	12.7	11.5
Total Metals	Aluminum (Al)-Total (mg/L)	0.0197	0.0225	0.0935	0.0142	0.167
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00049	0.00041	0.00044	0.00036	0.00054
	Barium (Ba)-Total (mg/L)	0.0506	0.0662	0.0313	0.0409	0.0490
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.015	0.014	<0.010	<0.010	<0.010
	Cadmium (Cd)-Total (mg/L)	0.0000063	0.0000108	0.0000068	<0.0000050	0.0000101
	Calcium (Ca)-Total (mg/L)	50.5	51.2	9.17	24.2	26.7
	Chromium (Cr)-Total (mg/L)	0.00016	0.00016	0.00055	0.00021	0.00044
	Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	0.00017	<0.00010	0.00023
	Copper (Cu)-Total (mg/L)	0.0334	0.0365	0.00282	0.00170	0.00156
	Iron (Fe)-Total (mg/L)	0.072	0.089	0.379	0.067	0.378
	Lead (Pb)-Total (mg/L)	0.000368	0.000172	<0.000050	<0.000050	0.000096
	Lithium (Li)-Total (mg/L)	0.0012	0.0012	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)-Total (mg/L)	15.2	15.8	2.97	6.41	6.76
	Manganese (Mn)-Total (mg/L)	0.0278	0.0289	0.0199	0.00301	0.0597

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2111705-6 Water 11-JUN-18 15:50 MN-2.5	L2111705-7 Water 12-JUN-18 08:35 W3	L2111705-8 Water 12-JUN-18 09:05 W50	L2111705-9 Water 12-JUN-18 09:35 W17	L2111705-10 Water 12-JUN-18 09:40 W16A
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	146	450	406	467	400
	Hardness (as CaCO3) (mg/L)	73.1	228	200	235	198
	pH (pH)	8.00	8.35	8.28	8.38	8.33
	Total Suspended Solids (mg/L)	10.6	4.6	<3.0	<3.0	3.8
	TDS (Calculated) (mg/L)	76.1	269	242	278	243
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	71.4	179	144	195	144
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	71.4	179	144	195	144
	Ammonia, Total (as N) (mg/L)	0.0081	0.0077	0.0135	0.0164	0.0154
	Chloride (Cl) (mg/L)	0.52	5.21	5.11	6.17	5.03
	Nitrate and Nitrite (as N) (mg/L)	0.0123	1.03	1.78	0.212	1.92
	Nitrate (as N) (mg/L)	0.0123	1.02	1.77	0.212	1.91
	Nitrite (as N) (mg/L)	<0.0010	0.0016	0.0058	<0.0010	0.0104
	Sulfate (SO4) (mg/L)	2.60	58.1	59.4	54.1	59.5
	Anion Sum (meq/L)	1.50	5.01	4.39	5.20	4.40
	Cation Sum (meq/L)	1.65	5.25	4.55	5.43	4.52
	Cation - Anion Balance (%)	4.8	2.4	1.8	2.2	1.3
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	14.5	14.1	18.9	10.1	20.1
Total Metals	Aluminum (Al)-Total (mg/L)	0.103	0.0382	0.0154	0.0058	0.0266
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00041	0.00041	0.00044	0.00035	0.00045
	Barium (Ba)-Total (mg/L)	0.0344	0.0658	0.0597	0.0639	0.0632
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	<0.010	0.020	0.015	0.024	0.015
	Cadmium (Cd)-Total (mg/L)	<0.0000050	0.0000063	0.0000056	<0.0000050	0.0000093
	Calcium (Ca)-Total (mg/L)	19.4	52.9	51.7	59.9	50.9
	Chromium (Cr)-Total (mg/L)	0.00041	0.00019	0.00017	0.00011	0.00018
	Cobalt (Co)-Total (mg/L)	0.00015	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Total (mg/L)	0.00251	0.0134	0.0313	0.00848	0.0379
	Iron (Fe)-Total (mg/L)	0.181	0.083	0.064	<0.010	0.097
	Lead (Pb)-Total (mg/L)	0.000060	<0.000050	0.000145	<0.000050	0.000596
	Lithium (Li)-Total (mg/L)	<0.0010	0.0021	0.0012	0.0016	0.0012
	Magnesium (Mg)-Total (mg/L)	5.58	20.4	15.7	18.1	15.4
	Manganese (Mn)-Total (mg/L)	0.0131	0.0396	0.0252	0.0119	0.0346

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2111705-11 Water 12-JUN-18 10:15 W16	L2111705-12 Water 12-JUN-18 10:50 W55	L2111705-13 Water 12-JUN-18 13:30 W2	L2111705-14 Water 12-JUN-18 14:35 MC1	L2111705-15 Water 12-JUN-18 DUP
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	404	291	315	312	316
	Hardness (as CaCO3) (mg/L)	201	154	154	152	153
	pH (pH)	8.36	8.14	8.30	8.30	8.29
	Total Suspended Solids (mg/L)	3.8	8.2	5.6	22.0	15.6
	TDS (Calculated) (mg/L)	242	166	170	175	177
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	143	125	142	139	143
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	143	125	142	139	143
	Ammonia, Total (as N) (mg/L)	0.0140	0.0157	0.0065	0.0075	0.0056
	Chloride (Cl) (mg/L)	5.05	2.18	0.79	2.13	2.18
	Nitrate and Nitrite (as N) (mg/L)	1.92	0.165	0.167	0.210	0.164
	Nitrate (as N) (mg/L)	1.91	0.165	0.165	0.210	0.164
	Nitrite (as N) (mg/L)	0.0106	<0.0010	0.0020	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	59.4	25.3	19.9	25.3	25.2
	Anion Sum (meq/L)	4.36	3.10	3.28	3.39	3.46
	Cation Sum (meq/L)	4.57	3.44	3.54	3.51	3.52
	Cation - Anion Balance (%)	2.3	5.1	3.9	1.8	0.9
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	19.3	27.1	12.1	12.6	11.7
Total Metals	Aluminum (Al)-Total (mg/L)	0.0241	0.124	0.0579	0.150	0.165
	Antimony (Sb)-Total (mg/L)	<0.00010	0.00012	<0.00010	0.00013	0.00011
	Arsenic (As)-Total (mg/L)	0.00038	0.00069	0.00055	0.00080	0.00063
	Barium (Ba)-Total (mg/L)	0.0639	0.0628	0.0587	0.0680	0.0626
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.014	0.016	<0.010	<0.010	<0.010
	Cadmium (Cd)-Total (mg/L)	0.0000123	0.0000119	0.0000068	0.0000111	0.0000079
	Calcium (Ca)-Total (mg/L)	51.6	41.2	37.5	37.0	37.2
	Chromium (Cr)-Total (mg/L)	0.00016	0.00036	0.00115	0.00042	0.00047
	Cobalt (Co)-Total (mg/L)	<0.00010	0.00024	0.00010	0.00032	0.00019
	Copper (Cu)-Total (mg/L)	0.0367	0.0353	0.00366	0.00436	0.00417
	Iron (Fe)-Total (mg/L)	0.082	0.265	0.173	0.398	0.322
	Lead (Pb)-Total (mg/L)	<0.000050	0.000115	<0.000050	0.000146	0.000101
	Lithium (Li)-Total (mg/L)	0.0012	0.0014	0.0015	0.0015	0.0015
	Magnesium (Mg)-Total (mg/L)	15.2	11.0	13.5	13.8	13.6
	Manganese (Mn)-Total (mg/L)	0.0257	0.0563	0.0155	0.135	0.0326

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2111705-16 Water 11-JUN-18 DUP				
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	187				
	Hardness (as CaCO3) (mg/L)	89.8				
	pH (pH)	8.11				
	Total Suspended Solids (mg/L)	3.4				
	TDS (Calculated) (mg/L)	99.3				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	87.0				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Total (as CaCO3) (mg/L)	87.0				
	Ammonia, Total (as N) (mg/L)	0.0060				
	Chloride (Cl) (mg/L)	<0.50				
	Nitrate and Nitrite (as N) (mg/L)	0.0234				
	Nitrate (as N) (mg/L)	0.0234				
	Nitrite (as N) (mg/L)	<0.0010				
	Sulfate (SO4) (mg/L)	9.44				
	Anion Sum (meq/L)	1.94				
	Cation Sum (meq/L)	2.04				
	Cation - Anion Balance (%)	2.6				
		12.3 ^{HTP}				
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)					
Total Metals	Aluminum (Al)-Total (mg/L)	0.0165				
	Antimony (Sb)-Total (mg/L)	<0.00010				
	Arsenic (As)-Total (mg/L)	0.00038				
	Barium (Ba)-Total (mg/L)	0.0412				
	Beryllium (Be)-Total (mg/L)	<0.000020				
	Bismuth (Bi)-Total (mg/L)	<0.000050				
	Boron (B)-Total (mg/L)	<0.010				
	Cadmium (Cd)-Total (mg/L)	<0.0000050				
	Calcium (Ca)-Total (mg/L)	24.3				
	Chromium (Cr)-Total (mg/L)	0.00024				
	Cobalt (Co)-Total (mg/L)	<0.00010				
	Copper (Cu)-Total (mg/L)	0.00166				
	Iron (Fe)-Total (mg/L)	0.071				
	Lead (Pb)-Total (mg/L)	<0.000050				
	Lithium (Li)-Total (mg/L)	<0.0010				
	Magnesium (Mg)-Total (mg/L)	6.43				
	Manganese (Mn)-Total (mg/L)	0.00325				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2111705-1 Water 10-JUN-18 09:00 W50	L2111705-2 Water 10-JUN-18 07:40 W16A	L2111705-3 Water 11-JUN-18 10:10 MN-0.2	L2111705-4 Water 11-JUN-18 14:15 MN-4.5	L2111705-5 Water 11-JUN-18 15:10 MN-0.5
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	0.0000241	0.0000234	0.0000297	0.0000147	0.0000161
	Molybdenum (Mo)-Total (mg/L)	0.00307	0.00266	0.000204	0.000984	0.000948
	Nickel (Ni)-Total (mg/L)	0.00086	0.00095	0.00139	0.00097	0.00121
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	2.61	2.59	0.25	0.90	0.96
	Selenium (Se)-Total (mg/L)	0.000892	0.000942	0.000096	0.000184	0.000188
	Silicon (Si)-Total (mg/L)	3.64	3.57	4.71	4.91	4.93
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	10.9	10.9	3.08	4.94	5.11
	Strontium (Sr)-Total (mg/L)	0.489	0.510	0.0574	0.185	0.232
	Sulfur (S)-Total (mg/L)	20.5	20.7	2.42	3.33	3.61
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	0.00085	<0.00090 ^{DLM}	0.00173	0.00058	0.00774
	Uranium (U)-Total (mg/L)	0.00128	0.00117	0.000025	0.000569	0.000690
	Vanadium (V)-Total (mg/L)	0.00051	0.00055	0.00064	0.00067	0.00128
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	0.00053	<0.00030	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0083	0.0120	0.0864	0.0105	0.0127
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00050	0.00043	0.00043	0.00036	0.00045
	Barium (Ba)-Dissolved (mg/L)	0.0509	0.0680	0.0313	0.0423	0.0469
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.015	0.014	<0.010	<0.010	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	0.0000097	<0.0000050	<0.0000050	0.0000059
	Calcium (Ca)-Dissolved (mg/L)	51.8	53.4	9.39	24.4	27.2
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00014	0.00046	0.00015	0.00014
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	0.00017	<0.00010	0.00011
	Copper (Cu)-Dissolved (mg/L)	0.0313	0.0364	0.00268	0.00172	0.00186
	Iron (Fe)-Dissolved (mg/L)	0.046	0.059	0.298	0.053	0.139
	Lead (Pb)-Dissolved (mg/L)	0.000172	0.000148	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0012	0.0012	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)-Dissolved (mg/L)	16.2	16.5	3.07	6.68	7.04
	Manganese (Mn)-Dissolved (mg/L)	0.0159	0.0207	0.0193	0.00090	0.0463

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2111705-6 Water 11-JUN-18 15:50 MN-2.5	L2111705-7 Water 12-JUN-18 08:35 W3	L2111705-8 Water 12-JUN-18 09:05 W50	L2111705-9 Water 12-JUN-18 09:35 W17	L2111705-10 Water 12-JUN-18 09:40 W16A
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	0.0000186	0.0000169	0.0000227	0.0000075	0.0000245
	Molybdenum (Mo)-Total (mg/L)	0.000652	0.00457	0.00290	0.00684	0.00265
	Nickel (Ni)-Total (mg/L)	0.00144	0.00129	0.00091	0.00061	0.00095
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	0.65	2.48	2.56	3.37	2.59
	Selenium (Se)-Total (mg/L)	0.000071	0.000568	0.000921	0.000445	0.000859
	Silicon (Si)-Total (mg/L)	5.24	4.71	3.65	5.52	3.51
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	3.81	13.9	11.2	14.1	10.9
	Strontium (Sr)-Total (mg/L)	0.0959	0.612	0.514	0.675	0.495
	Sulfur (S)-Total (mg/L)	0.97	20.4	20.5	18.9	19.8
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	0.00407	<0.0015 ^{DLM}	0.00053	<0.00030	0.00090
	Uranium (U)-Total (mg/L)	0.000112	0.00204	0.00124	0.00206	0.00119
	Vanadium (V)-Total (mg/L)	0.00081	0.00068	0.00051	<0.00050	0.00056
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0106	0.0064	0.0093	0.0027	0.0130
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00031	0.00040	0.00042	0.00038	0.00042
	Barium (Ba)-Dissolved (mg/L)	0.0326	0.0691	0.0610	0.0677	0.0675
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	<0.010	0.019	0.014	0.023	0.014
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050	0.0000066	<0.0000050	0.0000098
	Calcium (Ca)-Dissolved (mg/L)	19.7	54.7	53.0	61.1	52.6
	Chromium (Cr)-Dissolved (mg/L)	0.00013	0.00011	<0.00010	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00218	0.0132	0.0305	0.00822	0.0394
	Iron (Fe)-Dissolved (mg/L)	0.040	0.033	0.049	<0.010	0.077
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	0.000101	<0.000050	0.000900 ^{DTC}
	Lithium (Li)-Dissolved (mg/L)	<0.0010	0.0020	0.0011	0.0016	0.0012
	Magnesium (Mg)-Dissolved (mg/L)	5.78	22.1	16.4	20.0	16.3
	Manganese (Mn)-Dissolved (mg/L)	0.00716	0.0280	0.0206	0.00434	0.0245

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2111705-11 Water 12-JUN-18 10:15 W16	L2111705-12 Water 12-JUN-18 10:50 W55	L2111705-13 Water 12-JUN-18 13:30 W2	L2111705-14 Water 12-JUN-18 14:35 MC1	L2111705-15 Water 12-JUN-18 DUP
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	0.0000247	0.0000298	0.0000152	0.0000160	0.0000126
	Molybdenum (Mo)-Total (mg/L)	0.00266	0.00146	0.00228	0.00190	0.00209
	Nickel (Ni)-Total (mg/L)	0.00092	0.00123	0.00124	0.00182	0.00144
	Phosphorus (P)-Total (mg/L)	<0.050	0.064	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	2.57	1.97	1.47	1.50	1.51
	Selenium (Se)-Total (mg/L)	0.000926	0.000558	0.000189	0.000236	0.000184
	Silicon (Si)-Total (mg/L)	3.58	4.65	5.17	5.37	5.35
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	10.8	6.58	9.68	9.98	9.76
	Strontium (Sr)-Total (mg/L)	0.502	0.344	0.399	0.394	0.395
	Sulfur (S)-Total (mg/L)	20.8	6.74	8.79	8.83	8.78
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	0.00080	0.00462	0.00255	0.00481	0.00696
	Uranium (U)-Total (mg/L)	0.00118	0.000117	0.00173	0.00175	0.00170
	Vanadium (V)-Total (mg/L)	0.00054	0.00077	0.00114	0.00176	0.00136
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0208	0.0162	0.0065	0.0078	0.0066
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00045	0.00067	0.00055	0.00065	0.00055
	Barium (Ba)-Dissolved (mg/L)	0.0689	0.0653	0.0604	0.0640	0.0603
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.014	0.015	<0.010	<0.010	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	0.0000105	0.0000071	0.0000056	<0.0000050	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	53.1	42.0	38.1	36.9	37.7
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00023	0.00012	0.00012	0.00015
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00014	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.0373	0.0294	0.00328	0.00357	0.00330
	Iron (Fe)-Dissolved (mg/L)	0.069	0.043	0.057	0.096	0.056
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0012	0.0014	0.0014	0.0014	0.0014
	Magnesium (Mg)-Dissolved (mg/L)	16.5	11.9	14.2	14.5	14.3
Manganese (Mn)-Dissolved (mg/L)	0.0207	0.0105	0.00442	0.100	0.00449	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID				
		L2111705-16 Water 11-JUN-18 DUP				
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	0.0000152				
	Molybdenum (Mo)-Total (mg/L)	0.000987				
	Nickel (Ni)-Total (mg/L)	0.00098				
	Phosphorus (P)-Total (mg/L)	<0.050				
	Potassium (K)-Total (mg/L)	0.90				
	Selenium (Se)-Total (mg/L)	0.000202				
	Silicon (Si)-Total (mg/L)	4.94				
	Silver (Ag)-Total (mg/L)	<0.000010				
	Sodium (Na)-Total (mg/L)	4.96				
	Strontium (Sr)-Total (mg/L)	0.185				
	Sulfur (S)-Total (mg/L)	3.22				
	Thallium (Tl)-Total (mg/L)	<0.000010				
	Tin (Sn)-Total (mg/L)	<0.00010				
	Titanium (Ti)-Total (mg/L)	0.00068				
	Uranium (U)-Total (mg/L)	0.000585				
	Vanadium (V)-Total (mg/L)	0.00064				
	Zinc (Zn)-Total (mg/L)	<0.0030				
	Zirconium (Zr)-Total (mg/L)	<0.00030				
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD				
	Dissolved Metals Filtration Location	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	0.0104				
	Antimony (Sb)-Dissolved (mg/L)	<0.00010				
	Arsenic (As)-Dissolved (mg/L)	0.00037				
	Barium (Ba)-Dissolved (mg/L)	0.0429				
	Beryllium (Be)-Dissolved (mg/L)	<0.000020				
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050				
	Boron (B)-Dissolved (mg/L)	<0.010				
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050				
	Calcium (Ca)-Dissolved (mg/L)	24.7				
	Chromium (Cr)-Dissolved (mg/L)	0.00010				
	Cobalt (Co)-Dissolved (mg/L)	<0.00010				
	Copper (Cu)-Dissolved (mg/L)	0.00192				
	Iron (Fe)-Dissolved (mg/L)	0.056				
	Lead (Pb)-Dissolved (mg/L)	<0.000050				
	Lithium (Li)-Dissolved (mg/L)	<0.0010				
	Magnesium (Mg)-Dissolved (mg/L)	6.80				
	Manganese (Mn)-Dissolved (mg/L)	0.00108				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2111705-1 Water 10-JUN-18 09:00 W50	L2111705-2 Water 10-JUN-18 07:40 W16A	L2111705-3 Water 11-JUN-18 10:10 MN-0.2	L2111705-4 Water 11-JUN-18 14:15 MN-4.5	L2111705-5 Water 11-JUN-18 15:10 MN-0.5
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	0.0000244	0.0000249	0.0000267	0.0000195	0.0000159
	Molybdenum (Mo)-Dissolved (mg/L)	0.00294	0.00247	0.000208	0.000940	0.000967
	Nickel (Ni)-Dissolved (mg/L)	0.00089	0.00094	0.00128	0.00096	0.00091
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	2.71	2.66	0.26	0.90	0.96
	Selenium (Se)-Dissolved (mg/L)	0.000948	0.000871	0.000100	0.000157	0.000168
	Silicon (Si)-Dissolved (mg/L)	3.43	3.32	4.35	4.64	4.43
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	11.5	11.1	3.14	4.99	5.19
	Strontium (Sr)-Dissolved (mg/L)	0.471	0.489	0.0545	0.174	0.216
	Sulfur (S)-Dissolved (mg/L)	19.6	18.7	2.24	2.98	3.36
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00040	0.00039	0.00134	0.00040	0.00053
	Uranium (U)-Dissolved (mg/L)	0.00125	0.00112	0.000022	0.000558	0.000645
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	0.00052	0.00068
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	0.0018	0.0010	0.0017	0.0026
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	0.00049	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2111705-6 Water 11-JUN-18 15:50 MN-2.5	L2111705-7 Water 12-JUN-18 08:35 W3	L2111705-8 Water 12-JUN-18 09:05 W50	L2111705-9 Water 12-JUN-18 09:35 W17	L2111705-10 Water 12-JUN-18 09:40 W16A
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	0.0000196	0.0000168	0.0000258	0.0000085	0.0000284
	Molybdenum (Mo)-Dissolved (mg/L)	0.000622	0.00446	0.00271	0.00668	0.00264
	Nickel (Ni)-Dissolved (mg/L)	0.00136	0.00135	0.00092	0.00064	0.00103
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	0.66	2.63	2.61	3.64	2.71
	Selenium (Se)-Dissolved (mg/L)	0.000092	0.000653	0.000877	0.000456	0.000876
	Silicon (Si)-Dissolved (mg/L)	4.81	4.47	3.49	5.27	3.36
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	3.82	14.4	11.2	14.8	11.1
	Strontium (Sr)-Dissolved (mg/L)	0.0911	0.589	0.482	0.661	0.487
	Sulfur (S)-Dissolved (mg/L)	0.91	19.4	18.7	17.0	18.9
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00039	<0.00030	0.00037	<0.00030	0.00036
	Uranium (U)-Dissolved (mg/L)	0.000101	0.00199	0.00117	0.00204	0.00116
	Vanadium (V)-Dissolved (mg/L)	<0.00050	0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	0.0015	0.0018	<0.0010	0.0104 ^{DTC}
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2111705-11 Water 12-JUN-18 10:15 W16	L2111705-12 Water 12-JUN-18 10:50 W55	L2111705-13 Water 12-JUN-18 13:30 W2	L2111705-14 Water 12-JUN-18 14:35 MC1	L2111705-15 Water 12-JUN-18 DUP
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	0.0000060	0.0000337	0.0000151	0.0000135	0.0000131
	Molybdenum (Mo)-Dissolved (mg/L)	0.00252	0.00137	0.00197	0.00213	0.00202
	Nickel (Ni)-Dissolved (mg/L)	0.00101	0.00129	0.00119	0.00133	0.00116
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	2.70	2.08	1.52	1.52	1.53
	Selenium (Se)-Dissolved (mg/L)	0.000961	0.000522	0.000161	0.000258	0.000186
	Silicon (Si)-Dissolved (mg/L)	3.43	4.53	4.86	4.87	4.83
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	11.2	6.93	9.85	9.94	9.78
	Strontium (Sr)-Dissolved (mg/L)	0.500	0.333	0.374	0.378	0.377
	Sulfur (S)-Dissolved (mg/L)	19.0	6.50	7.93	8.04	7.96
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00079	0.00048	0.00043	0.00050	0.00041
	Uranium (U)-Dissolved (mg/L)	0.00116	0.000105	0.00165	0.00171	0.00161
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	0.00070	0.00096	0.00071
	Zinc (Zn)-Dissolved (mg/L)	0.0019	0.0016	<0.0010	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2111705-16 Water 11-JUN-18 DUP				
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	0.0000183				
	Molybdenum (Mo)-Dissolved (mg/L)	0.000946				
	Nickel (Ni)-Dissolved (mg/L)	0.00101				
	Phosphorus (P)-Dissolved (mg/L)	<0.050				
	Potassium (K)-Dissolved (mg/L)	0.92				
	Selenium (Se)-Dissolved (mg/L)	0.000197				
	Silicon (Si)-Dissolved (mg/L)	4.84				
	Silver (Ag)-Dissolved (mg/L)	<0.000010				
	Sodium (Na)-Dissolved (mg/L)	5.04				
	Strontium (Sr)-Dissolved (mg/L)	0.178				
	Sulfur (S)-Dissolved (mg/L)	2.96				
	Thallium (Tl)-Dissolved (mg/L)	<0.000010				
	Tin (Sn)-Dissolved (mg/L)	<0.00010				
	Titanium (Ti)-Dissolved (mg/L)	0.00045				
	Uranium (U)-Dissolved (mg/L)	0.000564				
	Vanadium (V)-Dissolved (mg/L)	0.00053				
	Zinc (Zn)-Dissolved (mg/L)	0.0010				
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Dissolved Organic Carbon	MS-B	L2111705-1, -10, -11, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Dissolved Organic Carbon	MS-B	L2111705-1, -10, -11, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Dissolved Organic Carbon	MS-B	L2111705-1, -10, -11, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2111705-1, -10, -11, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2111705-1, -10, -11, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Copper (Cu)-Dissolved	MS-B	L2111705-1, -10, -11, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2111705-1, -10, -11, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2111705-1, -10, -11, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2111705-1, -10, -11, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Total	MS-B	L2111705-1, -10, -11, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L2111705-1, -10, -11, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2111705-1, -10, -11, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L2111705-1, -10, -11, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DTC	Dissolved concentration exceeds total. Results were confirmed by re-analysis.
HTP	Sample preparation or preservation hold time was exceeded.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-WR	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510

Reference Information

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 µm), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-WR Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Reference Information

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-06-13 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lw - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com



L2111705-COFC

COC Number: 2018-06-13 A

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Report To		Report Format / Distribution		Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply	
Company:	Minto Explorations Ltd.	Select Report Format:	☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)	Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply	
Contact:	Minto Environment - Coordinator	Quality Control (QC) Report with Report	☒ YES ☐ NO	4 day [P4] ☐	
Phone:	1-604-759-4659	☒ Compare Results to Criteria on Report - provide details below if box checked		3 day [P3] ☐	
Company address below will appear on the final report		Select Distribution:	☒ EMAIL ☐ MAIL ☐ FAX	2 day [P2] ☐	
Street:	2100-510 West Georgia St.	Email 1 or Fax	minto_environment@mintomine.com	1 Business day [E1] ☐	
City/Province:	Vancouver, British Columbia	Email 2		Same Day, Weekend or Statutory holiday [E0] ☐	
Postal Code:	V6B 0M3	Email 3		Date and Time Required for all E&P TATs: dd-mm-yy hh:mm	
Invoice To	Same as Report To ☐ YES ☒ NO	Invoice Distribution		For tests that can not be performed according to the service level selected, you will be contacted.	
Copy of Invoice with Report ☐ YES ☒ NO		Select Invoice Distribution:	☒ EMAIL ☐ MAIL ☐ FAX	Analysis Request	
Company:	Minto Explorations Ltd.	Email 1 or Fax	ap@mintomine.com	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below	
Contact:	Ruth Cayetano	Email 2		pH / Conductivity / Alkalinity / Anions	
Project Information		Oil and Gas Required Fields (client use)		Total Suspended Solids (TSS)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#	Total Dissolved Solids (TDS)	
Job #:		Major/Minor Code:	Routing Code:	Total Metals (TM), Hardness	
PO / AFE:	229096 (WUL)	Requisitioner:		Dissolved Metals (DM) (Filtered and preserved)	
LSD:		Location:		Total Mercury, Hardness	
ALS Lab Work Order # (lab use only)		ALS Contact:	Shane Stack	Dissolved Mercury [1] (Filtered + preserved)	
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mm-yy)	Time (hh:mm)	Total Nutrients (Ammonia)	
	W16	12-Jun-18	10:15	Dissolved Organic Carbon (DOC)	
	W55	12-Jun-18	10:50	Number of Containers	
	W2	12-Jun-18	13:30		
	MC1	12-Jun-18	14:35		
	DUP	12-Jun-18			
	DUP	11-Jun-18			
Drinking Water (DW) Samples ¹ (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)		SAMPLE CONDITION AS RECEIVED (lab use only)	
Are samples taken from a Regulated DW System?				Frozen ☐ SIF Observations Yes ☐ No ☐	
☐ YES ☒ NO				Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐	
Are samples for human drinking water use?				Cooling Initiated ☒	
☐ YES ☒ NO				INITIAL COOLER TEMPERATURES °C: 6.0 FINAL COOLER TEMPERATURES °C: 7	
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)		FINAL SHIPMENT RECEPTION (lab use only)	
Released by: Corey Roberts	Date: 2018-6-13	Time:	Received by: EHF	Date: 13 June 2018	Time: 15:00
			Received by: AISC	Date: JUN 15 2018	Time: 10 AM

REFER BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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OCTOBER 2015 FRONT

Complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

If samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

B



Chain of Custody (COC) / Analytical Request Form

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COC Number: 2018-06-13 A

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Report To		Report Format / Distribution		Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply	
Company:	Minto Explorations Ltd.	Select Report Format:	☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)	Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply	
Contact:	Minto Environment - Coordinator	Quality Control (QC) Report with Report	☒ YES ☐ NO	4 day [P4] ☐	
Phone:	1-804-759-4659	☒ Compare Results to Criteria on Report - provide details below if box checked		3 day [P3] ☐	1 Business day [E1] ☐
Company address below will appear on the final report		Select Distribution:	☒ EMAIL ☐ MAIL ☐ FAX	2 day [P2] ☐	Same Day, Weekend or Statutory holiday [E0] ☐
Street:	2100-510 West Georgia St.	Email 1 or Fax:	minto_environment@mintomine.com	Date and Time Required for all E&P TATs: dd-mm-yy hh:mm	
City/Province:	Vancouver, British Columbia	Email 2:		For tests that can not be performed according to the service level selected, you will be contacted.	
Postal Code:	V6B 0M3	Email 3:		Analysis Request	
Invoice To:	Same as Report To ☐ YES ☒ NO	Invoice Distribution		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below	
	Copy of Invoice with Report ☐ YES ☒ NO	Select Invoice Distribution:	☒ EMAIL ☐ MAIL ☐ FAX		
Company:	Minto Explorations Ltd.	Email 1 or Fax:	ap@mintomine.com		
Contact:	Ruth Cayetano	Email 2:			
Project Information		Oil and Gas Required Fields (client use)			
ALS Account # / Quote #:		AFF/Cost Center:	PO#		
Job #:		Major/Minor Code:	Routing Code:		
PO / AFE:	229096 (WUL)	Requisitioner:			
LSD:		Location:			
ALS Lab Work Order # (lab use only)		ALS Contact:	Shane Stack	Sampler:	CR/EB
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mm-yy)	Time (hh:mm)	Sample Type	
	W50	10-Jun-18	9:00	Water	
	W16A	10-Jun-18	7:40	Water	
	MN-0.2	11-Jun-18	10:10	Water	
	MN-4.5	11-Jun-18	14:15	Water	
	MN-0.5	11-Jun-18	15:10	Water	
	MN-2.5	11-Jun-18	15:50	Water	
	W3	12-Jun-18	8:35	Water	
	W50	12-Jun-18	9:05	Water	
	W17	12-Jun-18	9:35	Water	
	W16A	12-Jun-18	9:40	Water	
Drinking Water (DW) Samples ¹ (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)		SAMPLE CONDITION AS RECEIVED (lab use only)	
Are samples taken from a Regulated DW System? ☐ YES ☒ NO				Frozen ☐ SIF Observations Yes ☐ No ☐	
Are samples for human drinking water use? ☐ YES ☒ NO				Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐	
				Cooling Initiated ☒	
				INITIAL COOLER TEMPERATURES °C: 7.0	
				FINAL COOLER TEMPERATURES °C: 7.0	
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)		FINAL SHIPMENT RECEPTION (lab use only)	
Released by: Corey Roberts	Date: 2018-06-13	Time:	Received by: EHF	Date: 13 June 2018	Time: 15:00
			Received by: H JC	Date: JUN 15 2018	Time: 10 am

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

If samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

OCTOBER 2015 PRINT

B



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 22-JUN-18
Report Date: 06-JUL-18 13:42 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2117413

Project P.O. #: 229096

Job Reference:

C of C Numbers: 2018-06-20 A (1of2), 2018-06-20 A (2of2)

Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2117413-1 Water 16-JUN-18 13:45 MN-1.5	L2117413-2 Water 18-JUN-18 11:10 MC1	L2117413-3 Water 18-JUN-18 09:40 MN	L2117413-4 Water 18-JUN-18 16:40 W17	L2117413-5 Water 18-JUN-18 17:00 W16
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	95.1	349	593	461	416
	Hardness (as CaCO3) (mg/L)	50.8	169	234	230	193
	pH (pH)	7.90	8.42	8.23	8.51	8.41
	Total Suspended Solids (mg/L)	3.2	12.0	1040	<3.0	4.4
	TDS (Calculated) (mg/L)	52.8	203	398	281	246
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	49.6	153	96.5	189	145
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	6.2	<1.0	12.4	5.4
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	49.6	159	96.5	201	151
	Ammonia, Total (as N) (mg/L)	0.0105	0.0151	0.166	<0.0050	0.0202
	Chloride (Cl) (mg/L)	<0.50	2.86	1.88	6.05	5.12
	Nitrate and Nitrite (as N) (mg/L)	0.0129	0.444	26.5	0.242	2.01
	Nitrate (as N) (mg/L)	0.0129	0.439	26.5	0.242	2.00
	Nitrite (as N) (mg/L)	<0.0010	0.0052	0.0300	<0.0010	0.0102
	Sulfate (SO4) (mg/L)	1.56	32.8	100	55.7	61.5
	Anion Sum (meq/L)	1.02	3.98	5.96	5.37	4.58
	Cation Sum (meq/L)	1.18	3.91	6.08	5.31	4.39
	Cation - Anion Balance (%)	7.0	-1.0	1.0	-0.5	-2.2
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	16.5	10.5		9.49	18.7
Total Metals	Aluminum (Al)-Total (mg/L)	0.166	0.377	14.7	<0.0060 ^{DLAI}	0.132
	Antimony (Sb)-Total (mg/L)	<0.00010	0.00013	0.00023	0.00011	0.00010
	Arsenic (As)-Total (mg/L)	0.00051	0.00090	0.00228	0.00035	0.00050
	Barium (Ba)-Total (mg/L)	0.0367	0.0845	0.112	0.0670	0.0718
	Beryllium (Be)-Total (mg/L)	<0.000020	0.000021	0.00107	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	0.00173	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	<0.010	0.011	0.110	0.027	0.014
	Cadmium (Cd)-Total (mg/L)	<0.0000050	0.0000147	0.000381	<0.0000050	0.0000125
	Calcium (Ca)-Total (mg/L)	13.0	41.9	88.4	60.6	53.2
	Chromium (Cr)-Total (mg/L)	0.00077	0.00086	0.00197	0.00014	0.00025
	Cobalt (Co)-Total (mg/L)	0.00031	0.00036	0.00467	<0.00010	0.00015
	Copper (Cu)-Total (mg/L)	0.00591	0.00491	1.26	0.00760	0.0400
	Iron (Fe)-Total (mg/L)	0.534	0.735	15.0	<0.010	0.264
	Lead (Pb)-Total (mg/L)	0.000052	0.000182	0.0776	<0.000050	0.000065
	Lithium (Li)-Total (mg/L)	<0.0010	0.0017	0.0090	0.0016	0.0012
	Magnesium (Mg)-Total (mg/L)	4.25	16.4	14.6	17.7	15.8
	Manganese (Mn)-Total (mg/L)	0.0330	0.161	0.486	0.00483	0.0343

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2117413-6 Water 19-JUN-18 08:50 W3	L2117413-7 Water 19-JUN-18 09:30 W50	L2117413-8 Water 19-JUN-18 09:55 W16A	L2117413-9 Water 19-JUN-18 14:10 W2	L2117413-10 Water 19-JUN-18 DUP
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	462	421	419	330	416
	Hardness (as CaCO3) (mg/L)	242	207	208	168	207
	pH (pH)	8.52	8.42	8.42	8.43	8.43
	Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0	<3.0	<3.0
	TDS (Calculated) (mg/L)	285	254	254	194	254
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	181	148	146	148	146
	Alkalinity, Carbonate (as CaCO3) (mg/L)	12.0	6.4	7.0	6.0	6.6
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	193	155	153	154	153
	Ammonia, Total (as N) (mg/L)	0.0075	0.0172	0.0220	0.0065	0.0241
	Chloride (Cl) (mg/L)	5.29	5.17	5.12	2.46	5.14
	Nitrate and Nitrite (as N) (mg/L)	0.976	1.89	2.01	0.249	2.02
	Nitrate (as N) (mg/L)	0.976	1.88	2.00	0.247	2.01
	Nitrite (as N) (mg/L)	<0.0010	0.0063	0.0104	0.0017	0.0100
	Sulfate (SO4) (mg/L)	59.7	61.2	61.5	28.2	61.7
	Anion Sum (meq/L)	5.32	4.65	4.62	3.76	4.63
	Cation Sum (meq/L)	5.57	4.69	4.73	3.86	4.71
	Cation - Anion Balance (%)	2.3	0.5	1.1	1.3	0.9
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	12.7	17.8	18.4	8.54	18.7
Total Metals	Aluminum (Al)-Total (mg/L)	0.0169	0.0115	0.0938	0.0338	0.0176
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	0.00011	0.00013
	Arsenic (As)-Total (mg/L)	0.00039	0.00040	0.00044	0.00054	0.00044
	Barium (Ba)-Total (mg/L)	0.0681	0.0691	0.0706	0.0667	0.0707
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.019	0.016	0.016	<0.010	0.014
	Cadmium (Cd)-Total (mg/L)	<0.0000050	0.0000052	0.0000098	<0.0000050	0.0000111
	Calcium (Ca)-Total (mg/L)	55.5	55.1	54.7	40.2	52.5
	Chromium (Cr)-Total (mg/L)	0.00020	0.00026	0.00021	0.00025	0.00020
	Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Total (mg/L)	0.0127	0.0300	0.0346	0.00307	0.0341
	Iron (Fe)-Total (mg/L)	0.049	0.057	0.081	0.109	0.076
	Lead (Pb)-Total (mg/L)	<0.000050	0.000113	0.000158	<0.000050	0.000150
	Lithium (Li)-Total (mg/L)	0.0019	0.0013	0.0012	0.0015	0.0011
	Magnesium (Mg)-Total (mg/L)	20.4	16.1	15.9	14.6	15.8
	Manganese (Mn)-Total (mg/L)	0.0162	0.0127	0.0286	0.0102	0.0279

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2117413-11 Water 18-JUN-18 DUP				
Grouping	Analyte						
WATER							
Physical Tests	Conductivity (uS/cm)	441					
	Hardness (as CaCO3) (mg/L)	174					
	pH (pH)	8.06					
	Total Suspended Solids (mg/L)	<3.0					
	TDS (Calculated) (mg/L)	287					
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	73.1					
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0					
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0					
	Alkalinity, Total (as CaCO3) (mg/L)	73.1					
	Ammonia, Total (as N) (mg/L)	0.322					
	Chloride (Cl) (mg/L)	1.28					
	Nitrate and Nitrite (as N) (mg/L)	17.2					
	Nitrate (as N) (mg/L)	17.1					
	Nitrite (as N) (mg/L)	0.113					
	Sulfate (SO4) (mg/L)	76.8					
	Anion Sum (meq/L)	4.33					
	Cation Sum (meq/L)	4.48					
	Cation - Anion Balance (%)	1.8					
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	4.78					
Total Metals	Aluminum (Al)-Total (mg/L)	0.0420					
	Antimony (Sb)-Total (mg/L)	0.00020					
	Arsenic (As)-Total (mg/L)	0.00046					
	Barium (Ba)-Total (mg/L)	0.0274					
	Beryllium (Be)-Total (mg/L)	<0.000020					
	Bismuth (Bi)-Total (mg/L)	<0.000050					
	Boron (B)-Total (mg/L)	0.075					
	Cadmium (Cd)-Total (mg/L)	0.0000663					
	Calcium (Ca)-Total (mg/L)	54.5					
	Chromium (Cr)-Total (mg/L)	<0.00010					
	Cobalt (Co)-Total (mg/L)	<0.00010					
	Copper (Cu)-Total (mg/L)	0.0335					
	Iron (Fe)-Total (mg/L)	0.053					
	Lead (Pb)-Total (mg/L)	0.000111					
	Lithium (Li)-Total (mg/L)	0.0041					
	Magnesium (Mg)-Total (mg/L)	8.38					
	Manganese (Mn)-Total (mg/L)	0.0315					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2117413-1 Water 16-JUN-18 13:45 MN-1.5	L2117413-2 Water 18-JUN-18 11:10 MC1	L2117413-3 Water 18-JUN-18 09:40 MN	L2117413-4 Water 18-JUN-18 16:40 W17	L2117413-5 Water 18-JUN-18 17:00 W16
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	0.000026	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.000348	0.00265	0.0195	0.00649	0.00258
	Nickel (Ni)-Total (mg/L)	0.00124	0.00177	0.00199	0.00071	0.00093
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	0.296	<0.050	<0.050
	Potassium (K)-Total (mg/L)	0.31	1.79	5.77	3.35	2.60
	Selenium (Se)-Total (mg/L)	0.000072	0.000383	0.0199	0.000444	0.000963
	Silicon (Si)-Total (mg/L)	5.94	5.91	32.9	5.29	3.65
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	0.000675	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	3.08	10.8	27.0	13.0	10.4
	Strontium (Sr)-Total (mg/L)	0.0670	0.457	2.07	0.646	0.513
	Sulfur (S)-Total (mg/L)	0.61	11.8	34.7	19.0	21.0
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	0.000049	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	0.00136	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	0.00590	0.0163	0.0941	<0.00030	0.00801
	Uranium (U)-Total (mg/L)	0.000035	0.00230	0.00168	0.00208	0.00126
	Vanadium (V)-Total (mg/L)	0.00112	0.00230	0.0274	<0.00050	0.00101
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	0.218	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	0.00047	0.00031	<0.00030	<0.00030	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0502	0.0052	0.0098	0.0021	0.0118
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	0.00022	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00035	0.00057	0.00038	0.00035	0.00036
	Barium (Ba)-Dissolved (mg/L)	0.0348	0.0689	0.0441	0.0697	0.0671
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	<0.010	<0.010	0.103	0.024	0.014
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050	0.000118	<0.0000050	0.0000114
	Calcium (Ca)-Dissolved (mg/L)	13.6	40.6	75.5	61.5	51.6
	Chromium (Cr)-Dissolved (mg/L)	0.00042	0.00015	<0.00010	0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	0.00021	0.00013	0.00021	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00519	0.00338	0.100	0.00758	0.0347
	Iron (Fe)-Dissolved (mg/L)	0.240	0.097	0.015	<0.010	0.056
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	0.00225	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	<0.0010	0.0014	0.0059	0.0016	0.0012
	Magnesium (Mg)-Dissolved (mg/L)	4.11	16.5	11.1	18.6	15.5
Manganese (Mn)-Dissolved (mg/L)	0.0236	0.121	0.0800	0.00155	0.0256	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2117413-6 Water 19-JUN-18 08:50 W3	L2117413-7 Water 19-JUN-18 09:30 W50	L2117413-8 Water 19-JUN-18 09:55 W16A	L2117413-9 Water 19-JUN-18 14:10 W2	L2117413-10 Water 19-JUN-18 DUP
Grouping	Analyte						
WATER							
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.00420	0.00265	0.00274	0.00209	0.00272	0.00272
	Nickel (Ni)-Total (mg/L)	0.00109	0.00087	0.00091	0.00107	0.00097	0.00097
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	2.48	2.57	2.59	1.60	2.58	2.58
	Selenium (Se)-Total (mg/L)	0.000535	0.00100	0.000908	0.000161	0.00101	0.00101
	Silicon (Si)-Total (mg/L)	4.57	3.57	3.55	4.91	3.41	3.41
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	13.1	10.7	10.5	9.75	10.4	10.4
	Strontium (Sr)-Total (mg/L)	0.613	0.506	0.524	0.412	0.514	0.514
	Sulfur (S)-Total (mg/L)	20.8	21.6	22.0	10.2	21.0	21.0
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	0.00082	0.00046	<0.00090 ^{DLM}	<0.0018 ^{DLM}	<0.00060 ^{DLM}	<0.00060 ^{DLM}
	Uranium (U)-Total (mg/L)	0.00195	0.00123	0.00126	0.00197	0.00125	0.00125
	Vanadium (V)-Total (mg/L)	0.00062	0.00057	0.00060	0.00094	0.00060	0.00060
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0105	0.0109	0.0116	0.0050	0.0128	0.0128
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00035	0.00038	0.00037	0.00047	0.00040	0.00040
	Barium (Ba)-Dissolved (mg/L)	0.0734	0.0677	0.0700	0.0674	0.0698	0.0698
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.018	0.014	0.014	<0.010	0.014	0.014
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050	0.0000096	<0.0000050	0.0000093	0.0000093
	Calcium (Ca)-Dissolved (mg/L)	59.1	55.7	56.5	41.8	55.9	55.9
	Chromium (Cr)-Dissolved (mg/L)	0.00012	0.00014	0.00012	0.00010	0.00012	0.00012
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.0160	0.0319	0.0356	0.00282	0.0355	0.0355
	Iron (Fe)-Dissolved (mg/L)	0.032	0.057	0.067	0.044	0.067	0.067
	Lead (Pb)-Dissolved (mg/L)	<0.000050	0.000106	0.000130	<0.000050	0.000136	0.000136
	Lithium (Li)-Dissolved (mg/L)	0.0020	0.0012	0.0013	0.0016	0.0012	0.0012
	Magnesium (Mg)-Dissolved (mg/L)	22.9	16.4	16.4	15.3	16.5	16.5
	Manganese (Mn)-Dissolved (mg/L)	0.0135	0.0127	0.0274	0.00403	0.0272	0.0272

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID				
		L2117413-11 Water 18-JUN-18 DUP				
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050				
	Molybdenum (Mo)-Total (mg/L)	0.0204				
	Nickel (Ni)-Total (mg/L)	<0.00050				
	Phosphorus (P)-Total (mg/L)	<0.050				
	Potassium (K)-Total (mg/L)	3.62				
	Selenium (Se)-Total (mg/L)	0.0146				
	Silicon (Si)-Total (mg/L)	2.61				
	Silver (Ag)-Total (mg/L)	<0.000010				
	Sodium (Na)-Total (mg/L)	20.5				
	Strontium (Sr)-Total (mg/L)	1.34				
	Sulfur (S)-Total (mg/L)	27.5				
	Thallium (Tl)-Total (mg/L)	<0.000010				
	Tin (Sn)-Total (mg/L)	<0.00010				
	Titanium (Ti)-Total (mg/L)	0.00164				
	Uranium (U)-Total (mg/L)	0.000891				
	Vanadium (V)-Total (mg/L)	0.00065				
	Zinc (Zn)-Total (mg/L)	<0.0030				
	Zirconium (Zr)-Total (mg/L)	<0.00030				
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD				
	Dissolved Metals Filtration Location	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	0.0077				
	Antimony (Sb)-Dissolved (mg/L)	0.00019				
	Arsenic (As)-Dissolved (mg/L)	0.00036				
	Barium (Ba)-Dissolved (mg/L)	0.0263				
	Beryllium (Be)-Dissolved (mg/L)	<0.000020				
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050				
	Boron (B)-Dissolved (mg/L)	0.068				
	Cadmium (Cd)-Dissolved (mg/L)	0.0000658				
	Calcium (Ca)-Dissolved (mg/L)	56.3				
	Chromium (Cr)-Dissolved (mg/L)	<0.00010				
	Cobalt (Co)-Dissolved (mg/L)	<0.00010				
	Copper (Cu)-Dissolved (mg/L)	0.0249				
	Iron (Fe)-Dissolved (mg/L)	0.012				
	Lead (Pb)-Dissolved (mg/L)	<0.000050				
	Lithium (Li)-Dissolved (mg/L)	0.0042				
	Magnesium (Mg)-Dissolved (mg/L)	8.12				
	Manganese (Mn)-Dissolved (mg/L)	0.0233				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2117413-1 Water 16-JUN-18 13:45 MN-1.5	L2117413-2 Water 18-JUN-18 11:10 MC1	L2117413-3 Water 18-JUN-18 09:40 MN	L2117413-4 Water 18-JUN-18 16:40 W17	L2117413-5 Water 18-JUN-18 17:00 W16
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.000343	0.00249	0.0259	0.00640	0.00264
	Nickel (Ni)-Dissolved (mg/L)	0.00107	0.00103	<0.00050	0.00062	0.00085
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	0.31	1.69	4.50	3.62	2.56
	Selenium (Se)-Dissolved (mg/L)	0.000064	0.000268	0.0175	0.000484	0.000901
	Silicon (Si)-Dissolved (mg/L)	5.13	4.83	2.61	5.01	3.21
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	3.09	10.8	29.0	14.2	10.7
	Strontium (Sr)-Dissolved (mg/L)	0.0692	0.431	2.00	0.680	0.493
	Sulfur (S)-Dissolved (mg/L)	0.84	10.9	29.6	17.0	20.1
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00095	0.00040	0.00058	<0.00030	0.00047
	Uranium (U)-Dissolved (mg/L)	0.000029	0.00213	0.000929	0.00214	0.00122
	Vanadium (V)-Dissolved (mg/L)	<0.00050	0.00088	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0015	<0.0010	0.0884	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	0.00045	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2117413-6 Water 19-JUN-18 08:50 W3	L2117413-7 Water 19-JUN-18 09:30 W50	L2117413-8 Water 19-JUN-18 09:55 W16A	L2117413-9 Water 19-JUN-18 14:10 W2	L2117413-10 Water 19-JUN-18 DUP
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00407	0.00275	0.00259	0.00209	0.00265
	Nickel (Ni)-Dissolved (mg/L)	0.00117	0.00081	0.00087	0.00099	0.00096
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	2.87	2.73	2.75	1.75	2.78
	Selenium (Se)-Dissolved (mg/L)	0.000558	0.000820	0.000862	0.000204	0.000914
	Silicon (Si)-Dissolved (mg/L)	4.30	3.31	3.16	4.41	3.23
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	15.2	11.1	11.1	10.7	11.2
	Strontium (Sr)-Dissolved (mg/L)	0.645	0.527	0.528	0.433	0.533
	Sulfur (S)-Dissolved (mg/L)	18.3	18.8	18.7	8.42	18.8
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00051	0.00053	<0.00090 ^{DLM}	0.00034	0.00046
	Uranium (U)-Dissolved (mg/L)	0.00199	0.00126	0.00129	0.00210	0.00131
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	0.00068	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0011	<0.0010	<0.0010	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2117413-11 Water 18-JUN-18 DUP				
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050				
	Molybdenum (Mo)-Dissolved (mg/L)	0.0201				
	Nickel (Ni)-Dissolved (mg/L)	<0.00050				
	Phosphorus (P)-Dissolved (mg/L)	<0.050				
	Potassium (K)-Dissolved (mg/L)	3.71				
	Selenium (Se)-Dissolved (mg/L)	0.0128				
	Silicon (Si)-Dissolved (mg/L)	2.30				
	Silver (Ag)-Dissolved (mg/L)	<0.000010				
	Sodium (Na)-Dissolved (mg/L)	20.4				
	Strontium (Sr)-Dissolved (mg/L)	1.36				
	Sulfur (S)-Dissolved (mg/L)	23.1				
	Thallium (Tl)-Dissolved (mg/L)	<0.000010				
	Tin (Sn)-Dissolved (mg/L)	<0.00010				
	Titanium (Ti)-Dissolved (mg/L)	0.00099				
	Uranium (U)-Dissolved (mg/L)	0.000920				
	Vanadium (V)-Dissolved (mg/L)	<0.00050				
	Zinc (Zn)-Dissolved (mg/L)	0.0014				
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Dissolved Organic Carbon	MS-B	L2117413-1, -10, -11, -2, -4, -5, -6, -7, -8, -9
Matrix Spike	Dissolved Organic Carbon	MS-B	L2117413-1, -10, -11, -2, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2117413-2
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2117413-2
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2117413-2
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2117413-2
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2117413-2
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2117413-2
Matrix Spike	Aluminum (Al)-Total	MS-B	L2117413-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Total	MS-B	L2117413-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L2117413-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2117413-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Total	MS-B	L2117413-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Total	MS-B	L2117413-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L2117413-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLAI	Detection limit raised due to low level analytical interference or background.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			

Reference Information

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)
This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
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VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
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Chain of Custody Numbers:

2018-06-20 A (1of2)	2018-06-20 A (2of2)
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Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lw - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

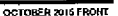
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.





L2117413-COFC

COC Number: 2018-06-20 A (1of2)

Page of

Report To Contact and company name below will appear on the final report			Report Format / Distribution			Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply											
Company: Minto Explorations Ltd.			Select Report Format: ☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)			Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply											
Contact: Minto Environment - Coordinator			Quality Control (QC) Report with Report ☒ YES ☐ NO			PROPERTY (Business Days) 4 day [P4] ☐ 3 day [P3] ☐ 2 day [P2] ☐				EMERGENCY 1 Business day [E1] ☐ Same Day, Weekend or Statutory holiday [E0] ☐							
Phone: 1-604-759-4659			☒ Compare Results to Criteria on Report - provide details below if box checked														
Company address below will appear on the final report			Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX														
Street: 2100-510 West Georgia St.			Email 1 or Fax: minto_environment@mintomine.com			Date and Time Required for all E&P TATs: dd-mm-yy hh:mm											
City/Province: Vancouver, British Columbia			Email 2			For tests that can not be performed according to the service level selected, you will be contacted.											
Postal Code: V6B 0M3			Email 3			Analysis Request											
Invoice To: Same as Report To ☐ YES ☒ NO			Invoice Distribution			Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below											
Copy of Invoice with Report ☐ YES ☒ NO			Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX														
Company: Minto Explorations Ltd.			Email 1 or Fax: ap@mintomine.com														
Contact: Ruth Cayetano			Email 2														
Project Information			Oil and Gas Required Fields (client use)														
ALS Account # / Quote #:			APE/Cost Center:			PO#											
Job #:			Major/Minor Code:			Routing Code:											
PO / AFE: 229096 (WUL)			Requisitioner:														
LSD:			Location:														
ALS Lab Work Order # (lab use only)			ALS Contact: Shane Stack			Sampler: SR/CP											
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)		Date (dd-mm-yy)	Time (hh:mm)	Sample Type	pH / Conductivity / Alkalinity / Anions	Total Suspended Solids (TSS)	Total Dissolved Solids (TDS)	Total Metals (TM), Hardness	Dissolved Metals (DM) (Filtered and preserved)	Total Mercury, Hardness	Dissolved Mercury [1] (Filtered + preserved)	Total Nutrients (Ammonia)	Dissolved Organic Carbon (DOC)	Number of Containers		
	MN-1.5 ✓		16-Jun-18	13:45	Water	R	R	R	R	R	R	R	R	R			7
	MC1 ✓		18-Jun-18	11:10	Water	R	R	R	R	R	R	R	R	R			7
	MN ✓		18-Jun-18	9:40	Water	R	R	R	R	R	R	R	R	R			6
	W17 ✓		18-Jun-18	16:40	Water	R	R	R	R	R	R	R	R	R			7
	W16 ✓		18-Jun-18	17:00	Water	R	R	R	R	R	R	R	R	R			7
	W3 ✓		19-Jun-18	8:50	Water	R	R	R	R	R	R	R	R	R			7
	W50 ✓		19-Jun-18	9:30	Water	R	R	R	R	R	R	R	R	R			7
	W16A ✓		19-Jun-18	9:55	Water	R	R	R	R	R	R	R	R	R			7
	W2 ✓		19-Jun-18	14:10	Water	R	R	R	R	R	R	R	R	R			7
	Dup ✓		19-Jun-18		Water	R	R	R	R	R	R	R	R	R			7
Drinking Water (DW) Samples¹ (client use)			SAMPLE CONDITION AS RECEIVED (lab use only)														
Are samples taken from a Regulated DW System? ☐ YES ☒ NO			Frozen ☐ SIF Observations Yes ☐ No ☐														
Are samples for human drinking water use? ☐ YES ☒ NO			Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐														
			Cooling Initiated ☐														
			INITIAL COOLER TEMPERATURES °C: 18°C														
			FINAL COOLER TEMPERATURES °C:														
SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)						FINAL SHIPMENT RECEPTION (lab use only)								
Released by: Shaun Roberts		Date: 2018-06-20	Time: 10:00	Received by:		Date: June 22/18	Time: 11:33	Received by:		Date:	Received by:		Date:	Time:			

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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OCTOBER 2015 PRINT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 27-JUN-18
Report Date: 09-JUL-18 17:38 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2119731
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-06-26 B
Legal Site Desc:

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2119731-1 Water 25-JUN-18 10:35 W55	L2119731-2 Water 25-JUN-18 11:30 MC1	L2119731-3 Water 25-JUN-18 15:20 W17	L2119731-4 Water 25-JUN-18 16:00 W16	L2119731-5 Water 25-JUN-18 DUP
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	241	265	470	428	424
	Hardness (as CaCO3) (mg/L)	122	130	223	207	207
	pH (pH)	8.00	8.13	8.23	8.29	8.37
	Total Suspended Solids (mg/L)	<3.0	321	<3.0	7.3	5.3
	TDS (Calculated) (mg/L)	142	148	274	255	253
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	88.2	128	192	149	146
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	2.8	4.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	88.2	128	192	152	150
	Ammonia, Total (as N) (mg/L)	0.0302	<0.0050	<0.0050	0.0302	0.0287
	Chloride (Cl) (mg/L)	0.73	1.18	5.99	5.27	5.27
	Nitrate and Nitrite (as N) (mg/L)	4.24	0.133	0.222	1.98	1.98
	Nitrate (as N) (mg/L)	4.23	0.131	0.222	1.97	1.97
	Nitrite (as N) (mg/L)	0.0137	0.0021	<0.0010	0.0097	0.0094
	Sulfate (SO4) (mg/L)	18.5	15.8	56.9	63.7	63.6
	Anion Sum (meq/L)	2.47	2.92	5.21	4.65	4.60
	Cation Sum (meq/L)	2.78	3.02	5.14	4.72	4.70
	Cation - Anion Balance (%)	5.9	1.6	-0.7	0.8	1.1
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)		11.8	9.88	18.4	18.3
Total Metals	Aluminum (Al)-Total (mg/L)	0.0650	5.87	0.0043	0.175	0.209
	Antimony (Sb)-Total (mg/L)	<0.00010	0.00031	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00049	0.00399	0.00035	0.00047	0.00049
	Barium (Ba)-Total (mg/L)	0.0526	0.181	0.0644	0.0713	0.0701
	Beryllium (Be)-Total (mg/L)	<0.000020	0.000205	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.012	<0.010	0.022	0.014	0.013
	Cadmium (Cd)-Total (mg/L)	0.0000117	0.000107	<0.0000050	0.0000120	0.0000141
	Calcium (Ca)-Total (mg/L)	31.8	35.6	59.5	54.9	54.4
	Chromium (Cr)-Total (mg/L)	<0.00095 ^{DLB}	0.0106	<0.00020 ^{DLB}	<0.00040 ^{DLB}	<0.00030 ^{DLB}
	Cobalt (Co)-Total (mg/L)	<0.00010	0.00417	<0.00010	0.00017	0.00019
	Copper (Cu)-Total (mg/L)	0.0627	0.0214	0.00743	0.0480	0.0459
	Iron (Fe)-Total (mg/L)	0.122	9.56	<0.010	0.341	0.396
	Lead (Pb)-Total (mg/L)	<0.000050	0.00259	<0.000050	0.000067	0.000082
	Lithium (Li)-Total (mg/L)	0.0011	0.0048	0.0014	0.0013	0.0013
	Magnesium (Mg)-Total (mg/L)	9.67	14.3	18.2	17.1	16.7
	Manganese (Mn)-Total (mg/L)	0.00726	0.574	0.00442	0.0429	0.0439

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2119731-1 Water 25-JUN-18 10:35 W55	L2119731-2 Water 25-JUN-18 11:30 MC1	L2119731-3 Water 25-JUN-18 15:20 W17	L2119731-4 Water 25-JUN-18 16:00 W16	L2119731-5 Water 25-JUN-18 DUP
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.000025 ^{DLM}	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.00145	0.00189	0.00654	0.00281	0.00267
	Nickel (Ni)-Total (mg/L)	0.00152	0.0131	0.00063	0.00096	0.00103
	Phosphorus (P)-Total (mg/L)	<0.050	0.333	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	1.56	1.98	3.53	2.78	2.74
	Selenium (Se)-Total (mg/L)	0.000350	0.000318	0.000499	0.000972	0.00103
	Silicon (Si)-Total (mg/L)	4.85	16.3	5.24	3.66	3.81
	Silver (Ag)-Total (mg/L)	<0.000010	0.000044	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	6.38	8.87	13.7	11.2	11.0
	Strontium (Sr)-Total (mg/L)	0.278	0.370	0.641	0.524	0.514
	Sulfur (S)-Total (mg/L)	6.56	5.26	18.6	20.8	21.4
	Thallium (Tl)-Total (mg/L)	<0.000010	0.000047	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	<0.0017 ^{DLM}	0.210	<0.00030	0.0109	0.0125
	Uranium (U)-Total (mg/L)	0.000210	0.00169	0.00182	0.00122	0.00123
	Vanadium (V)-Total (mg/L)	0.00094	0.0200	<0.00050	0.00115	0.00130
	Zinc (Zn)-Total (mg/L)	<0.0030	0.0238	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	0.00037	0.00069	<0.00030	<0.00030	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0239	0.0133	0.0018	0.0102	0.0098
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	0.00011	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00044	0.00057	0.00037	0.00041	0.00041
	Barium (Ba)-Dissolved (mg/L)	0.0555	0.0587	0.0713	0.0754	0.0741
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.011	<0.010	0.022	0.013	0.013
	Cadmium (Cd)-Dissolved (mg/L)	0.0000087	0.0000059	<0.0000050	0.0000113	0.0000091
	Calcium (Ca)-Dissolved (mg/L)	32.2	31.9	58.4	54.9	54.4
	Chromium (Cr)-Dissolved (mg/L)	0.00047	0.00028	0.00013	0.00018	0.00013
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00015	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.0612	0.00244	0.00732	0.0348	0.0346
	Iron (Fe)-Dissolved (mg/L)	0.054	0.119	<0.010	0.059	0.058
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0019	0.0021	0.0024	0.0022	0.0021
	Magnesium (Mg)-Dissolved (mg/L)	10.1	12.1	18.7	17.1	17.3
	Manganese (Mn)-Dissolved (mg/L)	0.00554	0.107	0.00176	0.0327	0.0332

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2119731-1 Water 25-JUN-18 10:35 W55	L2119731-2 Water 25-JUN-18 11:30 MC1	L2119731-3 Water 25-JUN-18 15:20 W17	L2119731-4 Water 25-JUN-18 16:00 W16	L2119731-5 Water 25-JUN-18 DUP
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00137	0.00182	0.00635	0.00270	0.00268
	Nickel (Ni)-Dissolved (mg/L)	0.00148	0.00130	0.00068	0.00091	0.00084
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	1.70	1.36	3.62	2.82	2.84
	Selenium (Se)-Dissolved (mg/L)	0.000324	0.000139	0.000444	0.000902	0.000916
	Silicon (Si)-Dissolved (mg/L)	4.41	4.75	5.16	3.13	3.20
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	6.61	8.80	13.7	11.3	11.3
	Strontium (Sr)-Dissolved (mg/L)	0.297	0.334	0.655	0.540	0.535
	Sulfur (S)-Dissolved (mg/L)	5.76	4.95	17.6	19.5	20.2
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00071	0.00087	<0.00030	0.00050	0.00035
	Uranium (U)-Dissolved (mg/L)	0.000240	0.00143	0.00193	0.00128	0.00125
	Vanadium (V)-Dissolved (mg/L)	0.00069	0.00108	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	0.00035	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Manganese (Mn)-Dissolved	MB-LOR	L2119731-1, -2, -3, -4, -5
Method Blank	Chromium (Cr)-Total	MB-LOR	L2119731-1, -2, -3, -4, -5
Method Blank	Molybdenum (Mo)-Total	MB-LOR	L2119731-1, -2, -3, -4, -5
Matrix Spike	Dissolved Organic Carbon	MS-B	L2119731-2, -3, -4, -5
Matrix Spike	Dissolved Organic Carbon	MS-B	L2119731-2, -3, -4, -5
Matrix Spike	Aluminum (Al)-Total	MS-B	L2119731-1, -2, -3
Matrix Spike	Barium (Ba)-Total	MS-B	L2119731-1, -2, -3, -4, -5
Matrix Spike	Barium (Ba)-Total	MS-B	L2119731-1, -2, -3
Matrix Spike	Calcium (Ca)-Total	MS-B	L2119731-1, -2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Total	MS-B	L2119731-1, -2, -3
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2119731-1, -2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2119731-1, -2, -3
Matrix Spike	Manganese (Mn)-Total	MS-B	L2119731-1, -2, -3, -4, -5
Matrix Spike	Manganese (Mn)-Total	MS-B	L2119731-1, -2, -3
Matrix Spike	Sodium (Na)-Total	MS-B	L2119731-1, -2, -3, -4, -5
Matrix Spike	Sodium (Na)-Total	MS-B	L2119731-1, -2, -3
Matrix Spike	Strontium (Sr)-Total	MS-B	L2119731-1, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Total	MS-B	L2119731-1, -2, -3
Matrix Spike	Sulfur (S)-Total	MS-B	L2119731-1, -2, -3, -4, -5
Matrix Spike	Nitrate (as N)	MS-B	L2119731-1, -2, -3, -4, -5

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLB	Detection Limit Raised. Analyte detected at comparable level in Method Blank.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-L-IC-N-WR	Water	Chloride in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			

Reference Information

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NO2-L-IC-N-WR	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-WR	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
SO4-IC-WR	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)
This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.			
TSS-MAN-WR	Water	Total Suspended Solids by Gravimetric	APHA 2540 D
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids are determined by filtering a sample through a glass fibre filter and drying the filter at 104 degrees celsius.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Reference Information

Chain of Custody Numbers:

2018-06-26 B

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com



L2119731-COFC

COC Number: 2018-06-26 B

Page of

Report To		Contact and company name below will appear on the final report		Report Format / Distribution		Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply													
Company:	Minto Explorations Ltd.	Select Report Format: ☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)		Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply															
Contact:	Minto Environment - Coordinator	Quality Control (QC) Report with Report ☒ YES ☐ NO		PRIORITY (Business Days)										EMERGENCY					
Phone:	1-804-759-4659	☒ Compare Results to Criteria on Report - provide details below if box checked		4 day [P4] ☐										1 Business day [E1] ☐					
Company address below will appear on the final report		Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX		3 day [P3] ☐										Same Day, Weekend or Statutory holiday [E0] ☐					
Street:	2100-510 West Georgia St.	Email 1 or Fax minto_environment@mintomine.com		2 day [P2] ☐															
City/Province:	Vancouver, British Columbia	Email 2		Date and Time Required for all E&P TATs: dd-mm-yy hh:mm															
Postal Code:	V6B 0M3	Email 3		For tests that can not be performed according to the service level selected, you will be contacted.															
Invoice To	Same as Report To ☐ YES ☒ NO	Invoice Distribution		Analysis Request															
Copy of Invoice with Report	☐ YES ☒ NO	Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below															
Company:	Minto Explorations Ltd.	Email 1 or Fax ap@mintomine.com		P F/P P F/P P F/P															
Contact:	Ruth Cayetano	Email 2		P F/P P F/P P F/P															
Project Information		Oil and Gas Required Fields (client use)		Number of Containers															
ALS Account # / Quote #:		AFE/Cost Center: PO#																	
Job #:		Major/Minor Code: Routing Code:																	
PO / AFE:	229096 (WUL)	Requisitioner:																	
LSD:		Location:																	
ALS Lab Work Order # (lab use only)		ALS Contact: Shane Stack		Sampler: SR/CH															
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mm-yy)	Time (hh:mm)	Sample Type	pH / Conductivity / Alkalinity / Anions	Total Suspended Solids (TSS)	Total Dissolved Solids (TDS)	Total Metals (TM), Hardness	Dissolved Metals (DM) (Filtered and preserved)	Total Mercury, Hardness	Dissolved Mercury [1] (Filtered + preserved)	Total Nutrients (Ammonia)	Dissolved Organic Carbon (DOC)						
	W55	25-Jun-18	10:35	Water	R	R	R	R	R	R	R	R	R			6			
	MC1	25-Jun-18	11:30	Water	R	R	R	R	R	R	R	R	R			7			
	W17	25-Jun-18	15:20	Water	R	R	R	R	R	R	R	R	R			7			
	W16	25-Jun-18	16:00	Water	R	R	R	R	R	R	R	R	R			7			
	DUP	25-Jun-18		Water	R	R	R	R	R	R	R	R	R			7			
Drinking Water (DW) Samples ¹ (client use)																			
Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)																			
Are samples taken from a Regulated DW System? ☐ YES ☒ NO																			
Are samples for human drinking water use? ☐ YES ☒ NO																			
SAMPLE CONDITION AS RECEIVED (lab use only)																			
Frozen ☐ SIF Observations Yes ☐ No ☐																			
Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐																			
Cooling Initiated ☐																			
INITIAL COOLER TEMPERATURES °C 10°C FINAL COOLER TEMPERATURES °C 10																			
SHIPMENT RELEASE (client use)																			
Released by: Shaun Roberts Date: 2018-06-26 Time: 11:00																			
INITIAL SHIPMENT RECEPTION (lab use only)																			
Received by: [Signature] Date: June 27/18 Time: 10:54																			
FINAL SHIPMENT RECEPTION (lab use only)																			
Received by: HA Date: 6/28 Time: 8pm																			

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2016 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 04-JUL-18
Report Date: 17-JUL-18 17:49 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2123725

Project P.O. #: 229096

Job Reference:

C of C Numbers: 2018-07-04 B 2 of 3, 2018-07-04 B 3 of 3,
2018-07-04 B 1 of 3

Legal Site Desc:

Comments: ADDITIONAL 17-JUL-18 17:27

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2123725-1 Water 30-JUN-18 15:10 UG4	L2123725-2 Water 02-JUL-18 07:45 W17	L2123725-3 Water 02-JUL-18 08:00 W16	L2123725-4 Water 02-JUL-18 10:30 W8A	L2123725-5 Water 02-JUL-18 09:25 W10
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	2180	469	420	544	209
	Hardness (as CaCO3) (mg/L)	1090	230	206	276	104
	pH (pH)	7.96	8.29	8.24	7.95	7.67
	Total Suspended Solids (mg/L)	995	<3.0	123	42.1	<3.0
	TDS (Calculated) (mg/L)	1830	276	253	340	118
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	147	192	152	226	96.9
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	147	192	152	226	96.9
	Ammonia, Total (as N) (mg/L)	15.1	<0.0050	0.0354	0.0390	0.0207
	Chloride (Cl) (mg/L)	19.9	5.86	4.87	2.76	0.11
	Nitrate and Nitrite (as N) (mg/L)	26.5	0.194	2.00	1.94	2.60
	Nitrate (as N) (mg/L)	25.9	0.194	1.99	1.93	2.59
	Nitrite (as N) (mg/L)	0.642	<0.0010	0.0088	0.0127	0.0095
	Sulfate (SO4) (mg/L)	1060	57.3	62.7	72.1	4.43
	Anion Sum (meq/L)	27.4	5.20	4.62	6.24	2.22
	Cation Sum (meq/L)	27.8	5.29	4.69	6.48	2.38
	Cation - Anion Balance (%)	0.7	0.8	0.8	1.9	3.6
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	3.33	9.84	18.6		
Total Metals	Aluminum (Al)-Total (mg/L)	20.0	<0.0030	0.396	1.69	0.0979
	Antimony (Sb)-Total (mg/L)	0.00095	<0.00010	<0.00010	0.00025	<0.00010
	Arsenic (As)-Total (mg/L)	0.00363	0.00036	0.00053	0.00181	0.00038
	Barium (Ba)-Total (mg/L)	0.417	0.0706	0.0806	0.116	0.167
	Beryllium (Be)-Total (mg/L)	0.000593	<0.000020	<0.000020	0.000082	<0.000020
	Bismuth (Bi)-Total (mg/L)	0.00141	<0.000050	<0.000050	0.000071	<0.000050
	Boron (B)-Total (mg/L)	0.551	0.026	0.014	0.019	<0.010
	Cadmium (Cd)-Total (mg/L)	0.00195	<0.0000050	0.0000168	0.000191	<0.0000050
	Calcium (Ca)-Total (mg/L)	403	59.0	54.5	72.1	32.1
	Chromium (Cr)-Total (mg/L)	0.00707	0.00014	0.00052	0.00371	0.00040
	Cobalt (Co)-Total (mg/L)	0.0152	<0.00010	0.00034	0.00158	0.00015
	Copper (Cu)-Total (mg/L)	10.1	0.00740	0.0491	0.559	0.0302
	Iron (Fe)-Total (mg/L)	50.5	0.014	0.692	5.42	0.549
	Lead (Pb)-Total (mg/L)	0.0399	<0.000050	0.000166	0.00101	<0.000050
	Lithium (Li)-Total (mg/L)	0.0236	0.0015	0.0014	0.0034	<0.0010
	Magnesium (Mg)-Total (mg/L)	49.6	17.9	17.3	21.5	7.50
	Manganese (Mn)-Total (mg/L)	1.19	0.00473	0.0594	0.722	0.0621

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2123725-6 Water 02-JUL-18 10:20 W30	L2123725-7 Water 02-JUL-18 10:50 W15	L2123725-8 Water 02-JUL-18 11:10 W12	L2123725-9 Water 02-JUL-18 13:40 W55	L2123725-10 Water 02-JUL-18 14:05 W35
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	423	437	2540	221	215
	Hardness (as CaCO3) (mg/L)	192	225	1210	109	109
	pH (pH)	8.35	8.25	8.06	8.17	8.09
	Total Suspended Solids (mg/L)	<3.0	<3.0	9.3	<3.0	<3.0
	TDS (Calculated) (mg/L)	254	266	2120	125	126
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	116	148	188	91.9	87.3
	Alkalinity, Carbonate (as CaCO3) (mg/L)	2.8	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	119	148	188	91.9	87.3
	Ammonia, Total (as N) (mg/L)	0.0238	0.0298	4.59	0.0114	0.0097
	Chloride (Cl) (mg/L)	1.25	1.01	31.0	0.63	0.64
	Nitrate and Nitrite (as N) (mg/L)	0.0949	2.71	12.1	2.61	3.22
	Nitrate (as N) (mg/L)	0.0924	2.70	4.86	2.61	3.21
	Nitrite (as N) (mg/L)	0.0025	0.0104	7.23	0.0030	0.0033
	Sulfate (SO4) (mg/L)	103	74.2	1310	12.4	13.9
	Anion Sum (meq/L)	4.55	4.73	32.7	2.30	2.28
	Cation Sum (meq/L)	4.48	4.95	31.5	2.46	2.46
	Cation - Anion Balance (%)	-0.7	2.3	-1.9	3.4	3.8
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)		23.6			25.7
Total Metals	Aluminum (Al)-Total (mg/L)	0.0206	0.0654	0.0862	0.0497	0.0437
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	0.00038	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00082	0.00044	0.00047	0.00045	0.00040
	Barium (Ba)-Total (mg/L)	0.0651	0.0601	0.0876	0.0578	0.0564
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000040 ^{DLA}	0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.00010 ^{DLA}	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.017	<0.010	0.288	0.011	<0.010
	Cadmium (Cd)-Total (mg/L)	0.0000107	<0.0000050	<0.000090 ^{DLM}	0.0000095	0.0000072
	Calcium (Ca)-Total (mg/L)	40.9	59.0	384	28.8	28.7
	Chromium (Cr)-Total (mg/L)	<0.00010	0.00036	<0.00020 ^{DLA}	0.00044	0.00055
	Cobalt (Co)-Total (mg/L)	<0.00010	0.00015	0.00150	<0.00010	<0.00010
	Copper (Cu)-Total (mg/L)	0.0303	0.0225	0.0565	0.0649	0.0344
	Iron (Fe)-Total (mg/L)	0.367	0.241	0.311	0.075	0.079
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.00010 ^{DLA}	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	0.0027	<0.0010	0.0198	<0.0010	<0.0010
	Magnesium (Mg)-Total (mg/L)	22.2	17.5	74.3	8.52	8.51
	Manganese (Mn)-Total (mg/L)	0.0360	0.0385	1.22	0.00241	0.00594

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2123725-11 Water 02-JUL-18 DUP	L2123725-12 Water 02-JUL-18 14:05 F-BL	L2123725-13 Water 02-JUL-18 14:30 W33S	L2123725-14 Water 02-JUL-18 15:00 W62	L2123725-15 Water 02-JUL-18 15:35 W14
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	215	<2.0	165	785	3280
	Hardness (as CaCO3) (mg/L)	104	<0.50	87.8	386	1680
	pH (pH)	8.17	5.57	7.95	8.30	8.16
	Total Suspended Solids (mg/L)	<3.0	<3.0	5.9	5.1	31.5
	TDS (Calculated) (mg/L)	124	<1.0	93.5	495	3060
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	92.2	<1.0	77.8	268	133
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	2.6	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	92.2	<1.0	77.8	271	133
	Ammonia, Total (as N) (mg/L)	0.0114	<0.0050	0.0163	0.0090	7.88
	Chloride (Cl) (mg/L)	0.63	<0.10	0.14	14.8	40.3
	Nitrate and Nitrite (as N) (mg/L)	2.66	<0.0051	1.05	5.60	22.8
	Nitrate (as N) (mg/L)	2.65	<0.0050	1.01	5.58	15.3
	Nitrite (as N) (mg/L)	0.0029	<0.0010	0.0353	0.0272	7.47
	Sulfate (SO4) (mg/L)	12.6	<0.30	6.36	131	1970
	Anion Sum (meq/L)	2.31	<0.10	1.77	8.96	46.4
	Cation Sum (meq/L)	2.37	<0.10	1.97	8.84	44.3
	Cation - Anion Balance (%)	1.2	0.0	5.3	-0.7	-2.3
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)		0.52			
Total Metals	Aluminum (Al)-Total (mg/L)	0.0480	0.0161 ^{RRV}	0.0330	0.0978	
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	0.00034	
	Arsenic (As)-Total (mg/L)	0.00046	<0.00010	0.00041	0.00050	
	Barium (Ba)-Total (mg/L)	0.0589	0.00049 ^{RRV}	0.0390	0.0823	
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Total (mg/L)	<0.010	<0.010	<0.010	0.023	
	Cadmium (Cd)-Total (mg/L)	0.0000114	0.0000429 ^{RRV}	0.0000118	0.0000799	
	Calcium (Ca)-Total (mg/L)	29.3	0.227 ^{RRV}	23.1	102	
	Chromium (Cr)-Total (mg/L)	0.00049	<0.00010	0.00056	0.00033	
	Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	<0.00010	0.00014	
	Copper (Cu)-Total (mg/L)	0.0676	0.00259 ^{RRV}	0.0302	0.0814	
	Iron (Fe)-Total (mg/L)	0.076	0.030 ^{RRV}	0.067	0.206	
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	0.000090	
	Lithium (Li)-Total (mg/L)	<0.0010	<0.0010	<0.0010	0.0028	
	Magnesium (Mg)-Total (mg/L)	8.77	<0.10	6.84	31.7	
	Manganese (Mn)-Total (mg/L)	0.00228	0.00156 ^{RRV}	0.0106	0.0321	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2123725-16 Water 03-JUL-18 08:30 W3	L2123725-17 Water 03-JUL-18 08:50 W50	L2123725-18 Water 03-JUL-18 09:05 W16A	L2123725-19 Water 03-JUL-18 09:50 W2	L2123725-20 Water 03-JUL-18 DUP
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	465	423	423	307	308
	Hardness (as CaCO3) (mg/L)	232	207	205	149	157
	pH (pH)	8.36	8.33	8.33	8.36	8.35
	Total Suspended Solids (mg/L)	4.1	<3.0	<3.0	17.7	15.9
	TDS (Calculated) (mg/L)	276	255	252	177	179
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	179	154	150	143	141
	Alkalinity, Carbonate (as CaCO3) (mg/L)	4.8	2.8	2.6	3.4	3.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	183	157	152	146	144
	Ammonia, Total (as N) (mg/L)	0.0083	0.0230	0.0363	0.0077	0.0079
	Chloride (Cl) (mg/L)	4.94	4.78	4.74	1.83	1.84
	Nitrate and Nitrite (as N) (mg/L)	1.08	1.91	1.97	0.206	0.207
	Nitrate (as N) (mg/L)	1.08	1.90	1.96	0.205	0.206
	Nitrite (as N) (mg/L)	0.0022	0.0081	0.0090	0.0014	0.0014
	Sulfate (SO4) (mg/L)	60.1	62.0	62.4	24.8	24.8
	Anion Sum (meq/L)	5.13	4.69	4.61	3.50	3.46
	Cation Sum (meq/L)	5.31	4.69	4.66	3.43	3.60
	Cation - Anion Balance (%)	1.7	0.0	0.5	-1.0	2.0
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	13.7	17.8	18.5	12.9	12.5
Total Metals	Aluminum (Al)-Total (mg/L)	0.0394	0.0309	0.0658	0.482	0.474
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	0.00013	0.00013
	Arsenic (As)-Total (mg/L)	0.00037	0.00044	0.00050	0.00089	0.00081
	Barium (Ba)-Total (mg/L)	0.0721	0.0739	0.0763	0.0723	0.0717
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.017	0.014	0.013	<0.010	<0.010
	Cadmium (Cd)-Total (mg/L)	0.0000058	0.0000095	0.0000100	0.0000105	0.0000122
	Calcium (Ca)-Total (mg/L)	51.4	53.4	53.3	37.8	35.3
	Chromium (Cr)-Total (mg/L)	0.00025	0.00025	0.00048	0.00118	0.00109
	Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	0.00012	0.00034	0.00033
	Copper (Cu)-Total (mg/L)	0.0179	0.0303	0.0357	0.00459	0.00454
	Iron (Fe)-Total (mg/L)	0.081	0.093	0.168	0.851	0.816
	Lead (Pb)-Total (mg/L)	<0.000050	0.000131	0.000160	0.000223	0.000209
	Lithium (Li)-Total (mg/L)	0.0017	0.0012	0.0012	0.0018	0.0016
	Magnesium (Mg)-Total (mg/L)	21.4	17.3	17.2	13.6	13.5
	Manganese (Mn)-Total (mg/L)	0.0186	0.0149	0.0454	0.0488	0.0474

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID	L2123725-21	L2123725-22		
		Description	Water	Water		
		Sampled Date	03-JUL-18	03-JUL-18		
		Sampled Time	10:45	11:45		
		Client ID	MC1	W7		
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)		302	199		
	Hardness (as CaCO3) (mg/L)		152	97.3		
	pH (pH)		8.35	8.22		
	Total Suspended Solids (mg/L)		86.2	61.4		
	TDS (Calculated) (mg/L)		175	110		
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)		141	105		
	Alkalinity, Carbonate (as CaCO3) (mg/L)		3.0	<1.0		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)		<1.0	<1.0		
	Alkalinity, Total (as CaCO3) (mg/L)		144	105		
	Ammonia, Total (as N) (mg/L)		0.0144	0.0098		
	Chloride (Cl) (mg/L)		1.66	0.21		
	Nitrate and Nitrite (as N) (mg/L)		0.199	0.0794		
	Nitrate (as N) (mg/L)		0.198	0.0794		
	Nitrite (as N) (mg/L)		0.0019	<0.0010		
	Sulfate (SO4) (mg/L)		23.4	6.52		
	Anion Sum (meq/L)		3.42	2.24		
	Cation Sum (meq/L)		3.48	2.25		
	Cation - Anion Balance (%)		1.0	0.1		
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)		13.2	16.5		
Total Metals	Aluminum (Al)-Total (mg/L)		1.91	1.25		
	Antimony (Sb)-Total (mg/L)		0.00018	0.00014		
	Arsenic (As)-Total (mg/L)		0.00176	0.00097		
	Barium (Ba)-Total (mg/L)		0.0982	0.0815		
	Beryllium (Be)-Total (mg/L)		0.000073	0.000049		
	Bismuth (Bi)-Total (mg/L)		<0.000050	<0.000050		
	Boron (B)-Total (mg/L)		<0.010	<0.010		
	Cadmium (Cd)-Total (mg/L)		0.0000282	0.0000260		
	Calcium (Ca)-Total (mg/L)		37.7	24.8		
	Chromium (Cr)-Total (mg/L)		0.00366	0.00285		
	Cobalt (Co)-Total (mg/L)		0.00124	0.00092		
	Copper (Cu)-Total (mg/L)		0.00880	0.00474		
	Iron (Fe)-Total (mg/L)		3.00	1.86		
	Lead (Pb)-Total (mg/L)		0.000828	0.000504		
	Lithium (Li)-Total (mg/L)		0.0026	0.0015		
	Magnesium (Mg)-Total (mg/L)		13.9	9.72		
	Manganese (Mn)-Total (mg/L)		0.124	0.0646		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2123725-1 Water 30-JUN-18 15:10 UG4	L2123725-2 Water 02-JUL-18 07:45 W17	L2123725-3 Water 02-JUL-18 08:00 W16	L2123725-4 Water 02-JUL-18 10:30 W8A	L2123725-5 Water 02-JUL-18 09:25 W10
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.00010 ^{DLM}	<0.0000050	<0.0000050	0.0000178	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.0228	0.00642	0.00272	0.00548	0.000344
	Nickel (Ni)-Total (mg/L)	0.00769	0.00061	0.00136	0.00328	0.00125
	Phosphorus (P)-Total (mg/L)	0.789	<0.050	<0.050	0.235	<0.050
	Potassium (K)-Total (mg/L)	15.9	3.57	2.78	4.44	0.80
	Selenium (Se)-Total (mg/L)	0.0123	0.000614	0.00102	0.00224	0.000242
	Silicon (Si)-Total (mg/L)	41.7	5.18	4.21	8.88	2.64
	Silver (Ag)-Total (mg/L)	0.00473	<0.000010	<0.000020 ^{DLAI}	0.000263	<0.000010
	Sodium (Na)-Total (mg/L)	111	13.9	11.7	18.3	6.03
	Strontium (Sr)-Total (mg/L)	6.02	0.632	0.519	0.937	0.208
	Sulfur (S)-Total (mg/L)	391	18.7	20.9	24.5	2.00
	Thallium (Tl)-Total (mg/L)	0.000237	<0.000010	<0.000010	0.000026	<0.000010
	Tin (Sn)-Total (mg/L)	0.00148	<0.00010	<0.00010	0.00016	<0.00010
	Titanium (Ti)-Total (mg/L)	1.37	<0.00030	0.0205	<0.11 ^{DLM}	0.00090
	Uranium (U)-Total (mg/L)	0.00930	0.00191	0.00126	0.00121	0.000091
	Vanadium (V)-Total (mg/L)	0.0825	<0.00050	0.00190	0.00838	<0.00050
	Zinc (Zn)-Total (mg/L)	0.319	<0.0030	0.0035	0.761	<0.0030
	Zirconium (Zr)-Total (mg/L)	0.00076	<0.00030	0.00032	0.00039	0.00050
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0105	0.0036	0.0167	0.0138	0.135 ^{DTMF}
	Antimony (Sb)-Dissolved (mg/L)	0.00079	<0.00010	<0.00010	0.00011	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00134	0.00037	0.00046	0.00067	0.00046
	Barium (Ba)-Dissolved (mg/L)	0.0367	0.0731	0.0729	0.0706	0.145
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	0.000031	0.000023
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.456	0.026	0.014	0.019	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	0.0000437	<0.0000050	0.0000085	0.000143	0.0000052
	Calcium (Ca)-Dissolved (mg/L)	376	61.3	54.4	75.1	30.2
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00031	0.00050
	Cobalt (Co)-Dissolved (mg/L)	0.00058	<0.00010	<0.00010	0.00047	0.00022
	Copper (Cu)-Dissolved (mg/L)	0.00167	0.0100	0.0329	0.167	0.0360
	Iron (Fe)-Dissolved (mg/L)	0.037	<0.010	0.082	0.188	0.890 ^{DTMF}
	Lead (Pb)-Dissolved (mg/L)	0.000103	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0116	0.0014	0.0011	0.0025	<0.0010
	Magnesium (Mg)-Dissolved (mg/L)	37.8	18.6	17.1	21.6	6.93
	Manganese (Mn)-Dissolved (mg/L)	0.0715	0.00519	0.0400	0.753	0.0913 ^{DTMF}

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2123725-6 Water 02-JUL-18 10:20 W30	L2123725-7 Water 02-JUL-18 10:50 W15	L2123725-8 Water 02-JUL-18 11:10 W12	L2123725-9 Water 02-JUL-18 13:40 W55	L2123725-10 Water 02-JUL-18 14:05 W35
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.00709	0.00216	0.0773	0.00130	0.00107
	Nickel (Ni)-Total (mg/L)	0.00050	0.00116	0.0050	0.00145	0.00156
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.10 ^{DLA}	<0.050	<0.050
	Potassium (K)-Total (mg/L)	3.58	1.92	48.6	1.52	0.75
	Selenium (Se)-Total (mg/L)	0.00203	0.00111	0.00801	0.000437	0.000356
	Silicon (Si)-Total (mg/L)	0.54	3.96	3.89	4.36	4.67
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000020 ^{DLA}	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	13.2	9.51	136	5.57	5.92
	Strontium (Sr)-Total (mg/L)	0.707	0.521	6.25	0.231	0.209
	Sulfur (S)-Total (mg/L)	35.9	25.3	467	4.43	4.90
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000020 ^{DLA}	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010 ^{DLM}	<0.00020 ^{DLA}	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	0.00096	<0.0030	0.00293	0.00146	0.00144
	Uranium (U)-Total (mg/L)	0.00131	0.00110	0.00740	0.000211	0.000145
	Vanadium (V)-Total (mg/L)	0.00060	0.00080	<0.0010 ^{DLA}	0.00080	0.00050
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0060 ^{DLA}	<0.0030	0.0034
	Zirconium (Zr)-Total (mg/L)	<0.00030	0.00040	<0.00030	0.00037	0.00040
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0094	0.0245	0.0064	0.0266	0.0270
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	0.00036	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00069	0.00043	0.00042	0.00045	0.00033
	Barium (Ba)-Dissolved (mg/L)	0.0580	0.0569	0.0844	0.0547	0.0529
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000040 ^{DLA}	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.00010 ^{DLA}	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.015	<0.010	0.261 ^{DLM}	<0.010	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.000080	0.0000079	0.0000063
	Calcium (Ca)-Dissolved (mg/L)	40.9	61.1	368 ^{DLA}	29.8	29.9
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00033	<0.00020	0.00043	0.00041
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00012	0.00135	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.0224	0.0178	0.0378	0.0628	0.0331
	Iron (Fe)-Dissolved (mg/L)	0.141	0.166	0.067	0.046	0.052
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	0.00016	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0025	<0.0010	0.0180	<0.0010	<0.0010
	Magnesium (Mg)-Dissolved (mg/L)	21.8	17.5	70.1	8.44	8.44
	Manganese (Mn)-Dissolved (mg/L)	0.0232	0.0370	1.17	0.00181	0.00529

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2123725-11 Water 02-JUL-18 DUP	L2123725-12 Water 02-JUL-18 14:05 F-BL	L2123725-13 Water 02-JUL-18 14:30 W33S	L2123725-14 Water 02-JUL-18 15:00 W62	L2123725-15 Water 02-JUL-18 15:35 W14
Grouping	Analyte						
WATER							
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Total (mg/L)	0.00124	<0.000050	0.000943	0.00649		
	Nickel (Ni)-Total (mg/L)	0.00139	<0.00050	0.00155	0.00091		
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050		
	Potassium (K)-Total (mg/L)	1.56	<0.10	0.46	4.86		
	Selenium (Se)-Total (mg/L)	0.000455	<0.000050	0.000312	0.00239		
	Silicon (Si)-Total (mg/L)	4.30	<0.10	4.74	6.68		
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000020 ^{DLAI}		
	Sodium (Na)-Total (mg/L)	5.66	<0.050	4.30	23.4		
	Strontium (Sr)-Total (mg/L)	0.233	0.00365 ^{RRV}	0.157	1.15		
	Sulfur (S)-Total (mg/L)	4.58	<0.50	2.28	45.4		
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010		
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010		
	Titanium (Ti)-Total (mg/L)	0.00169	0.00131 ^{RRV}	0.00072	0.00460		
	Uranium (U)-Total (mg/L)	0.000215	<0.000010	0.000054	0.00363		
	Vanadium (V)-Total (mg/L)	0.00081	<0.00050	<0.00050	0.00095		
	Zinc (Zn)-Total (mg/L)	<0.0030	0.0044 ^{RRV}	<0.0030	0.0617		
	Zirconium (Zr)-Total (mg/L)	0.00039	<0.00030	0.00043	<0.00030		
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0251	<0.0010	0.0837 ^{DTMF}	0.0049	0.0273	
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	0.00063	
	Arsenic (As)-Dissolved (mg/L)	0.00046	<0.00010	0.00039	0.00043	0.00041	
	Barium (Ba)-Dissolved (mg/L)	0.0558	<0.00010	0.0369	0.0727	0.174 ^{DLA}	
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000040 ^{DLA}	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.00010	
	Boron (B)-Dissolved (mg/L)	<0.010	<0.010	<0.010	0.021	0.372 ^{DLM}	
	Cadmium (Cd)-Dissolved (mg/L)	0.0000077	<0.0000050	0.0000112	0.0000798	<0.000030	
	Calcium (Ca)-Dissolved (mg/L)	27.5	<0.050	24.1	103	482 ^{DLA}	
	Chromium (Cr)-Dissolved (mg/L)	0.00043	<0.00010	0.00056	0.00017	<0.00020	
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	0.00012	<0.00010	0.00032	
	Copper (Cu)-Dissolved (mg/L)	0.0661	0.00038 ^{RRV}	0.0340	0.0656	0.00268 ^{DLA}	
	Iron (Fe)-Dissolved (mg/L)	0.045	<0.010	0.131 ^{DTMF}	0.030	<0.020 ^{DLA}	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.00010 ^{DLA}	
	Lithium (Li)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	0.0026	0.0357	
	Magnesium (Mg)-Dissolved (mg/L)	8.63	<0.10	6.68	31.2	115	
	Manganese (Mn)-Dissolved (mg/L)	0.00143	0.00027 ^{RRV}	0.0119	0.0271	0.612	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2123725-16 Water 03-JUL-18 08:30 W3	L2123725-17 Water 03-JUL-18 08:50 W50	L2123725-18 Water 03-JUL-18 09:05 W16A	L2123725-19 Water 03-JUL-18 09:50 W2	L2123725-20 Water 03-JUL-18 DUP
Grouping	Analyte						
WATER							
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.00352	0.00272	0.00280	0.00189	0.00175	0.00175
	Nickel (Ni)-Total (mg/L)	0.00119	0.00105	0.00115	0.00205	0.00202	0.00202
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	2.61	2.62	2.65	1.44	1.41	1.41
	Selenium (Se)-Total (mg/L)	0.000819	0.000939	0.00121	0.000183	0.000199	0.000199
	Silicon (Si)-Total (mg/L)	5.28	3.59	3.65	6.40	6.32	6.32
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	14.4	11.7	11.6	9.20	9.07	9.07
	Strontium (Sr)-Total (mg/L)	0.551	0.511	0.513	0.391	0.364	0.364
	Sulfur (S)-Total (mg/L)	24.0	21.5	22.2	8.47	8.94	8.94
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	0.00166	0.00118	0.00313	0.0209	0.0207	0.0207
	Uranium (U)-Total (mg/L)	0.00160	0.00122	0.00125	0.00146	0.00139	0.00139
	Vanadium (V)-Total (mg/L)	0.00056	0.00053	0.00069	0.00249	0.00243	0.00243
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	0.0037	0.0037
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	0.00033	0.00033
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0045	0.0126	0.0126	0.0111	0.0097	0.0097
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	0.00010	0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00033	0.00040	0.00044	0.00054	0.00053	0.00053
	Barium (Ba)-Dissolved (mg/L)	0.0730	0.0732	0.0757	0.0672	0.0699	0.0699
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.017	0.013	0.013	<0.010	<0.010	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	0.0000237 ^{DTMF}	0.0000077	0.0000080	<0.0000050	<0.0000050	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	58.3	55.1	54.9	36.7	39.4	39.4
	Chromium (Cr)-Dissolved (mg/L)	0.00011	0.00014	0.00014	0.00023	0.00018	0.00018
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.0150	0.0294	0.0325	0.00356	0.00324	0.00324
	Iron (Fe)-Dissolved (mg/L)	0.032	0.068	0.079	0.074	0.064	0.064
	Lead (Pb)-Dissolved (mg/L)	<0.000050	0.000105	0.000096	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0019	0.0012	0.0012	0.0014	0.0015	0.0015
	Magnesium (Mg)-Dissolved (mg/L)	21.0	16.8	16.6	13.8	14.2	14.2
	Manganese (Mn)-Dissolved (mg/L)	0.0123	0.0126	0.0426	0.00367	0.00372	0.00372

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2123725-21 Water 03-JUL-18 10:45 MC1	L2123725-22 Water 03-JUL-18 11:45 W7		
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050			
	Molybdenum (Mo)-Total (mg/L)	0.00195	0.00124			
	Nickel (Ni)-Total (mg/L)	0.00476	0.00392			
	Phosphorus (P)-Total (mg/L)	0.104	0.081			
	Potassium (K)-Total (mg/L)	1.52	0.82			
	Selenium (Se)-Total (mg/L)	0.000212	0.000165			
	Silicon (Si)-Total (mg/L)	9.44	7.88			
	Silver (Ag)-Total (mg/L)	0.000016	0.000010			
	Sodium (Na)-Total (mg/L)	8.94	6.36			
	Strontium (Sr)-Total (mg/L)	0.395	0.251			
	Sulfur (S)-Total (mg/L)	8.16	1.97			
	Thallium (Tl)-Total (mg/L)	0.000016	0.000011			
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010			
	Titanium (Ti)-Total (mg/L)	0.0822	0.0459			
	Uranium (U)-Total (mg/L)	0.00154	0.000854			
	Vanadium (V)-Total (mg/L)	0.00678	0.00477			
	Zinc (Zn)-Total (mg/L)	0.0081	0.0054			
	Zirconium (Zr)-Total (mg/L)	0.00050	0.00039			
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD			
	Dissolved Metals Filtration Location	FIELD	FIELD			
	Aluminum (Al)-Dissolved (mg/L)	0.0098	0.0197			
	Antimony (Sb)-Dissolved (mg/L)	0.00011	<0.00010			
	Arsenic (As)-Dissolved (mg/L)	0.00056	0.00044			
	Barium (Ba)-Dissolved (mg/L)	0.0681	0.0573			
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020			
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050			
	Boron (B)-Dissolved (mg/L)	<0.010	<0.010			
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050			
	Calcium (Ca)-Dissolved (mg/L)	37.8	23.8			
	Chromium (Cr)-Dissolved (mg/L)	0.00023	0.00041			
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010			
	Copper (Cu)-Dissolved (mg/L)	0.00317	0.00251			
	Iron (Fe)-Dissolved (mg/L)	0.092	0.103			
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050			
	Lithium (Li)-Dissolved (mg/L)	0.0013	<0.0010			
	Magnesium (Mg)-Dissolved (mg/L)	13.9	9.19			
	Manganese (Mn)-Dissolved (mg/L)	0.0146	0.0141			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2123725-1 Water 30-JUN-18 15:10 UG4	L2123725-2 Water 02-JUL-18 07:45 W17	L2123725-3 Water 02-JUL-18 08:00 W16	L2123725-4 Water 02-JUL-18 10:30 W8A	L2123725-5 Water 02-JUL-18 09:25 W10
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	0.0000087	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.0240	0.00611	0.00265	0.00522	0.000387
	Nickel (Ni)-Dissolved (mg/L)	0.00253	0.00060	0.00097	0.00119	0.00127
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	8.29	3.58	2.59	3.96	0.74
	Selenium (Se)-Dissolved (mg/L)	0.00855	0.000448	0.000894	0.00183	0.000128
	Silicon (Si)-Dissolved (mg/L)	7.29	5.29	3.39	5.62	3.52
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	0.000030	<0.000010
	Sodium (Na)-Dissolved (mg/L)	106	13.9	11.3	18.5	5.01
	Strontium (Sr)-Dissolved (mg/L)	5.72	0.643	0.507	0.952	0.197
	Sulfur (S)-Dissolved (mg/L)	372	19.0	20.8	25.5	1.43
	Thallium (Tl)-Dissolved (mg/L)	0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	0.00075	0.00054	0.00151 ^{DTMF}
	Uranium (U)-Dissolved (mg/L)	0.00871	0.00190	0.00123	0.00132	0.000109
	Vanadium (V)-Dissolved (mg/L)	0.00075	<0.00050 ^{DTC}	0.00052	0.00074	0.00060
	Zinc (Zn)-Dissolved (mg/L)	0.0070	0.0245	<0.0010	0.217	0.0019
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	0.00062

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2123725-6 Water 02-JUL-18 10:20 W30	L2123725-7 Water 02-JUL-18 10:50 W15	L2123725-8 Water 02-JUL-18 11:10 W12	L2123725-9 Water 02-JUL-18 13:40 W55	L2123725-10 Water 02-JUL-18 14:05 W35
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00684	0.00208	0.0769	0.00120	0.00102
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	0.00104	0.0048	0.00138	0.00142
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.10 ^{DLA}	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	3.47	1.87	48.5	1.49	0.75
	Selenium (Se)-Dissolved (mg/L)	0.00195	0.00112	0.00829	0.000272	0.000195
	Silicon (Si)-Dissolved (mg/L)	0.465	4.02	3.63	4.17	4.59
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000020 ^{DLA}	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	12.6	9.23	131	5.34	5.66
	Strontium (Sr)-Dissolved (mg/L)	0.673	0.519	5.93	0.229	0.207
	Sulfur (S)-Dissolved (mg/L)	35.1	26.1	482	4.29	4.59
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000020 ^{DLA}	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00020 ^{DLA}	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00052	0.00113	<0.00060 ^{DLA}	0.00099	0.00076
	Uranium (U)-Dissolved (mg/L)	0.00133	0.00111	0.00722	0.000200	0.000151
	Vanadium (V)-Dissolved (mg/L)	<0.00050	0.00058	<0.0010 ^{DLA}	0.00069	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	0.0040	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	0.00037	<0.00030	0.00038	0.00038

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2123725-11 Water 02-JUL-18 DUP	L2123725-12 Water 02-JUL-18 14:05 F-BL	L2123725-13 Water 02-JUL-18 14:30 W33S	L2123725-14 Water 02-JUL-18 15:00 W62	L2123725-15 Water 02-JUL-18 15:35 W14
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00110	<0.000050	0.000905	0.00628	0.131
	Nickel (Ni)-Dissolved (mg/L)	0.00132	<0.00050	0.00151	0.00075	0.0105
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.10 ^{DLA}
	Potassium (K)-Dissolved (mg/L)	1.55	<0.10	0.45	4.63	86.0
	Selenium (Se)-Dissolved (mg/L)	0.000295	<0.000050	0.000158	0.00235	0.0115
	Silicon (Si)-Dissolved (mg/L)	4.12	<0.050	4.65	6.56	2.26
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020 ^{DLA}
	Sodium (Na)-Dissolved (mg/L)	5.48	<0.050	4.16	22.7	184
	Strontium (Sr)-Dissolved (mg/L)	0.212	0.00082 ^{RRV}	0.156	1.14	8.36
	Sulfur (S)-Dissolved (mg/L)	4.33	<0.50	2.26	45.2	689
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020 ^{DLA}
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020 ^{DLA}
	Titanium (Ti)-Dissolved (mg/L)	0.00099	<0.00030	0.00239 ^{DTMF}	<0.00030	<0.00060 ^{DLA}
	Uranium (U)-Dissolved (mg/L)	0.000198	<0.000010	0.000057	0.00366	0.00837
	Vanadium (V)-Dissolved (mg/L)	0.00068	<0.00050	0.00056	0.00058	<0.0010 ^{DLA}
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	0.0014	0.0545	0.0023
	Zirconium (Zr)-Dissolved (mg/L)	0.00034	<0.00030	0.00044	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2123725-16 Water 03-JUL-18 08:30 W3	L2123725-17 Water 03-JUL-18 08:50 W50	L2123725-18 Water 03-JUL-18 09:05 W16A	L2123725-19 Water 03-JUL-18 09:50 W2	L2123725-20 Water 03-JUL-18 DUP
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00379	0.00259	0.00266	0.00178	0.00190
	Nickel (Ni)-Dissolved (mg/L)	0.00122	0.00086	0.00096	0.00126	0.00127
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	2.67	2.66	2.68	1.49	1.52
	Selenium (Se)-Dissolved (mg/L)	0.000478	0.000809	0.000925	0.000158	0.000215
	Silicon (Si)-Dissolved (mg/L)	4.50	3.60	3.54	5.48	5.70
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	13.8	11.1	10.9	9.52	9.70
	Strontium (Sr)-Dissolved (mg/L)	0.631	0.531	0.525	0.378	0.405
	Sulfur (S)-Dissolved (mg/L)	20.2	21.4	21.8	8.24	8.51
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	0.00056	0.00047	0.00052	<0.00060 ^{DLM}
	Uranium (U)-Dissolved (mg/L)	0.00180	0.00124	0.00128	0.00137	0.00147
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	0.00050	0.00093	0.00097
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2123725-21 Water 03-JUL-18 10:45 MC1	L2123725-22 Water 03-JUL-18 11:45 W7			
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050			
	Molybdenum (Mo)-Dissolved (mg/L)	0.00192	0.00122			
	Nickel (Ni)-Dissolved (mg/L)	0.00144	0.00163			
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050			
	Potassium (K)-Dissolved (mg/L)	1.40	0.70			
	Selenium (Se)-Dissolved (mg/L)	0.000182	0.000137			
	Silicon (Si)-Dissolved (mg/L)	5.50	5.73			
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010			
	Sodium (Na)-Dissolved (mg/L)	9.44	6.38			
	Strontium (Sr)-Dissolved (mg/L)	0.393	0.242			
	Sulfur (S)-Dissolved (mg/L)	7.87	2.06			
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010			
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010			
	Titanium (Ti)-Dissolved (mg/L)	0.00059	0.00100			
	Uranium (U)-Dissolved (mg/L)	0.00146	0.000705			
	Vanadium (V)-Dissolved (mg/L)	0.00103	0.00104			
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010			
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	0.00035			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Conductivity	B	L2123725-1
Laboratory Control Sample	Strontium (Sr)-Dissolved	MES	L2123725-1, -10, -11, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Dissolved Organic Carbon	MS-B	L2123725-1, -10, -2, -3, -7
Matrix Spike	Dissolved Organic Carbon	MS-B	L2123725-12
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2123725-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2123725-16, -17, -18, -19, -20, -21, -22
Matrix Spike	Boron (B)-Dissolved	MS-B	L2123725-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2123725-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2123725-16, -17, -18, -19, -20, -21, -22
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2123725-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2123725-16, -17, -18, -19, -20, -21, -22
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2123725-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Molybdenum (Mo)-Dissolved	MS-B	L2123725-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2123725-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2123725-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2123725-16, -17, -18, -19, -20, -21, -22
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2123725-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2123725-16, -17, -18, -19, -20, -21, -22
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2123725-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2123725-16, -17, -18, -19, -20, -21, -22
Matrix Spike	Uranium (U)-Dissolved	MS-B	L2123725-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Aluminum (Al)-Total	MS-B	L2123725-1, -10, -11, -13, -14, -16, -17, -18, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Aluminum (Al)-Total	MS-B	L2123725-19, -20, -21, -22
Matrix Spike	Barium (Ba)-Total	MS-B	L2123725-1, -10, -11, -13, -14, -16, -17, -18, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Total	MS-B	L2123725-19, -20, -21, -22
Matrix Spike	Barium (Ba)-Total	MS-B	L2123725-12, -2
Matrix Spike	Boron (B)-Total	MS-B	L2123725-1, -10, -11, -13, -14, -16, -17, -18, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L2123725-1, -10, -11, -13, -14, -16, -17, -18, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L2123725-19, -20, -21, -22
Matrix Spike	Calcium (Ca)-Total	MS-B	L2123725-12, -2
Matrix Spike	Copper (Cu)-Total	MS-B	L2123725-1, -10, -11, -13, -14, -16, -17, -18, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Iron (Fe)-Total	MS-B	L2123725-1, -10, -11, -13, -14, -16, -17, -18, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Lead (Pb)-Total	MS-B	L2123725-1, -10, -11, -13, -14, -16, -17, -18, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Lithium (Li)-Total	MS-B	L2123725-12, -2
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2123725-1, -10, -11, -13, -14, -16, -17, -18, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2123725-19, -20, -21, -22
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2123725-12, -2
Matrix Spike	Manganese (Mn)-Total	MS-B	L2123725-1, -10, -11, -13, -14, -16, -17, -18, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Total	MS-B	L2123725-19, -20, -21, -22

Reference Information

	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Manganese (Mn)-Total	MS-B	L2123725-12, -2
Matrix Spike	Molybdenum (Mo)-Total	MS-B	L2123725-1, -10, -11, -13, -14, -16, -17, -18, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Nickel (Ni)-Total	MS-B	L2123725-12, -2
Matrix Spike	Potassium (K)-Total	MS-B	L2123725-1, -10, -11, -13, -14, -16, -17, -18, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Potassium (K)-Total	MS-B	L2123725-12, -2
Matrix Spike	Silicon (Si)-Total	MS-B	L2123725-1, -10, -11, -13, -14, -16, -17, -18, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Silver (Ag)-Total	MS-B	L2123725-1, -10, -11, -13, -14, -16, -17, -18, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Total	MS-B	L2123725-1, -10, -11, -13, -14, -16, -17, -18, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Total	MS-B	L2123725-19, -20, -21, -22
Matrix Spike	Sodium (Na)-Total	MS-B	L2123725-12, -2
Matrix Spike	Strontium (Sr)-Total	MS-B	L2123725-1, -10, -11, -13, -14, -16, -17, -18, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L2123725-19, -20, -21, -22
Matrix Spike	Strontium (Sr)-Total	MS-B	L2123725-12, -2
Matrix Spike	Sulfur (S)-Total	MS-B	L2123725-1, -10, -11, -13, -14, -16, -17, -18, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sulfur (S)-Total	MS-B	L2123725-12, -2
Matrix Spike	Titanium (Ti)-Total	MS-B	L2123725-1, -10, -11, -13, -14, -16, -17, -18, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Uranium (U)-Total	MS-B	L2123725-1, -10, -11, -13, -14, -16, -17, -18, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Uranium (U)-Total	MS-B	L2123725-12, -2

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
DLA	Detection Limit adjusted for required dilution
DLAI	Detection limit raised due to low level analytical interference or background.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DTC	Dissolved concentration exceeds total. Results were confirmed by re-analysis.
DTMF	Dissolved concentration exceeds total for field-filtered metals sample. Metallic contaminants may have been introduced to dissolved sample during field filtration.
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-WR	Water	Nitrite & Nitrate Nitrogen	EPA 300.1
Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance.			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			

Reference Information

CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-L-IC-N-WR	Water	Chloride in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NO2-L-IC-N-WR	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-WR	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
SO4-IC-WR	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)

Reference Information

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-07-04 B 1 of 3 2018-07-04 B 2 of 3 2018-07-04 B 3 of 3

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Chain of Custody (COC) / Analytical Request Form

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COC Number: 2018-07-04 B

Page 1 of 2

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Report To Contact and company name below will appear on the final report Company: Minto Explorations Ltd. Contact: Minto Environment - Coordinator Phone: 1-604-759-4659 Company address below will appear on the final report Street: 2100-510 West Georgia St. City/Province: Vancouver, British Columbia Postal Code: V6B 0M3		Report Format / Distribution Select Report Format: ☒ PDF ☐ EXCEL ☒ EOD (DIGITAL) Quality Control (QC) Report with Report ☒ YES ☐ NO ☒ Compare Results to Criteria on Report - provide details below if box checked Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX Email 1 or Fax: minto_environment@mintomine.com Email 2 Email 3		Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply Priority [P] ☐ 4 day [P4] ☐ Emergency [E] ☐ 3 day [P3] ☐ 1 Business day [E1] ☐ Same Day, Weekend or Statutory holiday [E0] ☐ Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm For tests that can not be performed according to the service level selected, you will be contacted.																																																																																																																																																																	
Invoice To Same as Report To ☐ YES ☒ NO Copy of Invoice with Report ☐ YES ☒ NO Company: Minto Explorations Ltd. Contact: Ruth Cayetano		Invoice Distribution Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX Email 1 or Fax: ap@mintomine.com Email 2		Analysis Request Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below <table border="1"> <tr> <th></th> <th></th> <th></th> <th>P</th> <th>F/P</th> <th>P</th> <th>F/P</th> <th>P</th> <th>F/P</th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> </tr> <tr> <td rowspan="8">pH / Conductivity / Alkalinity / Anions</td> <td>Total Suspended Solids (TSS)</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Total Dissolved Solids (TDS)</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Total Metals (TM), Hardness</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Dissolved Metals (DM) (filtered and preserved)</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Total Mercury, Hardness</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Dissolved Mercury [1] (Filtered + preserved)</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Total Nutrients (Ammonia)</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Dissolved Organic Carbon (DOC)</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td colspan="15">Number of Containers</td> </tr> </table>													P	F/P	P	F/P	P	F/P								pH / Conductivity / Alkalinity / Anions	Total Suspended Solids (TSS)															Total Dissolved Solids (TDS)															Total Metals (TM), Hardness															Dissolved Metals (DM) (filtered and preserved)															Total Mercury, Hardness															Dissolved Mercury [1] (Filtered + preserved)															Total Nutrients (Ammonia)															Dissolved Organic Carbon (DOC)															Number of Containers														
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Project Information ALS Account # / Quote #: Job #: PO / AFE: 229096 (WUL) LSD:		Oil and Gas Required Fields (client use) AFE/Cost Center: Major/Minor Code: Requisitioner: Location:		ALS Contact: Shane Stack Sampler: CH/EB/SB																																																																																																																																																																	
ALS Lab Work Order # (lab use only)		ALS Sample # (lab use only)		Sample Identification and/or Coordinates (This description will appear on the report)		Date (dd-mmm-yy)		Time (hh:mm)		Sample Type						Number of Containers																																																																																																																																																					
		UG4				30-Jun-18		15:10		Water						7																																																																																																																																																					
		W17				2-Jul-18		7:45		Water						7																																																																																																																																																					
		W16				2-Jul-18		8:00		Water						7																																																																																																																																																					
		W8A				2-Jul-18		10:30		Water						6																																																																																																																																																					
		W10				2-Jul-18		9:25		Water						6																																																																																																																																																					
		W30				2-Jul-18		10:20		Water						6																																																																																																																																																					
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Drinking Water (DW) Samples¹ (client use) Are samples taken from a Regulated DW System? ☐ YES ☒ NO Are samples for human drinking water use? ☐ YES ☒ NO		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)		SAMPLE CONDITION AS RECEIVED (lab use only) Frozen ☐ SIF Observations Yes ☐ No ☐ Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐ Cooling Initiated ☐ INITIAL COOLER TEMPERATURES °C: 7.5 7.6 7.3 1.0 FINAL COOLER TEMPERATURES °C:																																																																																																																																																																	
SHIPMENT RELEASE (client use) Released by: Chris Harry Date: 2018-07-04 7:00 Time:		INITIAL SHIPMENT RECEPTION (lab use only) Received by: [Signature] Date: 04 July 18 Time: 3:15		FINAL SHIPMENT RECEPTION (lab use only) Received by: H A Date: 7/6 Time: 3:50																																																																																																																																																																	

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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OCTOBER 2015 FRCB

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.



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L2123725-COFC

COC Number: 2018-07-04 B

Page 2 of 3

Report To Contact and company name below will appear on the final report		Report Format / Distribution		Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply																			
Company: Minto Explorations Ltd.		Select Report Format: ☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)		Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply																			
Contact: Minto Environment - Coordinator		Quality Control (QC) Report with Report ☒ YES ☐ NO		PRIORITY (Business Days)				EMERGENCY															
Phone: 1-604-759-4659		☒ Compare Results to Criteria on Report - provide details below if box checked		4 day [P4] ☐				3 day [P3] ☐				2 day [P2] ☐											
Company address below will appear on the final report		Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX		1 Business day [E1] ☐				Same Day, Weekend or Statutory holiday [E0] ☐															
Street: 2100-510 West Georgia St.		Email 1 or Fax minto_environment@mintomine.com		Date and Time Required for all E&P TATs: dd-mm-yy hh:mm																			
City/Province: Vancouver, British Columbia		Email 2		For tests that can not be performed according to the service level selected, you will be contacted.																			
Postal Code: V6B 0M3		Email 3		Analysis Request																			
Invoice To: Same as Report To ☐ YES ☒ NO		Invoice Distribution		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below																			
Copy of Invoice with Report ☐ YES ☒ NO		Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX		P F/P P F/P P F/P P F/P																			
Company: Minto Explorations Ltd.		Email 1 or Fax ap@mintomine.com		pH / Conductivity / Alkalinity / Anions																			
Contact: Ruth Cayetano		Email 2		Total Suspended Solids (TSS)																			
Project Information		Oil and Gas Required Fields (client use)		Total Dissolved Solids (TDS)																			
ALS Account # / Quote #:		AFE/Cost Center:		PO#		Total Metals (TM), Hardness																	
Job #:		Major/Minor Code:		Routing Code:		Dissolved Metals (DM) (Filtered and preserved)																	
PO / AFE: 229096 (WUL)		Requisitioner:		Total Mercury, Hardness																			
LSD:		Location:		Dissolved Mercury [1] (Filtered + preserved)																			
ALS Lab Work Order # (lab use only)		ALS Contact: Shane Stack		Sampler: CH/EB/SB		Total Nutrients (Ammonia)																	
ALS Sample # (lab use only)		Sample Identification and/or Coordinates (This description will appear on the report)		Date (dd-mm-yy)		Time (hh:mm)		Sample Type		Dissolved Organic Carbon (DOC)													
DUP				2-Jul-18				Water		Number of Containers													
F-BL				2-Jul-18		14:05		Water		6													
W33S				2-Jul-18		14:30		Water		7													
W62				2-Jul-18		15:00		Water		6													
W14				2-Jul-18		15:35		Water		6													
W3				3-Jul-18		8:30		Water		4													
W50				3-Jul-18		8:50		Water		7													
W16A				3-Jul-18		9:05		Water		7													
W2				3-Jul-18		9:50		Water		7													
DUP				3-Jul-18				Water		7													
Drinking Water (DW) Samples¹ (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)										SAMPLE CONDITION AS RECEIVED (lab use only)											
Are samples taken from a Regulated DW System? ☐ YES ☒ NO												Frozen ☐ SIF Observations Yes ☐ No ☐											
Are samples for human drinking water use? ☐ YES ☒ NO												Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐											
												Cooling Initiated ☐											
												INITIAL COOLER TEMPERATURES °C: 7.8 9.6 7.3 10 FINAL COOLER TEMPERATURES °C: 7.3 10											
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)										FINAL SHIPMENT RECEPTION (lab use only)											
Released by: Chris Harry		Date: 2018-07-04 7:00		Time:		Received by:		Date: 07-04-18		Time: 3:15		Received by: HA		Date: 7/6		Time: 3:50P							

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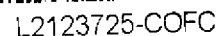
Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



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OCTOBER 2016 601



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 11-JUL-18
Report Date: 25-JUL-18 11:46 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2127781
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-07-10 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2127781-1 Water 09-JUL-18 10:45 W16	L2127781-2 Water 09-JUL-18 09:35 W8A	L2127781-3 Water 09-JUL-18 10:20 W17	L2127781-4 Water 10-JUL-18 DUP	L2127781-5 Water 10-JUL-18 08:20 W3
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	423	786	478	549	546
	Hardness (as CaCO3) (mg/L)	220	376	238	284	278
	pH (pH)	8.18	7.38	7.98	8.11	8.08
	Total Suspended Solids (mg/L)	<3.0	51.5	<3.0	<3.0	<3.0
	TDS (Calculated) (mg/L)	259	488	283	326	322
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	152	304	193	242	240
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	152	304	193	242	240
	Ammonia, Total (as N) (mg/L)	0.0358	0.0426	<0.0050	<0.0050	<0.0050
	Chloride (Cl) (mg/L)	4.77	4.84	5.86	4.95	4.94
	Nitrate and Nitrite (as N) (mg/L)	1.97	2.19	0.235	0.138	0.136
	Nitrate (as N) (mg/L)	1.96	2.15	0.235	0.138	0.136
	Nitrite (as N) (mg/L)	0.0089	0.0363	<0.0010	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	63.3	129	59.9	58.9	59.0
	Anion Sum (meq/L)	4.64	9.04	5.29	6.21	6.17
	Cation Sum (meq/L)	4.97	8.73	5.45	6.58	6.42
	Cation - Anion Balance (%)	3.4	-1.8	1.5	2.9	2.0
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	19.1		10.0	6.69	6.76
Total Metals	Aluminum (Al)-Total (mg/L)	0.0882	1.27	0.0054	0.0110	0.0040
	Antimony (Sb)-Total (mg/L)	<0.00010	0.00041	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00051	0.00139	0.00042	0.00028	0.00028
	Barium (Ba)-Total (mg/L)	0.0717	0.116	0.0711	0.0648	0.0655
	Beryllium (Be)-Total (mg/L)	<0.000020	0.000070	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.014	0.021	0.023	0.022	0.022
	Cadmium (Cd)-Total (mg/L)	0.0000101	0.000203	<0.0000050	<0.0000050	<0.0000050
	Calcium (Ca)-Total (mg/L)	53.7	89.1	55.6	55.7	56.3
	Chromium (Cr)-Total (mg/L)	0.00027	0.00195	0.00014	0.00013	0.00015
	Cobalt (Co)-Total (mg/L)	0.00013	0.00134	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Total (mg/L)	0.0365	0.368	0.00819	0.00434	0.00379
	Iron (Fe)-Total (mg/L)	0.219	3.87	<0.010	0.025	0.014
	Lead (Pb)-Total (mg/L)	0.000055	0.000988	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	0.0012	0.0033	0.0014	0.0027	0.0027
	Magnesium (Mg)-Total (mg/L)	16.5	27.0	18.2	27.3	27.6
	Manganese (Mn)-Total (mg/L)	0.0503	1.03	0.00860	0.0352	0.0327

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID				
		L2127781-6 Water 10-JUL-18 09:55 MC1				
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	353				
	Hardness (as CaCO3) (mg/L)	177				
	pH (pH)	8.21				
	Total Suspended Solids (mg/L)	5.3				
	TDS (Calculated) (mg/L)	198				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	166				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Total (as CaCO3) (mg/L)	166				
	Ammonia, Total (as N) (mg/L)	0.0062				
	Chloride (Cl) (mg/L)	1.76				
	Nitrate and Nitrite (as N) (mg/L)	0.132				
	Nitrate (as N) (mg/L)	0.131				
	Nitrite (as N) (mg/L)	0.0012				
	Sulfate (SO4) (mg/L)	23.3				
	Anion Sum (meq/L)	3.87				
	Cation Sum (meq/L)	4.05				
	Cation - Anion Balance (%)	2.4				
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	8.88				
Total Metals	Aluminum (Al)-Total (mg/L)	0.124				
	Antimony (Sb)-Total (mg/L)	<0.00010				
	Arsenic (As)-Total (mg/L)	0.00064				
	Barium (Ba)-Total (mg/L)	0.0655				
	Beryllium (Be)-Total (mg/L)	<0.000020				
	Bismuth (Bi)-Total (mg/L)	<0.000050				
	Boron (B)-Total (mg/L)	<0.010				
	Cadmium (Cd)-Total (mg/L)	<0.0000050				
	Calcium (Ca)-Total (mg/L)	42.2				
	Chromium (Cr)-Total (mg/L)	0.00046				
	Cobalt (Co)-Total (mg/L)	0.00011				
	Copper (Cu)-Total (mg/L)	0.00234				
	Iron (Fe)-Total (mg/L)	0.257				
	Lead (Pb)-Total (mg/L)	0.000058				
	Lithium (Li)-Total (mg/L)	0.0015				
	Magnesium (Mg)-Total (mg/L)	15.5				
	Manganese (Mn)-Total (mg/L)	0.0184				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2127781-1 Water 09-JUL-18 10:45 W16	L2127781-2 Water 09-JUL-18 09:35 W8A	L2127781-3 Water 09-JUL-18 10:20 W17	L2127781-4 Water 10-JUL-18 DUP	L2127781-5 Water 10-JUL-18 08:20 W3
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	0.0000053	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.00266	0.00723	0.00676	0.00454	0.00457
	Nickel (Ni)-Total (mg/L)	0.00116	0.00249	0.00069	0.00089	0.00089
	Phosphorus (P)-Total (mg/L)	<0.050	0.133	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	2.68	4.72	3.63	2.31	2.30
	Selenium (Se)-Total (mg/L)	0.000904	0.00273	0.000508	0.000295	0.000278
	Silicon (Si)-Total (mg/L)	3.58	8.55	5.46	5.96	5.85
	Silver (Ag)-Total (mg/L)	<0.000020 ^{DLM}	0.000243	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	11.0	22.4	14.0	18.0	18.2
	Strontium (Sr)-Total (mg/L)	0.538	1.26	0.664	0.762	0.764
	Sulfur (S)-Total (mg/L)	21.0	38.3	20.2	19.2	19.6
	Thallium (Tl)-Total (mg/L)	<0.000010	0.000017	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	0.00016	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	0.00475	0.0560	<0.00030	0.00056	<0.00030
	Uranium (U)-Total (mg/L)	0.00127	0.00175	0.00196	0.00293	0.00289
	Vanadium (V)-Total (mg/L)	0.00097	0.00612	0.00064	0.00060	0.00060
	Zinc (Zn)-Total (mg/L)	<0.0030	0.674	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	<0.00030	0.00068	<0.00030	<0.00030	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0148	0.0126	0.0018	0.0022	0.0086
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	0.00015	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00045	0.00073	0.00037	0.00027	0.00026
	Barium (Ba)-Dissolved (mg/L)	0.0761	0.0969	0.0739	0.0709	0.0692
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	0.000030	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.014	0.022	0.024	0.023	0.022
	Cadmium (Cd)-Dissolved (mg/L)	0.0000074	0.000135	<0.0000050	0.0000051	0.0000076
	Calcium (Ca)-Dissolved (mg/L)	59.6	104	64.3	64.1	63.1
	Chromium (Cr)-Dissolved (mg/L)	0.00015	0.00036	0.00010	0.00011	0.00012
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00057	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.0316	0.129	0.00762	0.00383	0.00491
	Iron (Fe)-Dissolved (mg/L)	0.079	0.355	<0.010	0.010	0.027
	Lead (Pb)-Dissolved (mg/L)	<0.000050	0.000059	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0011	0.0026	0.0013	0.0027	0.0026
	Magnesium (Mg)-Dissolved (mg/L)	17.3	28.3	18.8	30.1	29.1
Manganese (Mn)-Dissolved (mg/L)	0.0435	1.01	0.00160	0.0329	0.0332	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID				
		L2127781-6 Water 10-JUL-18 09:55 MC1				
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050				
	Molybdenum (Mo)-Total (mg/L)	0.00198				
	Nickel (Ni)-Total (mg/L)	0.00127				
	Phosphorus (P)-Total (mg/L)	<0.050				
	Potassium (K)-Total (mg/L)	1.50				
	Selenium (Se)-Total (mg/L)	0.000168				
	Silicon (Si)-Total (mg/L)	6.05				
	Silver (Ag)-Total (mg/L)	<0.000010				
	Sodium (Na)-Total (mg/L)	10.7				
	Strontium (Sr)-Total (mg/L)	0.443				
	Sulfur (S)-Total (mg/L)	7.27				
	Thallium (Tl)-Total (mg/L)	<0.000010				
	Tin (Sn)-Total (mg/L)	<0.00010				
	Titanium (Ti)-Total (mg/L)	0.00502				
	Uranium (U)-Total (mg/L)	0.00191				
	Vanadium (V)-Total (mg/L)	0.00151				
	Zinc (Zn)-Total (mg/L)	<0.0030				
	Zirconium (Zr)-Total (mg/L)	<0.00030				
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD				
	Dissolved Metals Filtration Location	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	0.0062				
	Antimony (Sb)-Dissolved (mg/L)	0.00010				
	Arsenic (As)-Dissolved (mg/L)	0.00054				
	Barium (Ba)-Dissolved (mg/L)	0.0701				
	Beryllium (Be)-Dissolved (mg/L)	<0.000020				
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050				
	Boron (B)-Dissolved (mg/L)	<0.010				
	Cadmium (Cd)-Dissolved (mg/L)	0.0000060				
	Calcium (Ca)-Dissolved (mg/L)	44.6				
	Chromium (Cr)-Dissolved (mg/L)	0.00015				
	Cobalt (Co)-Dissolved (mg/L)	<0.00010				
	Copper (Cu)-Dissolved (mg/L)	0.00193				
	Iron (Fe)-Dissolved (mg/L)	0.057				
	Lead (Pb)-Dissolved (mg/L)	<0.000050				
	Lithium (Li)-Dissolved (mg/L)	0.0014				
	Magnesium (Mg)-Dissolved (mg/L)	16.0				
	Manganese (Mn)-Dissolved (mg/L)	0.00923				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2127781-1 Water 09-JUL-18 10:45 W16	L2127781-2 Water 09-JUL-18 09:35 W8A	L2127781-3 Water 09-JUL-18 10:20 W17	L2127781-4 Water 10-JUL-18 DUP	L2127781-5 Water 10-JUL-18 08:20 W3
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00279	0.00770	0.00679	0.00479	0.00460
	Nickel (Ni)-Dissolved (mg/L)	0.00102	0.00123	0.00058	0.00093	0.00088
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	2.54	4.63	3.57	2.42	2.30
	Selenium (Se)-Dissolved (mg/L)	0.000848	0.00281	0.000481	0.000321	0.000297
	Silicon (Si)-Dissolved (mg/L)	3.33	6.05	5.27	5.74	5.98
	Silver (Ag)-Dissolved (mg/L)	<0.000010	0.000022	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	11.3	23.8	14.0	19.2	18.7
	Strontium (Sr)-Dissolved (mg/L)	0.549	1.39	0.688	0.792	0.778
	Sulfur (S)-Dissolved (mg/L)	20.8	39.2	19.9	19.9	20.7
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00057	<0.00060 ^{DLM}	<0.00030	<0.00030	0.00048
	Uranium (U)-Dissolved (mg/L)	0.00127	0.00176	0.00197	0.00294	0.00292
	Vanadium (V)-Dissolved (mg/L)	0.00056	0.00089	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	0.183	<0.0010	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	0.00034	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2127781-6 Water 10-JUL-18 09:55 MC1				
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050				
	Molybdenum (Mo)-Dissolved (mg/L)	0.00202				
	Nickel (Ni)-Dissolved (mg/L)	0.00097				
	Phosphorus (P)-Dissolved (mg/L)	<0.050				
	Potassium (K)-Dissolved (mg/L)	1.46				
	Selenium (Se)-Dissolved (mg/L)	0.000176				
	Silicon (Si)-Dissolved (mg/L)	5.63				
	Silver (Ag)-Dissolved (mg/L)	<0.000010				
	Sodium (Na)-Dissolved (mg/L)	10.9				
	Strontium (Sr)-Dissolved (mg/L)	0.457				
	Sulfur (S)-Dissolved (mg/L)	7.76				
	Thallium (Tl)-Dissolved (mg/L)	<0.000010				
	Tin (Sn)-Dissolved (mg/L)	<0.00010				
	Titanium (Ti)-Dissolved (mg/L)	<0.00030				
	Uranium (U)-Dissolved (mg/L)	0.00186				
	Vanadium (V)-Dissolved (mg/L)	0.00085				
	Zinc (Zn)-Dissolved (mg/L)	<0.0010				
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Laboratory Control Sample	Lithium (Li)-Dissolved	MES	L2127781-1, -2, -3, -4, -5, -6
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2127781-1, -2, -3, -4, -5, -6
Matrix Spike	Boron (B)-Dissolved	MS-B	L2127781-1, -2, -3, -4, -5, -6
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2127781-1, -2, -3, -4, -5, -6
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2127781-1, -2, -3, -4, -5, -6
Matrix Spike	Molybdenum (Mo)-Dissolved	MS-B	L2127781-1, -2, -3, -4, -5, -6
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2127781-1, -2, -3, -4, -5, -6
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2127781-1, -2, -3, -4, -5, -6
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2127781-1, -2, -3, -4, -5, -6
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2127781-1, -2, -3, -4, -5, -6
Matrix Spike	Uranium (U)-Dissolved	MS-B	L2127781-1, -2, -3, -4, -5, -6
Matrix Spike	Barium (Ba)-Total	MS-B	L2127781-1, -2, -3, -4, -5, -6
Matrix Spike	Calcium (Ca)-Total	MS-B	L2127781-1, -2, -3, -4, -5, -6
Matrix Spike	Copper (Cu)-Total	MS-B	L2127781-1, -2, -3, -4, -5, -6
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2127781-1, -2, -3, -4, -5, -6
Matrix Spike	Manganese (Mn)-Total	MS-B	L2127781-1, -2, -3, -4, -5, -6
Matrix Spike	Sodium (Na)-Total	MS-B	L2127781-1, -2, -3, -4, -5, -6
Matrix Spike	Strontium (Sr)-Total	MS-B	L2127781-1, -2, -3, -4, -5, -6
Matrix Spike	Sulfur (S)-Total	MS-B	L2127781-1, -2, -3, -4, -5, -6
Matrix Spike	Sulfate (SO4)	MS-B	L2127781-1, -2, -3, -4, -5, -6

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-WR	Water	Nitrite & Nitrate Nitrogen	EPA 300.1
Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance.			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-WR	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			

Reference Information

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NO2-L-IC-N-WR	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-WR	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
SO4-IC-WR	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)
This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.			
TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA

Reference Information

VA

ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-07-10 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com



L2127781-COFC

COC Number: 2018-07-10 A

Page 1 of 1

Report To Contact and company name below will appear on the final report		Report Format / Distribution		Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply											
Company: Minto Explorations Ltd.		Select Report Format: ☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)		Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply											
Contact: Minto Environment - Coordinator		Quality Control (QC) Report with Report ☒ YES ☐ NO		PRIORITY (Business Days)				EMERGENCY							
Phone: 1-604-759-4659		☒ Compare Results to Criteria on Report - provide details below if box checked		4 day [P4] ☐				1 Business day [E1] ☐							
Company address below will appear on the final report		Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX		3 day [P3] ☐				Same Day, Weekend or Statutory holiday [E0] ☐							
Street: 2100-510 West Georgia St.		Email 1 or Fax: minto_environment@mintomine.com		Date and Time Required for all E&P TATs: dd-mm-yy hh:mm											
City/Province: Vancouver, British Columbia		Email 2		For tests that can not be performed according to the service level selected, you will be contacted.											
Postal Code: V6B 0M3		Email 3		Analysis Request											
Invoice To: Same as Report To ☐ YES ☒ NO		Invoice Distribution		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below											
Copy of Invoice with Report ☐ YES ☒ NO		Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX													
Company: Minto Explorations Ltd.		Email 1 or Fax: ap@mintomine.com													
Contact: Ruth Cayetano		Email 2													
Project Information		Oil and Gas Required Fields (client use)													
ALS Account # / Quote #:		AFE/Cost Center:		PO#											
Job #:		Major/Minor Code:		Routing Code:											
PO / AFE: 229096 (WUL)		Requisitioner:													
LSD:		Location:													
ALS Lab Work Order # (lab use only)		ALS Contact: Shane Stack		Sampler: CR/EB											
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mm-yy)	Time (hh:mm)	Sample Type	pH / Conductivity / Alkalinity / Anions	Total Suspended Solids (TSS)	Total Dissolved Solids (TDS)	Total Metals (TM), Hardness	Dissolved Metals (DM) (filtered and preserved)	Total Mercury, Hardness	Dissolved Mercury (1) (filtered + preserved)	Total Nutrients (Ammonia)	Dissolved Organic Carbon (DOC)	Number of Containers	
	W16	9-Jul-18	10:45	Water	R	R	R	R	R	R	R	R	R	7	
	W8A	9-Jul-18	9:35	Water	R	R	R	R	R	R	R	R	R	6	
	W17	9-Jul-18	10:20	Water	R	R	R	R	R	R	R	R	R	7	
	DUP	10-Jul-18		Water	R	R	R	R	R	R	R	R	R	7	
	W3	10-Jul-18	8:20	Water	R	R	R	R	R	R	R	R	R	7	
	MC1	10-Jul-18	9:55	Water	R	R	R	R	R	R	R	R	R	7	
Drinking Water (DW) Samples¹ (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)			SAMPLE CONDITION AS RECEIVED (lab use only)										
Are samples taken from a Regulated DW System? ☐ YES ☒ NO					Frozen ☐ SIF Observations Yes ☐ No ☐										
Are samples for human drinking water use? ☐ YES ☒ NO					Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐										
					Cooling Initiated ☒										
					INITIAL COOLER TEMPERATURES °C: 6.0 FINAL COOLER TEMPERATURES °C: 9										
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)										
Released by: Corey Roberts		Date: 2018-07-10		Time:	Received by: EHF	Date: 11 July 2018		Time: 16:20	Received by: HA	Date: 7/3		Time: 3:35p			

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 12-JUL-18
Report Date: 25-JUL-18 18:00 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2130082
Project P.O. #: 229096 (WUL)
Job Reference:
C of C Numbers: 2018-07-15 A
Legal Site Desc:

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2130082-1 Water 11-JUL-18 13:35 W16	L2130082-2 Water 11-JUL-18 14:05 W17		
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)		433	475		
	Hardness (as CaCO3) (mg/L)		212	233		
	pH (pH)		8.30	8.28		
	Total Suspended Solids (mg/L)		<3.0	<3.0		
	TDS (Calculated) (mg/L)		257	279		
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)		155	192		
	Alkalinity, Carbonate (as CaCO3) (mg/L)		1.8	<1.0		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)		<1.0	<1.0		
	Alkalinity, Total (as CaCO3) (mg/L)		157	192		
	Ammonia, Total (as N) (mg/L)		0.0404	<0.0050		
	Chloride (Cl) (mg/L)		4.76	5.79		
	Nitrate and Nitrite (as N) (mg/L)		1.89	0.232		
	Nitrate (as N) (mg/L)		1.88	0.232		
	Nitrite (as N) (mg/L)		0.0072	<0.0010		
	Sulfate (SO4) (mg/L)		62.2	58.8		
	Anion Sum (meq/L)		4.71	5.24		
	Cation Sum (meq/L)		4.78	5.33		
	Cation - Anion Balance (%)		0.7	0.9		
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)		18.7	9.70		
Total Metals	Aluminum (Al)-Total (mg/L)		0.0507	<0.0030		
	Antimony (Sb)-Total (mg/L)		0.00012	0.00012		
	Arsenic (As)-Total (mg/L)		0.00046	0.00039		
	Barium (Ba)-Total (mg/L)		0.0708	0.0678		
	Beryllium (Be)-Total (mg/L)		<0.000020	<0.000020		
	Bismuth (Bi)-Total (mg/L)		<0.000050	<0.000050		
	Boron (B)-Total (mg/L)		0.014	0.024		
	Cadmium (Cd)-Total (mg/L)		0.0000102	<0.0000050		
	Calcium (Ca)-Total (mg/L)		54.5	59.7		
	Chromium (Cr)-Total (mg/L)		0.00023	0.00011		
	Cobalt (Co)-Total (mg/L)		0.00012	<0.00010		
	Copper (Cu)-Total (mg/L)		0.0342	0.00789		
	Iron (Fe)-Total (mg/L)		0.147	<0.010		
	Lead (Pb)-Total (mg/L)		<0.000050	<0.000050		
	Lithium (Li)-Total (mg/L)		0.0012	0.0015		
	Magnesium (Mg)-Total (mg/L)		16.9	18.6		
	Manganese (Mn)-Total (mg/L)		0.0514	0.00425		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2130082-1 Water 11-JUL-18 13:35 W16	L2130082-2 Water 11-JUL-18 14:05 W17		
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050			
	Molybdenum (Mo)-Total (mg/L)	0.00261	0.00643			
	Nickel (Ni)-Total (mg/L)	0.00092	0.00057			
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050			
	Potassium (K)-Total (mg/L)	2.52	3.55			
	Selenium (Se)-Total (mg/L)	0.000806	0.000447			
	Silicon (Si)-Total (mg/L)	3.75	5.57			
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010			
	Sodium (Na)-Total (mg/L)	11.2	13.8			
	Strontium (Sr)-Total (mg/L)	0.507	0.635			
	Sulfur (S)-Total (mg/L)	22.5	21.2			
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010			
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010			
	Titanium (Ti)-Total (mg/L)	0.00252	<0.00030			
	Uranium (U)-Total (mg/L)	0.00128	0.00196			
	Vanadium (V)-Total (mg/L)	0.00071	<0.00050			
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030			
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030			
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD			
	Dissolved Metals Filtration Location	FIELD	FIELD			
	Aluminum (Al)-Dissolved (mg/L)	0.0171	0.0025			
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010			
	Arsenic (As)-Dissolved (mg/L)	0.00044	0.00039			
	Barium (Ba)-Dissolved (mg/L)	0.0728	0.0704			
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020			
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050			
	Boron (B)-Dissolved (mg/L)	0.012	0.022			
	Cadmium (Cd)-Dissolved (mg/L)	0.0000113	0.0000078			
	Calcium (Ca)-Dissolved (mg/L)	56.5	61.9			
	Chromium (Cr)-Dissolved (mg/L)	0.00018	<0.00010			
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010			
	Copper (Cu)-Dissolved (mg/L)	0.0332	0.00837			
	Iron (Fe)-Dissolved (mg/L)	0.091	<0.010			
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050			
	Lithium (Li)-Dissolved (mg/L)	0.0011	0.0014			
	Magnesium (Mg)-Dissolved (mg/L)	17.1	19.0			
	Manganese (Mn)-Dissolved (mg/L)	0.0446	0.00237			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2130082-1 Water 11-JUL-18 13:35 W16	L2130082-2 Water 11-JUL-18 14:05 W17			
Grouping	Analyte						
WATER							
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050				
	Molybdenum (Mo)-Dissolved (mg/L)	0.00256	0.00646				
	Nickel (Ni)-Dissolved (mg/L)	0.00099	0.00103				
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050				
	Potassium (K)-Dissolved (mg/L)	2.47	3.52				
	Selenium (Se)-Dissolved (mg/L)	0.000821	0.000483				
	Silicon (Si)-Dissolved (mg/L)	3.29	5.19				
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010				
	Sodium (Na)-Dissolved (mg/L)	10.8	13.6				
	Strontium (Sr)-Dissolved (mg/L)	0.521	0.652				
	Sulfur (S)-Dissolved (mg/L)	19.4	18.9				
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010				
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010				
	Titanium (Ti)-Dissolved (mg/L)	0.00091	<0.00030				
	Uranium (U)-Dissolved (mg/L)	0.00119	0.00186				
	Vanadium (V)-Dissolved (mg/L)	0.00056	<0.00050				
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	0.0024				
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Laboratory Control Sample	Lithium (Li)-Total	MES	L2130082-1, -2
Matrix Spike	Dissolved Organic Carbon	MS-B	L2130082-1, -2
Matrix Spike	Sulfate (SO4)	MS-B	L2130082-1, -2

Qualifiers for Individual Parameters Listed:

Qualifier	Description
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			

Reference Information

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)
 Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
 This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)
 Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)
 Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value
 This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode
 It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)
 Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)
 This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
 The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC
 This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-07-15 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

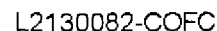
Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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Page 1 of 1

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Report To Contact and company name below will appear on the final report						Report Format / Distribution								Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply																					
Company: Minto Explorations Ltd.						Select Report Format: ☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)								Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply																					
Contact: Minto Environment - Coordinator						Quality Control (QC) Report with Report ☒ YES ☐ NO								PRIORITY (Business Days) 4 day [P4] ☐ 3 day [P3] ☐ 2 day [P2] ☐ EMERGENCY 1 Business day [E1] ☐ Same Day, Weekend or Statutory holiday [E0] ☐																					
Phone: 1-604-759-4659						☒ Compare Results to Criteria on Report - provide details below if box checked																													
Company address below will appear on the final report						Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX																													
Street: 2100-510 West Georgia St.						Email 1 or Fax minto_environment@mintomine.com								Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm																					
City/Province: Vancouver, British Columbia						Email 2								For tests that can not be performed according to the service level selected, you will be contacted.																					
Postal Code: V6B 0M3						Email 3								Analysis Request																					
Invoice To: Same as Report To ☐ YES ☒ NO						Invoice Distribution								Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below																					
Copy of Invoice with Report ☐ YES ☒ NO						Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX																													
Company: Minto Explorations Ltd.						Email 1 or Fax ap@mintomine.com																													
Contact: Ruth Cayetano						Email 2																													
Project Information						Oil and Gas Required Fields (client use)								pH / Conductivity / Alkalinity / Anions Total Suspended Solids (TSS) Total Dissolved Solids (TDS) Total Metals (TM), Hardness Dissolved Metals (DM) (filtered and preserved) Total Mercury, Hardness Dissolved Mercury [1] (Filtered + preserved) Total Nutrients (Ammonia) Dissolved Organic Carbon (DOC) Number of Containers																					
ALS Account # / Quote #:						AFE/Cost Center: PO#																													
Job #:						Major/Minor Code: Routing Code:																													
PO / AFE: 229096 (WUL)						Requisitioner:																													
LSD:						Location:																													
ALS Lab Work Order # (lab use only)						ALS Contact: Shane Stack Sampler: CR																													
ALS Sample # (lab use only)						Sample Identification and/or Coordinates (This description will appear on the report)						Date (dd-mmm-yy)		Time (hh:mm)		Sample Type																			
W16												11-Jul-18		13:35		Water		R	R	R	R	R	R	R	R	R	R	R	R	R	R	7			
W17												11-Jul-18		14:05		Water		R	R	R	R	R	R	R	R	R	R	R	R	R	R	7			
Drinking Water (DW) Samples¹ (client use)												Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)												SAMPLE CONDITION AS RECEIVED (lab use only)											
Are samples taken from a Regulated DW System? ☐ YES ☒ NO																								Frozen ☐ SIF Observations Yes ☐ No ☐											
Are samples for human drinking water use? ☐ YES ☒ NO																								Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐											
																								Cooling Initiated ☐											
																								INITIAL COOLER TEMPERATURES °C 7°C FINAL COOLER TEMPERATURES °C 9°C											
SHIPMENT RELEASE (client use)												INITIAL SHIPMENT RECEPTION (lab use only)												FINAL SHIPMENT RECEPTION (lab use only)											
Released by: Corey Roberts				Date: 2018-07-15				Time:				Received by: (Signature)				Date: July 16/18				Time: 12:58				Received by: (Signature)				Date: 7/17				Time: 12:40			

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

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OCTOBER 2014 EDITION



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 18-JUL-18
Report Date: 27-JUL-18 13:54 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2131756
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-07-18 A
Legal Site Desc:

Shane Stack
Account Manager

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ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2131756-1 Water 16-JUL-18 10:40 W17	L2131756-2 Water 16-JUL-18 11:15 W16	L2131756-3 Water 17-JUL-18 08:30 W3	L2131756-4 Water 17-JUL-18 09:10 W50	L2131756-5 Water 17-JUL-18 13:45 MC1
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	466	429	493	436	354
	Hardness (as CaCO3) (mg/L)	220	203	232	205	169
	pH (pH)	8.32	8.34	8.38	8.29	8.40
	Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0	<3.0	12.9
	TDS (Calculated) (mg/L)	275	256	288	258	199
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	192	158	207	161	173
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	192	158	207	161	173
	Ammonia, Total (as N) (mg/L)	<0.0050	0.0498	0.0052	0.0107	0.0078
	Chloride (Cl) (mg/L)	5.67	4.80	5.04	4.88	1.70
	Nitrate and Nitrite (as N) (mg/L)	0.226	1.86	0.721	1.75	0.0990
	Nitrate (as N) (mg/L)	0.226	1.85	0.721	1.75	0.0990
	Nitrite (as N) (mg/L)	<0.0010	0.0093	<0.0010	0.0043	<0.0010
	Sulfate (SO4) (mg/L)	59.7	63.7	59.9	63.7	23.2
	Anion Sum (meq/L)	5.26	4.74	5.58	4.81	4.00
	Cation Sum (meq/L)	5.09	4.61	5.36	4.66	3.88
	Cation - Anion Balance (%)	-1.7	-1.4	-2.0	-1.6	-1.5
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	9.89	18.3	11.2	17.7	8.30
Total Metals	Aluminum (Al)-Total (mg/L)	0.0032	0.0386	0.0609	0.0203	0.286
	Antimony (Sb)-Total (mg/L)	0.00013	0.00012	0.00011	<0.00010	0.00014
	Arsenic (As)-Total (mg/L)	0.00037	0.00046	0.00035	0.00045	0.00082
	Barium (Ba)-Total (mg/L)	0.0661	0.0704	0.0652	0.0713	0.0724
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.024	0.013	0.022	0.015	<0.010
	Cadmium (Cd)-Total (mg/L)	<0.0000050	0.0000062	<0.0000050	0.0000072	0.0000081
	Calcium (Ca)-Total (mg/L)	61.8	57.5	59.5	59.0	44.9
	Chromium (Cr)-Total (mg/L)	0.00011	0.00021	0.00020	0.00028	0.00067
	Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	0.00021
	Copper (Cu)-Total (mg/L)	0.00755	0.0316	0.0134	0.0274	0.00273
	Iron (Fe)-Total (mg/L)	<0.010	0.130	0.100	0.088	0.498
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	0.000054	0.000191	0.000133
	Lithium (Li)-Total (mg/L)	0.0015	0.0012	0.0025	0.0013	0.0018
	Magnesium (Mg)-Total (mg/L)	17.7	16.5	23.2	17.0	15.6
	Manganese (Mn)-Total (mg/L)	0.00274	0.0457	0.0303	0.0375	0.0276

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2131756-6 Water 17-JUL-18 15:50 UG1	L2131756-7 Water 17-JUL-18 09:45 W16A	L2131756-8 Water 17-JUL-18 DUP	L2131756-9 Water 15-JUL-18 15:15 MN	
Grouping	Analyte						
WATER							
Physical Tests	Conductivity (uS/cm)		2060	437	357	438	
	Hardness (as CaCO3) (mg/L)		1060	203	165	159	
	pH (pH)		7.92	8.35	8.40	8.00	
	Total Suspended Solids (mg/L)		153	4.1	23.5	3.3	
	TDS (Calculated) (mg/L)		1720	254	197	277	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)		186	156	173	72.2	
	Alkalinity, Carbonate (as CaCO3) (mg/L)		<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)		<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Total (as CaCO3) (mg/L)		186	156	173	72.2	
	Ammonia, Total (as N) (mg/L)		6.97	0.0493	0.0083	0.175	
	Chloride (Cl) (mg/L)		14.4	4.78	1.70	1.25	
	Nitrate and Nitrite (as N) (mg/L)		14.3	1.85	0.0994	17.0	
	Nitrate (as N) (mg/L)		13.4	1.84	0.0983	17.0	
	Nitrite (as N) (mg/L)		0.909	0.0087	0.0010	0.0712	
	Sulfate (SO4) (mg/L)		1030	63.6	23.2	76.1	
	Anion Sum (meq/L)		26.6	4.72	4.00	4.28	
	Cation Sum (meq/L)		25.5	4.61	3.80	4.10	
	Cation - Anion Balance (%)		-2.2	-1.2	-2.6	-2.1	
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)			18.1	8.52		
Total Metals	Aluminum (Al)-Total (mg/L)		6.84	0.0278	0.418	0.0546	
	Antimony (Sb)-Total (mg/L)		0.00050	<0.00010	0.00041	0.00019	
	Arsenic (As)-Total (mg/L)		0.00180	0.00052	0.00117	0.00044	
	Barium (Ba)-Total (mg/L)		0.151	0.0782	0.0756	0.0245	
	Beryllium (Be)-Total (mg/L)		0.000171	<0.000020	0.000050	<0.000020	
	Bismuth (Bi)-Total (mg/L)		0.00010	<0.000050	0.000286	<0.000050	
	Boron (B)-Total (mg/L)		0.431	0.016	<0.010	0.073	
	Cadmium (Cd)-Total (mg/L)		0.000342	0.0000107	0.0000425	0.0000610	
	Calcium (Ca)-Total (mg/L)		392	58.6	45.1	53.7	
	Chromium (Cr)-Total (mg/L)		0.00273	0.00024	0.00097	<0.00010	
	Cobalt (Co)-Total (mg/L)		0.00372	<0.00010	0.00036	<0.00010	
	Copper (Cu)-Total (mg/L)		0.784	0.0336	0.00438	0.0260	
	Iron (Fe)-Total (mg/L)		10.5	0.140	0.689	0.071	
	Lead (Pb)-Total (mg/L)		0.00582	0.000249	0.000322	<0.000050	
	Lithium (Li)-Total (mg/L)		0.0168	0.0012	0.0019	0.0041	
	Magnesium (Mg)-Total (mg/L)		42.7	17.3	15.9	8.08	
	Manganese (Mn)-Total (mg/L)		0.375	0.0516	0.0389	0.0250	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2131756-1 Water 16-JUL-18 10:40 W17	L2131756-2 Water 16-JUL-18 11:15 W16	L2131756-3 Water 17-JUL-18 08:30 W3	L2131756-4 Water 17-JUL-18 09:10 W50	L2131756-5 Water 17-JUL-18 13:45 MC1
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.00640	0.00264	0.00448	0.00292	0.00202
	Nickel (Ni)-Total (mg/L)	0.00060	0.00111	0.00128	0.00100	0.00154
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	3.42	2.42	2.34	2.59	1.46
	Selenium (Se)-Total (mg/L)	0.000454	0.000879	0.000493	0.000918	0.000156
	Silicon (Si)-Total (mg/L)	5.45	3.48	5.41	3.83	6.70
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	13.5	11.1	15.5	12.6	11.5
	Strontium (Sr)-Total (mg/L)	0.649	0.519	0.682	0.535	0.453
	Sulfur (S)-Total (mg/L)	21.3	22.6	21.3	23.1	8.03
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	<0.00030	0.00198	0.00290	<0.00090 ^{DLM}	0.0128
	Uranium (U)-Total (mg/L)	0.00189	0.00122	0.00215	0.00129	0.00203
	Vanadium (V)-Total (mg/L)	<0.00050	0.00063	0.00059	0.00057	0.00180
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0018	0.0141	0.0060	0.0093	0.0061
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00038	0.00044	0.00029	0.00044	0.00051
	Barium (Ba)-Dissolved (mg/L)	0.0684	0.0710	0.0662	0.0654	0.0643
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.022	0.013	0.021	0.013	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	0.0000062	<0.0000050	<0.0000050	0.0000301 ^{DTMF}
	Calcium (Ca)-Dissolved (mg/L)	58.5	54.2	55.1	54.8	42.0
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00019	0.00027	0.00018	0.00019
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00773	0.0299	0.00909	0.0246	0.00266
	Iron (Fe)-Dissolved (mg/L)	<0.010	0.081	0.021	0.059	0.041
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	0.000129	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0015	0.0012	0.0025	0.0012	0.0016
	Magnesium (Mg)-Dissolved (mg/L)	18.0	16.5	22.9	16.6	15.5
	Manganese (Mn)-Dissolved (mg/L)	0.00171	0.0392	0.0165	0.0286	0.0137

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2131756-6 Water 17-JUL-18 15:50 UG1	L2131756-7 Water 17-JUL-18 09:45 W16A	L2131756-8 Water 17-JUL-18 DUP	L2131756-9 Water 15-JUL-18 15:15 MN	
Grouping	Analyte						
WATER							
Total Metals	Mercury (Hg)-Total (mg/L)		<0.000025 ^{DLM}	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Total (mg/L)		0.0231	0.00283	0.00210	0.0198	
	Nickel (Ni)-Total (mg/L)		0.0029	0.00112	0.00195	<0.00050	
	Phosphorus (P)-Total (mg/L)		0.16	<0.050	<0.050	<0.050	
	Potassium (K)-Total (mg/L)		10.9	2.66	1.50	3.52	
	Selenium (Se)-Total (mg/L)		0.00251	0.00102	0.000466	0.0134	
	Silicon (Si)-Total (mg/L)		19.8	3.74	7.00	2.51	
	Silver (Ag)-Total (mg/L)		0.000439	<0.000010	0.000032	0.000030	
	Sodium (Na)-Total (mg/L)		88.8	12.2	11.4	20.1	
	Strontium (Sr)-Total (mg/L)		7.19	0.540	0.462	1.33	
	Sulfur (S)-Total (mg/L)		375	23.7	8.27	27.2	
	Thallium (Tl)-Total (mg/L)		0.000078	<0.000010	0.000271	<0.000010	
	Tin (Sn)-Total (mg/L)		0.00030	<0.00010	0.00015	<0.00010	
	Titanium (Ti)-Total (mg/L)		0.424	<0.00090 ^{DLM}	0.0173	0.00285	
	Uranium (U)-Total (mg/L)		0.00892	0.00132	0.00203	0.000892	
	Vanadium (V)-Total (mg/L)		0.0234	0.00066	0.00237	0.00059	
	Zinc (Zn)-Total (mg/L)		0.0675	<0.0030	<0.0030	<0.0030	
	Zirconium (Zr)-Total (mg/L)		0.00042	<0.00030	0.00035	<0.00030	
Dissolved Metals	Dissolved Mercury Filtration Location		FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location		FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)		0.0115	0.0145	0.0063	0.0049	
	Antimony (Sb)-Dissolved (mg/L)		0.00046	<0.00010	<0.00010	0.00016	
	Arsenic (As)-Dissolved (mg/L)		0.00096	0.00045	0.00049	0.00040	
	Barium (Ba)-Dissolved (mg/L)		0.0309	0.0708	0.0638	0.0236	
	Beryllium (Be)-Dissolved (mg/L)		<0.000040 ^{DLA}	<0.000020	<0.000020	<0.000020	
	Bismuth (Bi)-Dissolved (mg/L)		<0.00010 ^{DLA}	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)		0.393	0.014	<0.010	0.067	
	Cadmium (Cd)-Dissolved (mg/L)		0.000014	0.0000071	<0.0000050	0.0000505	
	Calcium (Ca)-Dissolved (mg/L)		359 ^{DLA}	53.5	41.0	51.4	
	Chromium (Cr)-Dissolved (mg/L)		<0.00020	0.00018	0.00017	<0.00010	
	Cobalt (Co)-Dissolved (mg/L)		0.00049	<0.00010	<0.00010	<0.00010	
	Copper (Cu)-Dissolved (mg/L)		0.0168	0.0300	0.00184	0.0196	
	Iron (Fe)-Dissolved (mg/L)		<0.020 ^{DLA}	0.083	0.044	<0.010	
	Lead (Pb)-Dissolved (mg/L)		<0.00010 ^{DLA}	0.000181	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)		0.0134	0.0012	0.0016	0.0042	
	Magnesium (Mg)-Dissolved (mg/L)		39.6	16.8	15.3	7.50	
	Manganese (Mn)-Dissolved (mg/L)		0.0869	0.0395	0.0109	0.0214	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2131756-1 Water 16-JUL-18 10:40 W17	L2131756-2 Water 16-JUL-18 11:15 W16	L2131756-3 Water 17-JUL-18 08:30 W3	L2131756-4 Water 17-JUL-18 09:10 W50	L2131756-5 Water 17-JUL-18 13:45 MC1
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00621	0.00255	0.00437	0.00262	0.00181
	Nickel (Ni)-Dissolved (mg/L)	0.00065	0.00100	0.00245 ^{DTMF}	0.00072	0.00090
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	3.63	2.52	2.37	2.46	1.42
	Selenium (Se)-Dissolved (mg/L)	0.000526	0.000859	0.000459	0.000899	0.000177
	Silicon (Si)-Dissolved (mg/L)	5.36	3.35	5.19	3.62	6.01
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	13.7	11.0	15.3	11.1	10.7
	Strontium (Sr)-Dissolved (mg/L)	0.630	0.506	0.656	0.506	0.434
	Sulfur (S)-Dissolved (mg/L)	20.2	21.8	20.7	21.9	8.06
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	0.00064	0.00040	<0.00060 ^{DLM}	0.00037
	Uranium (U)-Dissolved (mg/L)	0.00184	0.00125	0.00219	0.00125	0.00198
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	0.00079
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	0.0033
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID	L2131756-6	L2131756-7	L2131756-8	L2131756-9	
		Description	Water	Water	Water	Water	
		Sampled Date	17-JUL-18	17-JUL-18	17-JUL-18	15-JUL-18	
		Sampled Time	15:50	09:45		15:15	
		Client ID	UG1	W16A	DUP	MN	
Grouping	Analyte						
WATER							
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)		<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Dissolved (mg/L)		0.0211	0.00253	0.00182	0.0187	
	Nickel (Ni)-Dissolved (mg/L)		0.0011	0.00094	0.00084	<0.00050	
	Phosphorus (P)-Dissolved (mg/L)		<0.10 ^{DLA}	<0.050	<0.050	<0.050	
	Potassium (K)-Dissolved (mg/L)		8.43	2.47	1.36	3.40	
	Selenium (Se)-Dissolved (mg/L)		0.00185	0.000860	0.000148	0.0133	
	Silicon (Si)-Dissolved (mg/L)		6.98	3.36	5.91	2.43	
	Silver (Ag)-Dissolved (mg/L)		<0.000020 ^{DLA}	<0.000010	<0.000010	<0.000010	
	Sodium (Na)-Dissolved (mg/L)		82.2	11.0	10.4	18.8	
	Strontium (Sr)-Dissolved (mg/L)		6.83	0.501	0.427	1.26	
	Sulfur (S)-Dissolved (mg/L)		394	21.9	8.13	27.2	
	Thallium (Tl)-Dissolved (mg/L)		<0.000020 ^{DLA}	<0.000010	<0.000010	<0.000010	
	Tin (Sn)-Dissolved (mg/L)		<0.00020 ^{DLA}	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Dissolved (mg/L)		<0.00060 ^{DLA}	0.00078	0.00035	<0.00030	
	Uranium (U)-Dissolved (mg/L)		0.00887	0.00125	0.00198	0.000863	
	Vanadium (V)-Dissolved (mg/L)		<0.0010 ^{DLA}	<0.00050	0.00076	<0.00050	
	Zinc (Zn)-Dissolved (mg/L)		0.0049	<0.0010	<0.0010	0.0019	
	Zirconium (Zr)-Dissolved (mg/L)		<0.00030	<0.00030	<0.00030	<0.00030	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2131756-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2131756-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Copper (Cu)-Dissolved	MS-B	L2131756-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2131756-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2131756-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2131756-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2131756-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2131756-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Total	MS-B	L2131756-4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L2131756-4, -5, -6, -7, -8, -9
Matrix Spike	Copper (Cu)-Total	MS-B	L2131756-4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2131756-4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Total	MS-B	L2131756-4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L2131756-4, -5, -6, -7, -8, -9
Matrix Spike	Nitrate (as N)	MS-B	L2131756-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sulfate (SO4)	MS-B	L2131756-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sulfate (SO4)	MS-B	L2131756-1, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DTMF	Dissolved concentration exceeds total for field-filtered metals sample. Metallic contaminants may have been introduced to dissolved sample during field filtration.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-WR	Water	Nitrite & Nitrate Nitrogen	EPA 300.1
Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance.			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-WR	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Reference Information

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 µm), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-WR Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
----------------------------	---------------------

WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
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	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
--	---

Reference Information

VA

Chain of Custody Numbers:

2018-07-18 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com



L2131756-COFC

COC Number: 2018-07-18 A

Page 1 of 1

Report To		Report Format / Distribution		Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply																																																																																																																																																							
Company: Minto Explorations Ltd.		Select Report Format: ☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)		Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply																																																																																																																																																							
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W16				16-Jul-18		11:15		Water		7																																																																																																																																																	
W3				17-Jul-18		8:30		Water		7																																																																																																																																																	
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Are samples taken from a Regulated DW System? ☐ YES ☒ NO				Frozen ☐ SIF Observations Yes ☐ No ☐																																																																																																																																																							
Are samples for human drinking water use? ☐ YES ☒ NO				Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐																																																																																																																																																							
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Released by: Corey Roberts Date: 2018-07-18 Time:		Received by: [Signature] Date: July 18/18 Time: 14:50		Received by: HA Date: 7/19 Time: 2:25p																																																																																																																																																							

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 25-JUL-18
Report Date: 07-AUG-18 15:19 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2135817

Project P.O. #: 229096

Job Reference:

C of C Numbers: 2018-07-25 A 1 of 2, 2018-07-25 A 2 of 2

Legal Site Desc:

Shane Stack
Account Manager

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ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2135817-1 Water 18-JUL-18 15:50 W8A	L2135817-2 Water 23-JUL-18 10:05 C4	L2135817-3 Water 23-JUL-18 10:30 W46	L2135817-4 Water 23-JUL-18 11:00 W6	L2135817-5 Water 23-JUL-18 14:00 W8A
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	1100	311	412	245	1160
	Hardness (as CaCO3) (mg/L)	508	147	184	114	546
	pH (pH)	8.07	8.35	8.37	8.23	8.11
	Total Suspended Solids (mg/L)	80.9	3.7	3.1	38.5	144
	TDS (Calculated) (mg/L)	722	175	241	139	759
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	448	170	212	151	421
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	5.0	6.8	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	448	175	219	151	421
	Ammonia, Total (as N) (mg/L)	0.126	0.0113	0.0154	0.0073	0.159
	Chloride (Cl) (mg/L)	7.75	<0.50	2.46	<0.50	8.37
	Fluoride (F) (mg/L)	0.506	0.301	0.443	0.254	0.528
	Nitrate and Nitrite (as N) (mg/L)	4.07	0.0267	0.129	0.0085	5.32
	Nitrate (as N) (mg/L)	3.91	0.0267	0.129	0.0085	5.14
	Nitrite (as N) (mg/L)	0.155	<0.0010	<0.0010	<0.0010	0.186
	Sulfate (SO4) (mg/L)	205	10.3	30.3	2.17	235
	Anion Sum (meq/L)	13.8	3.73	5.10	3.08	13.9
	Cation Sum (meq/L)	12.0	3.29	4.24	2.53	12.9
	Cation - Anion Balance (%)	-7.0	-6.2	-9.2	-9.7	-4.0
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)		13.4	7.08	10.4	
Total Metals	Aluminum (Al)-Total (mg/L)	2.12	0.0263	0.0512	0.0670	0.480
	Antimony (Sb)-Total (mg/L)	0.00041	<0.00010	<0.00010	<0.00010	0.00022
	Arsenic (As)-Total (mg/L)	0.00205	0.00089	0.00050	0.00062	0.00091
	Barium (Ba)-Total (mg/L)	0.180	0.0702	0.0736	0.0578	0.143
	Beryllium (Be)-Total (mg/L)	0.000104	<0.000020	<0.000020	<0.000020	0.000037
	Bismuth (Bi)-Total (mg/L)	0.000085	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.028	<0.010	0.011	<0.010	0.028
	Cadmium (Cd)-Total (mg/L)	0.000261	<0.0000050	<0.0000050	0.0000051	0.000204
	Calcium (Ca)-Total (mg/L)	147	40.0	44.4	32.2	151
	Chromium (Cr)-Total (mg/L)	0.00302	0.00046	0.00027	0.00032	0.00112
	Cobalt (Co)-Total (mg/L)	0.00218	0.00026	<0.00010	0.00018	0.00113
	Copper (Cu)-Total (mg/L)	0.547	0.00123	0.00185	0.00134	0.194
	Iron (Fe)-Total (mg/L)	7.27	0.576	0.166	0.279	2.41
	Lead (Pb)-Total (mg/L)	0.00160	<0.000050	<0.000050	<0.000050	0.000502
	Lithium (Li)-Total (mg/L)	0.0047	0.0013	0.0017	<0.0010	0.0040
	Magnesium (Mg)-Total (mg/L)	39.5	11.9	16.8	8.55	41.0

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2135817-6 Water 23-JUL-18 14:45 W45	L2135817-7 Water 23-JUL-18 15:10 W16	L2135817-8 Water 24-JUL-18 08:40 W12	L2135817-9 Water 24-JUL-18 11:00 MC1	L2135817-10 Water 24-JUL-18 12:05 W3
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	3420	464	2660	394	580
	Hardness (as CaCO3) (mg/L)	1640	214	1210	183	261
	pH (pH)	8.09	8.41	8.16	8.43	8.44
	Total Suspended Solids (mg/L)	15.3	6.3	7.5	4.7	3.1
	TDS (Calculated) (mg/L)	2910	282	2100	232	347
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	147	185	229	206	280
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	7.0	<1.0	8.8	14.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	147	192	229	215	294
	Ammonia, Total (as N) (mg/L)	9.20	0.0411	4.44	<0.0050	<0.0050
	Chloride (Cl) (mg/L)	28.9	4.97	31.7	1.81	4.80
	Fluoride (F) (mg/L)	1.63	0.221	1.86	0.469	0.505
	Nitrate and Nitrite (as N) (mg/L)	22.2	1.73	10.7	0.102	0.112
	Nitrate (as N) (mg/L)	18.7	1.72	5.12	0.102	0.112
	Nitrite (as N) (mg/L)	3.51	0.0097	5.59	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	1860	64.6	1270	24.1	58.5
	Anion Sum (meq/L)	44.1	5.46	32.7	4.88	7.26
	Cation Sum (meq/L)	42.1	4.86	31.1	4.21	6.06
	Cation - Anion Balance (%)	-2.3	-5.9	-2.5	-7.3	-9.0
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	17.8	17.9	20.2	7.59	5.89
Total Metals	Aluminum (Al)-Total (mg/L)	0.226	0.0504	0.0802	0.139	0.0043
	Antimony (Sb)-Total (mg/L)	0.00052	<0.00010	0.00036	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	<0.00050 ^{DLA}	0.00048	0.00053	0.00062	0.00026
	Barium (Ba)-Total (mg/L)	0.0920	0.0764	0.0833	0.0726	0.0660
	Beryllium (Be)-Total (mg/L)	<0.00010 ^{DLA}	<0.000020	<0.000040 ^{DLA}	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.00025 ^{DLA}	<0.000050	<0.00010 ^{DLA}	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.483	0.014	0.297	<0.010	0.024
	Cadmium (Cd)-Total (mg/L)	0.000072	0.0000089	0.000080	0.0000052	<0.0000050
	Calcium (Ca)-Total (mg/L)	509	56.6	394	45.5	59.5
	Chromium (Cr)-Total (mg/L)	<0.00050 ^{DLA}	0.00021	<0.00020	0.00068	<0.00010
	Cobalt (Co)-Total (mg/L)	0.00065	0.00011	0.00118	0.00013	<0.00010
	Copper (Cu)-Total (mg/L)	0.0613	0.0342	0.0404	0.00226	0.00315
	Iron (Fe)-Total (mg/L)	0.442	0.147	0.224	0.272	0.015
	Lead (Pb)-Total (mg/L)	0.00029	<0.000050	0.00012	0.000061	<0.000050
	Lithium (Li)-Total (mg/L)	0.0238	0.0013	0.0197	0.0017	0.0032
	Magnesium (Mg)-Total (mg/L)	82.5	16.8	67.9	15.7	27.4

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2135817-11 Water 24-JUL-18 12:30 W17	L2135817-12 Water 24-JUL-18 DUP	L2135817-13 Water 24-JUL-18 10:00 W51	L2135817-14 Water 23-JUL-18 DUP	
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	509	585	2490	225	
	Hardness (as CaCO3) (mg/L)	228	261	1220	114	
	pH (pH)	8.36	8.44	8.17	8.20	
	Total Suspended Solids (mg/L)	5.9	<3.0	132	19.9	
	TDS (Calculated) (mg/L)	303	350	1970	121	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	224	283	187	122	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	6.4	14.6	<1.0	<1.0	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Total (as CaCO3) (mg/L)	231	298	187	122	
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	4.89	0.0085	
	Chloride (Cl) (mg/L)	5.66	4.79	17.8	<0.50	
	Fluoride (F) (mg/L)	0.355	0.512	1.40	0.253	
	Nitrate and Nitrite (as N) (mg/L)	0.214	0.114	17.6	0.0090	
	Nitrate (as N) (mg/L)	0.214	0.114	16.1	0.0090	
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	1.51	<0.0010	
	Sulfate (SO4) (mg/L)	61.0	58.5	1190	2.18	
	Anion Sum (meq/L)	6.07	7.34	30.4	2.49	
	Cation Sum (meq/L)	5.25	6.08	29.8	2.51	
	Cation - Anion Balance (%)	-7.3	-9.3	-1.1	0.4	
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	10.1	6.00		10.2	
Total Metals	Aluminum (Al)-Total (mg/L)	0.0032	0.0060	3.46	0.182	
	Antimony (Sb)-Total (mg/L)	0.00011	<0.00010	0.00084	<0.00010	
	Arsenic (As)-Total (mg/L)	0.00040	0.00028	0.00220	0.00065	
	Barium (Ba)-Total (mg/L)	0.0702	0.0681	0.132	0.0596	
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	0.000197	<0.000020	
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	0.00011	<0.000050	
	Boron (B)-Total (mg/L)	0.024	0.024	0.426	<0.010	
	Cadmium (Cd)-Total (mg/L)	<0.0000050	<0.0000050	0.000441	0.0000066	
	Calcium (Ca)-Total (mg/L)	61.7	58.8	364	33.2	
	Chromium (Cr)-Total (mg/L)	0.00015	0.00012	0.00292	0.00052	
	Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	0.00269	0.00021	
	Copper (Cu)-Total (mg/L)	0.00778	0.00333	0.644	0.00150	
	Iron (Fe)-Total (mg/L)	<0.010	0.015	6.02	0.381	
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	0.00450	0.000086	
	Lithium (Li)-Total (mg/L)	0.0015	0.0032	0.0194	<0.0010	
	Magnesium (Mg)-Total (mg/L)	18.1	28.8	84.5	8.89	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2135817-1 Water 18-JUL-18 15:50 W8A	L2135817-2 Water 23-JUL-18 10:05 C4	L2135817-3 Water 23-JUL-18 10:30 W46	L2135817-4 Water 23-JUL-18 11:00 W6	L2135817-5 Water 23-JUL-18 14:00 W8A
Grouping	Analyte					
WATER						
Total Metals	Manganese (Mn)-Total (mg/L)	1.94 ^{DLM}	0.130	0.0519	0.0667	2.02 ^{DLM}
	Mercury (Hg)-Total (mg/L)	<0.000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.00956	0.000615	0.00222	0.000491	0.0109
	Nickel (Ni)-Total (mg/L)	0.00382	0.00185	0.00091	0.00154	0.00182
	Phosphorus (P)-Total (mg/L)	0.305	<0.050	<0.050	<0.050	0.088
	Potassium (K)-Total (mg/L)	7.41	0.90	1.45	0.42	6.76
	Selenium (Se)-Total (mg/L)	0.00404	0.000084	0.000176	0.000088	0.00408
	Silicon (Si)-Total (mg/L)	11.1	6.29	5.67	7.33	7.84
	Silver (Ag)-Total (mg/L)	0.000217	<0.000010	<0.000010	<0.000010	0.000077
	Sodium (Na)-Total (mg/L)	31.6	6.55	10.2	4.61	34.3
	Strontium (Sr)-Total (mg/L)	1.81	0.245	0.473	0.142	2.04
	Sulfur (S)-Total (mg/L)	72.8	3.64	10.2	0.84	86.5
	Thallium (Tl)-Total (mg/L)	0.000025	<0.000010	<0.000010	<0.000010	0.000017
	Tin (Sn)-Total (mg/L)	0.00018	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	0.107	0.00124	0.00366	0.00261	0.0220
	Uranium (U)-Total (mg/L)	0.00261	0.000474	0.00183	0.000244	0.00283
	Vanadium (V)-Total (mg/L)	0.0110	0.00065	0.00105	0.00095	0.00376
	Zinc (Zn)-Total (mg/L)	0.789	<0.0030	<0.0030	<0.0030	0.321
	Zirconium (Zr)-Total (mg/L)	0.00101	<0.00030	<0.00030	<0.00030	0.00054
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0107	0.0075	0.0046	0.0109	0.0218
	Antimony (Sb)-Dissolved (mg/L)	0.00011	<0.00010	<0.00010	<0.00010	0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00067	0.00083	0.00048	0.00050	0.00061
	Barium (Ba)-Dissolved (mg/L)	0.118	0.0687	0.0765	0.0546	0.125
	Beryllium (Be)-Dissolved (mg/L)	0.000023	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.026	<0.010	0.010	<0.010	0.027
	Cadmium (Cd)-Dissolved (mg/L)	0.000159	<0.0000050	0.0000050	<0.0000050	0.000165
	Calcium (Ca)-Dissolved (mg/L)	138 ^{DLB}	39.3 ^{DLB}	44.2 ^{DLB}	31.8 ^{DLB}	149 ^{DLB}
	Chromium (Cr)-Dissolved (mg/L)	<0.00060	<0.00030	<0.00020	<0.00030	<0.00050
	Cobalt (Co)-Dissolved (mg/L)	0.00087	0.00022	<0.00010	0.00010	0.00079
	Copper (Cu)-Dissolved (mg/L)	0.0865	0.00125	0.00174	0.00114	0.0783
	Iron (Fe)-Dissolved (mg/L)	0.838	0.421	0.104	0.095	0.674
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0037	0.0012	0.0017	<0.0010	0.0038
	Magnesium (Mg)-Dissolved (mg/L)	39.6	11.9	17.9	8.50	42.1

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2135817-6 Water 23-JUL-18 14:45 W45	L2135817-7 Water 23-JUL-18 15:10 W16	L2135817-8 Water 24-JUL-18 08:40 W12	L2135817-9 Water 24-JUL-18 11:00 MC1	L2135817-10 Water 24-JUL-18 12:05 W3
Grouping	Analyte					
WATER						
Total Metals	Manganese (Mn)-Total (mg/L)	0.572	0.0476	1.06	0.0205	0.0317
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.0911	0.00269	0.0706	0.00207	0.00478
	Nickel (Ni)-Total (mg/L)	0.0082	0.00108	0.0056	0.00133	0.00089
	Phosphorus (P)-Total (mg/L)	<0.25 ^{DLA}	<0.050	<0.10 ^{DLA}	<0.050	<0.050
	Potassium (K)-Total (mg/L)	72.1	2.73	51.7	1.53	2.37
	Selenium (Se)-Total (mg/L)	0.00668	0.000846	0.00679	0.000153	0.000294
	Silicon (Si)-Total (mg/L)	4.19	3.43	4.48	6.40	5.92
	Silver (Ag)-Total (mg/L)	<0.000050 ^{DLA}	<0.000010	<0.000020 ^{DLA}	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	142	10.4	119	9.93	16.4
	Strontium (Sr)-Total (mg/L)	6.98	0.511	6.16	0.472	0.747
	Sulfur (S)-Total (mg/L)	669	23.5	500	8.73	21.2
	Thallium (Tl)-Total (mg/L)	<0.000050 ^{DLA}	<0.000010	<0.000020 ^{DLA}	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00050 ^{DLA}	<0.00010	<0.00020 ^{DLA}	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	0.0121	0.00291	0.00398	0.00616	<0.00030
	Uranium (U)-Total (mg/L)	0.00510	0.00124	0.00732	0.00202	0.00292
	Vanadium (V)-Total (mg/L)	<0.0025 ^{DLA}	0.00082	<0.0010 ^{DLA}	0.00141	0.00054
	Zinc (Zn)-Total (mg/L)	<0.015 ^{DLA}	<0.0030	<0.0060 ^{DLA}	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0156	0.0129	0.0096	0.0050	0.0019
	Antimony (Sb)-Dissolved (mg/L)	0.00051	<0.00010	0.00034	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00035	0.00046	0.00046	0.00055	0.00024
	Barium (Ba)-Dissolved (mg/L)	0.0852	0.0731	0.0751	0.0700	0.0655
	Beryllium (Be)-Dissolved (mg/L)	<0.000040 ^{DLA}	<0.000020	<0.000040 ^{DLA}	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.00010 ^{DLA}	<0.000050	<0.00010 ^{DLA}	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.461	0.016	0.285	0.010	0.023
	Cadmium (Cd)-Dissolved (mg/L)	<0.000050 ^{DLM}	0.0000110	<0.000070 ^{DLM}	<0.0000050	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	519	56.8	375	45.7	57.7
	Chromium (Cr)-Dissolved (mg/L)	<0.00020 ^{DLA}	<0.00020 ^{DLB}	<0.00020 ^{DLA}	<0.00020 ^{DLB}	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	0.00047	<0.00010	0.00087	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00752	0.0307	0.0218	0.00182	0.00310
	Iron (Fe)-Dissolved (mg/L)	<0.020 ^{DLA}	0.065	<0.020 ^{DLA}	0.057	0.010
	Lead (Pb)-Dissolved (mg/L)	<0.00010 ^{DLA}	<0.000050	<0.00010 ^{DLA}	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0247	0.0013	0.0197	0.0017	0.0032
	Magnesium (Mg)-Dissolved (mg/L)	84.0	17.4	65.7	16.8	28.4

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2135817-11 Water 24-JUL-18 12:30 W17	L2135817-12 Water 24-JUL-18 DUP	L2135817-13 Water 24-JUL-18 10:00 W51	L2135817-14 Water 23-JUL-18 DUP	
Grouping	Analyte					
WATER						
Total Metals	Manganese (Mn)-Total (mg/L)	0.00238	0.0323	0.547	0.0477	
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	0.0000064	<0.0000050	
	Molybdenum (Mo)-Total (mg/L)	0.00626	0.00478	0.0404	0.000532	
	Nickel (Ni)-Total (mg/L)	0.00060	0.00085	0.0046	0.00173	
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	0.12	<0.050	
	Potassium (K)-Total (mg/L)	3.94	2.42	23.6	0.45	
	Selenium (Se)-Total (mg/L)	0.000440	0.000279	0.00558	0.000086	
	Silicon (Si)-Total (mg/L)	5.40	6.02	12.2	7.49	
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	0.000356	<0.000010	
	Sodium (Na)-Total (mg/L)	12.9	17.5	106	4.84	
	Strontium (Sr)-Total (mg/L)	0.646	0.754	7.41	0.151	
	Sulfur (S)-Total (mg/L)	21.8	21.7	477	0.78	
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	0.000033	<0.000010	
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	0.00028	<0.00010	
	Titanium (Ti)-Total (mg/L)	<0.00030	<0.00030	0.110	0.00896	
	Uranium (U)-Total (mg/L)	0.00192	0.00290	0.0116	0.000253	
	Vanadium (V)-Total (mg/L)	0.00061	0.00053	0.0138	0.00127	
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	0.0530	<0.0030	
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	0.00087	<0.00030	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0018	0.0340 ^{DTMF}	0.0055	0.0070	
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	0.00077	<0.00010	
	Arsenic (As)-Dissolved (mg/L)	0.00042	0.00030	0.00091	0.00051	
	Barium (Ba)-Dissolved (mg/L)	0.0690	0.0648	0.0612	0.0536	
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000040 ^{DLA}	<0.000020	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.00010 ^{DLA}	<0.000050	
	Boron (B)-Dissolved (mg/L)	0.024	0.024	0.409	<0.010	
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050	0.000230	<0.0000050	
	Calcium (Ca)-Dissolved (mg/L)	61.8	58.8	355 ^{DLA}	32.0 ^{DLB}	
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00017	<0.00020	<0.00030	
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00012	0.00069	<0.00010	
	Copper (Cu)-Dissolved (mg/L)	0.00782	0.00376	0.0919 ^{DLA}	0.00127	
	Iron (Fe)-Dissolved (mg/L)	<0.010	0.203 ^{DTMF}	<0.020	0.079	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	0.000074	0.00022	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.0015	0.0033	0.0168	<0.0010	
	Magnesium (Mg)-Dissolved (mg/L)	18.0	27.8	79.9	8.23	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2135817-1 Water 18-JUL-18 15:50 W8A	L2135817-2 Water 23-JUL-18 10:05 C4	L2135817-3 Water 23-JUL-18 10:30 W46	L2135817-4 Water 23-JUL-18 11:00 W6	L2135817-5 Water 23-JUL-18 14:00 W8A
Grouping	Analyte					
WATER						
Dissolved Metals	Manganese (Mn)-Dissolved (mg/L)	1.77	0.119	0.0507	0.0283	1.81
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00950	0.000602	0.00226	0.000480	0.0106
	Nickel (Ni)-Dissolved (mg/L)	0.00149	0.00166	0.00085	0.00137	0.00125
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	6.00	0.89	1.50	0.46	6.17
	Selenium (Se)-Dissolved (mg/L)	0.00393	0.000095	0.000244	0.000082	0.00499
	Silicon (Si)-Dissolved (mg/L)	6.65	6.19	5.78	6.90	6.64
	Silver (Ag)-Dissolved (mg/L)	0.000018	<0.000010	<0.000010	<0.000010	0.000016
	Sodium (Na)-Dissolved (mg/L)	35.2	6.97	12.0	5.18	38.5
	Strontium (Sr)-Dissolved (mg/L)	1.85	0.256	0.498	0.141	1.95
	Sulfur (S)-Dissolved (mg/L)	69.1	3.90	10.6	0.96	80.4
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00066	0.00055	<0.00030	0.00059	0.00193
	Uranium (U)-Dissolved (mg/L)	0.00253	0.000473	0.00189	0.000236	0.00267
	Vanadium (V)-Dissolved (mg/L)	0.00122	<0.00050	0.00081	0.00053	0.00125
	Zinc (Zn)-Dissolved (mg/L)	0.295	<0.0010	<0.0010	<0.0010	0.238
	Zirconium (Zr)-Dissolved (mg/L)	0.00044	<0.00030	<0.00030	<0.00030	0.00042

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2135817-6 Water 23-JUL-18 14:45 W45	L2135817-7 Water 23-JUL-18 15:10 W16	L2135817-8 Water 24-JUL-18 08:40 W12	L2135817-9 Water 24-JUL-18 11:00 MC1	L2135817-10 Water 24-JUL-18 12:05 W3
Grouping	Analyte					
WATER						
Dissolved Metals	Manganese (Mn)-Dissolved (mg/L)	0.539	0.0259	0.852	0.00593	0.0296
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.0920	0.00282	0.0672	0.00200	0.00480
	Nickel (Ni)-Dissolved (mg/L)	0.0082	0.00100	0.0050	0.00092	0.00084
	Phosphorus (P)-Dissolved (mg/L)	<0.10 ^{DLA}	<0.050	<0.10 ^{DLA}	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	68.8	2.69	44.8	1.53	2.28
	Selenium (Se)-Dissolved (mg/L)	0.00733	0.000936	0.00691	0.000191	0.000332
	Silicon (Si)-Dissolved (mg/L)	3.84	3.22	4.00	6.05	5.51
	Silver (Ag)-Dissolved (mg/L)	<0.000020 ^{DLA}	<0.000010	<0.000020 ^{DLA}	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	158	11.8	126	11.8	18.1
	Strontium (Sr)-Dissolved (mg/L)	7.06	0.528	5.98	0.470	0.764
	Sulfur (S)-Dissolved (mg/L)	674	23.8	455	8.75	18.9
	Thallium (Tl)-Dissolved (mg/L)	<0.000020 ^{DLA}	<0.000010	<0.000020 ^{DLA}	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00020 ^{DLA}	<0.00010	<0.00020 ^{DLA}	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00060 ^{DLA}	0.00064	<0.00060 ^{DLA}	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00525	0.00125	0.00718	0.00202	0.00300
	Vanadium (V)-Dissolved (mg/L)	<0.0010 ^{DLA}	<0.00050	<0.0010 ^{DLA}	0.00079	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0020 ^{DLA}	<0.0010	0.0022	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2135817-11 Water 24-JUL-18 12:30 W17	L2135817-12 Water 24-JUL-18 DUP	L2135817-13 Water 24-JUL-18 10:00 W51	L2135817-14 Water 23-JUL-18 DUP	
Grouping	Analyte					
WATER						
Dissolved Metals	Manganese (Mn)-Dissolved (mg/L)	0.00255	0.0297	0.368	0.0259	
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Dissolved (mg/L)	0.00625	0.00475	0.0411	0.000548	
	Nickel (Ni)-Dissolved (mg/L)	0.00060	0.00094	0.0013	0.00134	
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.10 ^{DLA}	<0.050	
	Potassium (K)-Dissolved (mg/L)	3.52	2.30	23.2	0.45	
	Selenium (Se)-Dissolved (mg/L)	0.000507	0.000279	0.00551	0.000089	
	Silicon (Si)-Dissolved (mg/L)	5.02	5.65	5.51	6.73	
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000020 ^{DLA}	<0.000010	
	Sodium (Na)-Dissolved (mg/L)	13.8	18.1	104	4.99	
	Strontium (Sr)-Dissolved (mg/L)	0.637	0.741	7.44	0.145	
	Sulfur (S)-Dissolved (mg/L)	20.5	19.5	483	1.24	
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000020 ^{DLA}	<0.000010	
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00020 ^{DLA}	<0.00010	
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	0.00065	<0.00060 ^{DLA}	0.00046	
	Uranium (U)-Dissolved (mg/L)	0.00184	0.00289	0.0114 ^{DLA}	0.000234	
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.0010	<0.00050	
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	0.0013	0.0222	<0.0010	
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Chromium (Cr)-Dissolved	MB-LOR	L2135817-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Dissolved Organic Carbon	MS-B	L2135817-10, -11, -12, -14, -2, -3, -4, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2135817-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2135817-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2135817-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2135817-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2135817-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2135817-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Aluminum (Al)-Total	MS-B	L2135817-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Total	MS-B	L2135817-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L2135817-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Copper (Cu)-Total	MS-B	L2135817-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Iron (Fe)-Total	MS-B	L2135817-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2135817-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Total	MS-B	L2135817-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Potassium (K)-Total	MS-B	L2135817-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Silicon (Si)-Total	MS-B	L2135817-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Total	MS-B	L2135817-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L2135817-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sulfur (S)-Total	MS-B	L2135817-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Titanium (Ti)-Total	MS-B	L2135817-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Zinc (Zn)-Total	MS-B	L2135817-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLB	Detection Limit Raised. Analyte detected at comparable level in Method Blank.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DTMF	Dissolved concentration exceeds total for field-filtered metals sample. Metallic contaminants may have been introduced to dissolved sample during field filtration.
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-WR	Water	Nitrite & Nitrate Nitrogen	EPA 300.1

Reference Information

Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance.

BE-D-L-CCMS-VA Water Diss. Be (low) in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

BE-T-L-CCMS-VA Water Total Be (Low) in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

CARBONS-DOC-VA Water Dissolved organic carbon by combustion APHA 5310B

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.

CL-IC-N-WR Water Chloride in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

EC-PCT-VA Water Conductivity (Automated) APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-SCREEN-VA Water Conductivity Screen (Internal Use Only) APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

F-IC-N-WR Water Fluoride in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-WR Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

Reference Information

NO3-L-IC-N-WR	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
SO4-IC-WR	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)
This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".			
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.			
TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.			
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-07-25 A 1 of 2 2018-07-25 A 2 of 2

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com



L2135817-COFC

COC Number: 2018-07-25 A

Page 1 of 2

Report To Contact and company name below will appear on the final report		Report Format / Distribution			Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply														
Company:	Minto Explorations Ltd.	Select Report Format: ☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)			Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply														
Contact:	Minto Environment - Coordinator	Quality Control (QC) Report with Report ☒ YES ☐ NO			PRIORITY (Business Days) 4 day [P4] ☐ 3 day [P3] ☐ 2 day [P2] ☐				EMERGENCY 1 Business day [E1] ☐ Same Day, Weekend or Statutory holiday [E0] ☐										
Phone:	1-604-759-4659	☒ Compare Results to Criteria on Report - provide details below if box checked			Date and Time Required for all E&P TATs: dd-mm-yy hh:mm														
Company address below will appear on the final report		Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX			For tests that can not be performed according to the service level selected, you will be contacted.														
Street:	2100-510 West Georgia St.	Email 1 or Fax minto_environment@mintomine.com			Analysis Request														
City/Province:	Vancouver, British Columbia	Email 2			Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below														
Postal Code:	V6B 0M3	Email 3																	
Invoice To		Invoice Distribution																	
Same as Report To ☐ YES ☒ NO		Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX																	
Copy of Invoice with Report ☐ YES ☒ NO		Email 1 or Fax ap@mintomine.com																	
Company:	Minto Explorations Ltd.	Email 2																	
Contact:	Ruth Cayetano																		
Project Information		Oil and Gas Required Fields (client use)																	
ALS Account # / Quote #:		AFE/Cost Center:																	
Job #:		Major/Minor Code:																	
PO / AFE: 229096 (WUL)		Requisitioner:																	
LSD:		Location:																	
ALS Lab Work Order # (lab use only)		ALS Contact: Shane Stack			Sampler: CR/SMB														
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mm-yy)	Time (hh:mm)	Sample Type	pH / Conductivity / Alkalinity / Anions	Total Suspended Solids (TSS)	Total Dissolved Solids (TDS)	Total Metals (TM), Hardness	Dissolved Metals (DM) (filtered and preserved)	Total Mercury, Hardness	Dissolved Mercury [1] (Filtered + preserved)	Total Nutrients (Ammonia)	Dissolved Organic Carbon (DOC)	Number of Containers					
	W8A	18-Jul-18	15:50	Water	R	R	R	R	R	R	R	R	R			6			
	C4	23-Jul-18	10:05	Water	R	R	R	R	R	R	R	R	R			7			
	W46	23-Jul-18	10:30	Water	R	R	R	R	R	R	R	R	R			7			
	W6	23-Jul-18	11:00	Water	R	R	R	R	R	R	R	R	R			7			
	W8A	23-Jul-18	14:00	Water	R	R	R	R	R	R	R	R	R			6			
	W45	23-Jul-18	14:45	Water	R	R	R	R	R	R	R	R	R			7			
	W16	23-Jul-18	15:10	Water	R	R	R	R	R	R	R	R	R			7			
	W12	24-Jul-18	8:40	Water	R	R	R	R	R	R	R	R	R			7			
	MC1	24-Jul-18	11:00	Water	R	R	R	R	R	R	R	R	R			7			
	W3	24-Jul-18	12:05	Water	R	R	R	R	R	R	R	R	R			7			
Drinking Water (DW) Samples¹ (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)			SAMPLE CONDITION AS RECEIVED (lab use only)														
Are samples taken from a Regulated DW System? ☐ YES ☒ NO					Frozen ☐ SIF Observations Yes ☐ No ☐														
Are samples for human drinking water use? ☐ YES ☒ NO					Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐														
					Cooling Initiated ☐														
					INITIAL COOLER TEMPERATURES °C: 12/10 8 10 7														
					FINAL COOLER TEMPERATURES °C: 14/12 14 7 127														
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)														
Released by: Corey Roberts	Date: 2018-07-25	Time:	Received by: [Signature]	Date: July 25/18	Time: 14:12	Received by: HA	Date: 7/27	Time: 11:58											

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

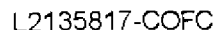
Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



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~~COC Number: 2018-07-25-A~~

Page 2 of 2

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1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

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OCTOBER 2015 FROM



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 01-AUG-18
Report Date: 13-AUG-18 12:15 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2139562
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-07-31 A
Legal Site Desc:

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2139562-1 Water 30-JUL-18 09:05 W16	L2139562-2 Water 30-JUL-18 10:10 W8A		
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)		452	1210		
	Hardness (as CaCO3) (mg/L)		226	641		
	pH (pH)		8.39	7.81		
	Total Suspended Solids (mg/L)		<3.0	32.2		
	TDS (Calculated) (mg/L)		269	826		
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)		157	428		
	Alkalinity, Carbonate (as CaCO3) (mg/L)		6.8	<1.0		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)		<1.0	<1.0		
	Alkalinity, Total (as CaCO3) (mg/L)		163	428		
	Ammonia, Total (as N) (mg/L)		0.0154	0.163		
	Chloride (Cl) (mg/L)		5.09	9.3		
	Nitrate and Nitrite (as N) (mg/L)		1.65	4.64		
	Nitrate (as N) (mg/L)		1.64	4.42		
	Nitrite (as N) (mg/L)		0.0109	0.219		
	Sulfate (SO4) (mg/L)		65.4	261		
	Anion Sum (meq/L)		4.89	14.6		
	Cation Sum (meq/L)		5.12	15.0		
	Cation - Anion Balance (%)		2.3	1.5		
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)		18.1	20.8		
Total Metals	Aluminum (Al)-Total (mg/L)		0.0825	0.116		
	Antimony (Sb)-Total (mg/L)		0.00011	0.00014		
	Arsenic (As)-Total (mg/L)		0.00051	0.00073		
	Barium (Ba)-Total (mg/L)		0.0737	0.135		
	Beryllium (Be)-Total (mg/L)		<0.000020	0.000020		
	Bismuth (Bi)-Total (mg/L)		<0.000050	<0.000050		
	Boron (B)-Total (mg/L)		0.014	0.028		
	Cadmium (Cd)-Total (mg/L)		0.0000091	0.000170		
	Calcium (Ca)-Total (mg/L)		59.3	170		
	Chromium (Cr)-Total (mg/L)		0.00023	0.00078		
	Cobalt (Co)-Total (mg/L)		0.00011	0.00091		
	Copper (Cu)-Total (mg/L)		0.0356	0.111		
	Iron (Fe)-Total (mg/L)		0.192	1.69		
	Lead (Pb)-Total (mg/L)		<0.000050	0.000125		
	Lithium (Li)-Total (mg/L)		0.0014	0.0040		
	Magnesium (Mg)-Total (mg/L)		18.7	48.6		
	Manganese (Mn)-Total (mg/L)		0.0426	2.11		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2139562-1 Water 30-JUL-18 09:05 W16	L2139562-2 Water 30-JUL-18 10:10 W8A		
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	0.0000075			
	Molybdenum (Mo)-Total (mg/L)	0.00292	0.0127			
	Nickel (Ni)-Total (mg/L)	0.00104	0.00165			
	Phosphorus (P)-Total (mg/L)	<0.050	0.065			
	Potassium (K)-Total (mg/L)	2.71	6.76			
	Selenium (Se)-Total (mg/L)	0.000806	0.00456			
	Silicon (Si)-Total (mg/L)	3.59	7.40			
	Silver (Ag)-Total (mg/L)	<0.000010	0.000033			
	Sodium (Na)-Total (mg/L)	11.8	42.6			
	Strontium (Sr)-Total (mg/L)	0.554	2.25			
	Sulfur (S)-Total (mg/L)	24.0	95.8			
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010			
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010			
	Titanium (Ti)-Total (mg/L)	0.00443	0.00590			
	Uranium (U)-Total (mg/L)	0.00136	0.00323			
	Vanadium (V)-Total (mg/L)	0.00085	0.00278			
	Zinc (Zn)-Total (mg/L)	<0.0030	0.264			
	Zirconium (Zr)-Total (mg/L)	<0.00030	0.00047			
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD			
	Dissolved Metals Filtration Location	FIELD	FIELD			
	Aluminum (Al)-Dissolved (mg/L)	0.0052	0.0383			
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	0.00011			
	Arsenic (As)-Dissolved (mg/L)	0.00046	0.00061			
	Barium (Ba)-Dissolved (mg/L)	0.0770	0.136			
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020			
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050			
	Boron (B)-Dissolved (mg/L)	0.014	0.030			
	Cadmium (Cd)-Dissolved (mg/L)	0.0000052	0.000193			
	Calcium (Ca)-Dissolved (mg/L)	59.9	176			
	Chromium (Cr)-Dissolved (mg/L)	0.00013	0.00049			
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00097			
	Copper (Cu)-Dissolved (mg/L)	0.0295	0.0680			
	Iron (Fe)-Dissolved (mg/L)	0.032	0.693			
	Lead (Pb)-Dissolved (mg/L)	<0.000050	0.000069			
	Lithium (Li)-Dissolved (mg/L)	0.0012	0.0040			
	Magnesium (Mg)-Dissolved (mg/L)	18.6	48.9			
	Manganese (Mn)-Dissolved (mg/L)	0.00278	2.24			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID				
		Description				
		Sampled Date				
		Sampled Time				
		Client ID				
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050			
	Molybdenum (Mo)-Dissolved (mg/L)	0.00281	0.0129			
	Nickel (Ni)-Dissolved (mg/L)	0.00094	0.00163			
	Phosphorus (P)-Dissolved (mg/L)	<0.050	0.061			
	Potassium (K)-Dissolved (mg/L)	2.73	7.03			
	Selenium (Se)-Dissolved (mg/L)	0.000847	0.00511			
	Silicon (Si)-Dissolved (mg/L)	3.22	7.32			
	Silver (Ag)-Dissolved (mg/L)	<0.000010	0.000014			
	Sodium (Na)-Dissolved (mg/L)	12.1	43.5			
	Strontium (Sr)-Dissolved (mg/L)	0.555	2.33			
	Sulfur (S)-Dissolved (mg/L)	21.4	95.4			
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010			
	Tin (Sn)-Dissolved (mg/L)	<0.00010	0.00036 ^{DTMF}			
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	0.00411			
	Uranium (U)-Dissolved (mg/L)	0.00132	0.00316			
	Vanadium (V)-Dissolved (mg/L)	<0.00050	0.00151			
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	0.319			
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	0.00046			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Dissolved Organic Carbon	MS-B	L2139562-1, -2
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2139562-1, -2
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2139562-1, -2
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2139562-1, -2
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2139562-1, -2
Matrix Spike	Calcium (Ca)-Total	MS-B	L2139562-1, -2
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2139562-1, -2
Matrix Spike	Sodium (Na)-Total	MS-B	L2139562-1, -2
Matrix Spike	Strontium (Sr)-Total	MS-B	L2139562-1, -2
Matrix Spike	Sulfur (S)-Total	MS-B	L2139562-1, -2

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DTMF	Dissolved concentration exceeds total for field-filtered metals sample. Metallic contaminants may have been introduced to dissolved sample during field filtration.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-WR	Water	Nitrite & Nitrate Nitrogen	EPA 300.1
Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance.			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-WR	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions)			

Reference Information

should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-WR Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-MAN-WR Water Total Suspended Solids by Gravimetric APHA 2540 D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids are determined by filtering a sample through a glass fibre filter and drying the filter at 104 degrees celsius.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-07-31 A

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lw - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

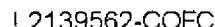
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Canada Toll Free: 1 800 668 9878

www.alsglobal.com



COC Number: 2018-07-31-A

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REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FROM



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 03-AUG-18
Report Date: 15-AUG-18 17:00 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2141004
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-08-02 A
Legal Site Desc:

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2141004-1 Water 31-JUL-18 08:20 UG4	L2141004-2 Water 31-JUL-18 09:20 W3	L2141004-3 Water 31-JUL-18 09:40 W17	L2141004-4 Water 31-JUL-18 10:45 MC1	L2141004-5 Water 31-JUL-18 DUP
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	1750	553	483	384	485
	Hardness (as CaCO3) (mg/L)	878	254	220	174	223
	pH (pH)	7.95	8.39	8.31	8.44	8.34
	Total Suspended Solids (mg/L)	1230	<3.0	<3.0	<3.0	<3.0
	TDS (Calculated) (mg/L)	1400	322	283	211	280
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	167	247	197	178	191
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	10.2	3.8	9.2	5.4
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	167	257	201	187	197
	Ammonia, Total (as N) (mg/L)	1.67	0.0055	<0.0050	0.0098	<0.0050
	Chloride (Cl) (mg/L)	20.6	4.72	5.63	1.83	5.63
	Nitrate and Nitrite (as N) (mg/L)	3.30	0.110	0.166	0.0996	0.166
	Nitrate (as N) (mg/L)	3.04	0.110	0.166	0.0996	0.166
	Nitrite (as N) (mg/L)	0.260	<0.0010	<0.0010	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	848	58.0	61.1	24.4	61.1
	Anion Sum (meq/L)	21.8	6.48	5.46	4.30	5.37
	Cation Sum (meq/L)	21.2	5.98	5.13	4.05	5.16
	Cation - Anion Balance (%)	-1.3	-4.0	-3.2	-3.1	-2.1
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)		5.90	9.90	7.00	10.0
Total Metals	Aluminum (Al)-Total (mg/L)	26.9	0.0075	<0.0030	0.0263	<0.0030
	Antimony (Sb)-Total (mg/L)	0.00032	<0.00010	0.00014	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00325	0.00026	0.00040	0.00054	0.00040
	Barium (Ba)-Total (mg/L)	0.531	0.0670	0.0674	0.0680	0.0670
	Beryllium (Be)-Total (mg/L)	0.000706	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	0.00172	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.213	0.025	0.024	<0.010	0.025
	Cadmium (Cd)-Total (mg/L)	0.00264	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Calcium (Ca)-Total (mg/L)	339	60.5	61.2	46.9	62.2
	Chromium (Cr)-Total (mg/L)	0.0109	0.00010	0.00013	0.00019	<0.00010
	Cobalt (Co)-Total (mg/L)	0.0183	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Total (mg/L)	18.1	0.00492	0.00770	0.00224	0.00805
	Iron (Fe)-Total (mg/L)	67.2	0.023	<0.010	0.107	<0.010
	Lead (Pb)-Total (mg/L)	0.0191	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	0.0231	0.0031	0.0016	0.0016	0.0015
	Magnesium (Mg)-Total (mg/L)	48.5	28.3	19.2	15.8	17.8
	Manganese (Mn)-Total (mg/L)	1.61	0.0317	0.00303	0.00877	0.00276

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2141004-1 Water 31-JUL-18 08:20 UG4	L2141004-2 Water 31-JUL-18 09:20 W3	L2141004-3 Water 31-JUL-18 09:40 W17	L2141004-4 Water 31-JUL-18 10:45 MC1	L2141004-5 Water 31-JUL-18 DUP
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.00025 ^{DLM}	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.0231	0.00511	0.00641	0.00213	0.00644
	Nickel (Ni)-Total (mg/L)	0.0091	0.00082	0.00074	0.00090	0.00060
	Phosphorus (P)-Total (mg/L)	1.16	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	18.2	2.33	3.60	1.47	3.65
	Selenium (Se)-Total (mg/L)	0.00937	0.000293	0.000521	0.000109	0.000401
	Silicon (Si)-Total (mg/L)	57.3	5.75	5.71	5.84	5.14
	Silver (Ag)-Total (mg/L)	0.00678	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	77.3	18.4	14.3	10.8	13.2
	Strontium (Sr)-Total (mg/L)	5.82	0.824	0.672	0.503	0.653
	Sulfur (S)-Total (mg/L)	312	19.7	23.0	7.66	20.8
	Thallium (Tl)-Total (mg/L)	0.000400	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	0.00279	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	2.08	<0.00060 ^{DLM}	<0.00030	<0.0012 ^{DLM}	<0.00030
	Uranium (U)-Total (mg/L)	0.00732	0.00294	0.00198	0.00206	0.00193
	Vanadium (V)-Total (mg/L)	0.103	0.00053	0.00054	0.00104	0.00064
	Zinc (Zn)-Total (mg/L)	0.367	<0.0030	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	0.00078	<0.00030	<0.00030	<0.00030	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0139	0.0021	0.0021	0.0053	0.0020
	Antimony (Sb)-Dissolved (mg/L)	0.00014	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00103	0.00023	0.00039	0.00053	0.00040
	Barium (Ba)-Dissolved (mg/L)	0.0326	0.0641	0.0691	0.0700	0.0699
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.183	0.022	0.022	<0.010	0.022
	Cadmium (Cd)-Dissolved (mg/L)	0.0000398	<0.0000050	0.0000054	<0.0000050	0.0000053
	Calcium (Ca)-Dissolved (mg/L)	293	54.6	57.9	42.1	58.8
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	0.00011	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	0.00027	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00496	0.00308	0.00755	0.00283	0.00756
	Iron (Fe)-Dissolved (mg/L)	<0.010	0.011	<0.010	0.061	<0.010
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0093	0.0029	0.0013	0.0014	0.0014
	Magnesium (Mg)-Dissolved (mg/L)	35.8	28.5	18.4	16.6	18.4
	Manganese (Mn)-Dissolved (mg/L)	0.0681	0.0303	0.00192	0.00570	0.00157

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2141004-1 Water 31-JUL-18 08:20 UG4	L2141004-2 Water 31-JUL-18 09:20 W3	L2141004-3 Water 31-JUL-18 09:40 W17	L2141004-4 Water 31-JUL-18 10:45 MC1	L2141004-5 Water 31-JUL-18 DUP
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.0231	0.00495	0.00643	0.00203	0.00632
	Nickel (Ni)-Dissolved (mg/L)	0.00109	0.00090	0.00061	0.00096	0.00060
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	6.51	2.30	3.76	1.55	3.59
	Selenium (Se)-Dissolved (mg/L)	0.00466	0.000314	0.000485	0.000178	0.000469
	Silicon (Si)-Dissolved (mg/L)	6.67	5.20	4.87	5.53	4.71
	Silver (Ag)-Dissolved (mg/L)	0.000014	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	78.6	19.6	14.5	12.2	14.1
	Strontium (Sr)-Dissolved (mg/L)	5.81	0.769	0.652	0.471	0.634
	Sulfur (S)-Dissolved (mg/L)	283	17.4	18.3	7.33	18.6
	Thallium (Tl)-Dissolved (mg/L)	0.000026	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00031 ^{DTMF}	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	0.00034	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00729	0.00310	0.00200	0.00212	0.00198
	Vanadium (V)-Dissolved (mg/L)	0.00057	<0.00050	<0.00050	0.00078	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0018	0.0014	<0.0010	0.0016	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Dissolved Organic Carbon	B	L2141004-2, -3, -4, -5
Method Blank	Barium (Ba)-Dissolved	B	L2141004-2
Method Blank	Barium (Ba)-Total	MB-LOR	L2141004-2, -4, -5
Matrix Spike	Dissolved Organic Carbon	MS-B	L2141004-2, -3, -4, -5
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2141004-1, -2, -3, -4, -5
Matrix Spike	Boron (B)-Dissolved	MS-B	L2141004-1, -2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2141004-1, -2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2141004-1, -2, -3, -4, -5
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2141004-1, -2, -3, -4, -5
Matrix Spike	Molybdenum (Mo)-Dissolved	MS-B	L2141004-1, -2, -3, -4, -5
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2141004-1, -2, -3, -4, -5
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2141004-1, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2141004-1, -2, -3, -4, -5
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2141004-1, -2, -3, -4, -5
Matrix Spike	Uranium (U)-Dissolved	MS-B	L2141004-1, -2, -3, -4, -5
Matrix Spike	Aluminum (Al)-Total	MS-B	L2141004-2, -4, -5
Matrix Spike	Barium (Ba)-Total	MS-B	L2141004-2, -4, -5
Matrix Spike	Barium (Ba)-Total	MS-B	L2141004-3
Matrix Spike	Calcium (Ca)-Total	MS-B	L2141004-2, -4, -5
Matrix Spike	Calcium (Ca)-Total	MS-B	L2141004-3
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2141004-2, -4, -5
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2141004-3
Matrix Spike	Sodium (Na)-Total	MS-B	L2141004-2, -4, -5
Matrix Spike	Sodium (Na)-Total	MS-B	L2141004-3
Matrix Spike	Strontium (Sr)-Total	MS-B	L2141004-2, -4, -5
Matrix Spike	Strontium (Sr)-Total	MS-B	L2141004-3
Matrix Spike	Sulfur (S)-Total	MS-B	L2141004-3

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DTMF	Dissolved concentration exceeds total for field-filtered metals sample. Metallic contaminants may have been introduced to dissolved sample during field filtration.
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-WR	Water	Nitrite & Nitrate Nitrogen	EPA 300.1
Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance.			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B

Reference Information

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.

CL-IC-N-WR Water Chloride in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

EC-PCT-VA Water Conductivity (Automated) APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-SCREEN-VA Water Conductivity Screen (Internal Use Only) APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 µm), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Weston et al.

NO2-L-IC-N-WR Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

Reference Information

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

**** ALS test methods may incorporate modifications from specified reference methods to improve performance.**

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-08-02 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2141004-COFC

COC Number: 2018-08-02 A

Page 1 of 1

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Report To						Report Format / Distribution							Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply												
Contact and company name below will appear on the final report Company: Minto Explorations Ltd. Contact: Minto Environment - Coordinator Phone: 1-804-759-4659 Company address below will appear on the final report Street: 2100-510 West Georgia St. City/Province: Vancouver, British Columbia Postal Code: V6B 0M3						Select Report Format: ☒ PDF ☐ EXCEL ☒ EDD (DIGITAL) Quality Control (QC) Report with Report ☒ YES ☐ NO ☒ Compare Results to Criteria on Report - provide details below if box checked Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX Email 1 or Fax minto_environment@mintomine.com Email 2 Email 3							Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply 4 day [P4] ☐ 3 day [P3] ☐ 2 day [P2] ☐ Date and Time Required for all E&P TATs: For tests that can not be performed according to the service level selected, you will be contacted.												
Invoice To Same as Report To ☐ YES ☒ NO Copy of Invoice with Report ☐ YES ☒ NO Company: Minto Explorations Ltd. Contact: Ruth Cayetano						Invoice Distribution Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX Email 1 or Fax ap@mintonline.com Email 2							Analysis Request Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below												
Project Information ALS Account # / Quote #: Job #: PO / AFE: 229096 (WUL) LSD:						Oil and Gas Required Fields (client use) AFE/Cost Center: PO# Major/Minor Code: Routing Code: Requisitioner: Location:																			
ALS Lab Work Order # (lab use only)						ALS Contact: Shane Stack Sampler: EB																			
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)					Date (dd-mm-yy)	Time (hh:mm)	Sample Type		pH / Conductivity / Alkalinity / Anions	Total Suspended Solids (TSS)	Total Dissolved Solids (TDS)	Total Metals (TM), Hardness	Dissolved Metals (DM) (Filtered and preserved)	Total Mercury, Hardness	Dissolved Mercury [M] (Filtered + preserved)	Total Nutrients (Ammonia)	Dissolved Organic Carbon (DOC)	Number of Containers						
	UG4					31-Jul-18	8:20	Water		R	R	R	R	R	R	R	R			6					
	W3					31-Jul-18	9:20	Water		R	R	R	R	R	R	R	R			7					
	W17					31-Jul-18	9:40	Water		R	R	R	R	R	R	R	R			7					
	MC1					31-Jul-18	10:45	Water		R	R	R	R	R	R	R	R			7					
	DUP					31-Jul-18		Water		R	R	R	R	R	R	R	R			7					
Drinking Water (DW) Samples¹ (client use)						Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)						SAMPLE CONDITION AS RECEIVED (lab use only)													
Are samples taken from a Regulated DW System? ☐ YES ☒ NO												Frozen ☐ SIF Observations Yes ☐ No ☐													
Are samples for human drinking water use? ☐ YES ☒ NO												Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐													
													Cooling Initiated ☐												
INITIAL COOLER TEMPERATURES °C													FINAL COOLER TEMPERATURES °C												
SHIPMENT RELEASE (client use)													INITIAL SHIPMENT RECEPTION (lab use only)												
Released by: Chris Harry Date: 2018-08-02 8:00 Time:						Received by: VO Date: Aug 3 2018 Time: 8:30						Received by: Date: Time:						FINAL SHIPMENT RECEPTION (lab use only)							

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2016 EDITION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 08-AUG-18
Report Date: 07-SEP-18 16:41 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2143384
Project P.O. #: NOT SUBMITTED
Job Reference:
C of C Numbers: 2018-08-08 A
Legal Site Desc:

Comments: Please note, the ALS Fort Collins Ra226 detailed analysis report can be found at the end of the attachment.

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2143384-1 Water 07-AUG-18 10:00 W3	L2143384-2 Water 07-AUG-18 10:30 W17	L2143384-3 Water 07-AUG-18 13:50 MC1	L2143384-4 Water 07-AUG-18 DUP	
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	525	459	350	350	
	Hardness (as CaCO3) (mg/L)	272	229	174	186	
	pH (pH)	8.29	8.17	8.29	8.31	
	Total Suspended Solids (mg/L)	<3.0	<3.0	15.0	13.7	
	TDS (Calculated) (mg/L)	318	279	201	206	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	242	193	178	176	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	1.2	3.8	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Total (as CaCO3) (mg/L)	242	193	180	179	
	Ammonia, Total (as N) (mg/L)	0.0059	0.0084	0.0102	0.0057	
	Chloride (Cl) (mg/L)	4.82	5.54	1.42	1.42	
	Nitrate and Nitrite (as N) (mg/L)	0.0958	0.134	0.0630	0.0637	
	Nitrate (as N) (mg/L)	0.0958	0.134	0.0630	0.0637	
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Sulfate (SO4) (mg/L)	56.7	60.0	20.7	20.6	
	Anion Sum (meq/L)	6.17	5.27	4.06	4.06	
	Cation Sum (meq/L)	6.31	5.26	3.96	4.25	
	Cation - Anion Balance (%)	1.1	0.0	-1.3	2.3	
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	6.13	9.88	8.23	8.19	
Total Metals	Aluminum (Al)-Total (mg/L)	0.0041	0.0033	0.433	0.371	
	Antimony (Sb)-Total (mg/L)	<0.00010	0.00010	0.00013	0.00011	
	Arsenic (As)-Total (mg/L)	0.00028	0.00040	0.00085	0.00086	
	Barium (Ba)-Total (mg/L)	0.0680	0.0691	0.0753	0.0744	
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	0.000021	0.000021	
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Total (mg/L)	0.025	0.024	<0.010	<0.010	
	Cadmium (Cd)-Total (mg/L)	0.0000057	<0.0000050	0.0000121	0.0000097	
	Calcium (Ca)-Total (mg/L)	60.4	61.7	45.2	44.8	
	Chromium (Cr)-Total (mg/L)	0.00012	0.00022	0.00095	0.00088	
	Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	0.00032	0.00029	
	Copper (Cu)-Total (mg/L)	0.00327	0.00815	0.00464	0.00298	
	Iron (Fe)-Total (mg/L)	<0.020 ^{DLB}	<0.010	0.791	0.694	
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	0.000228	0.000169	
	Lithium (Li)-Total (mg/L)	0.0032	0.0015	0.0019	0.0018	
	Magnesium (Mg)-Total (mg/L)	30.7	19.9	17.2	17.3	
	Manganese (Mn)-Total (mg/L)	0.0378	0.00493	0.0594	0.0581	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID	L2143384-1	L2143384-2	L2143384-3	L2143384-4	
		Description	Water	Water	Water	Water	
		Sampled Date	07-AUG-18	07-AUG-18	07-AUG-18	07-AUG-18	
		Sampled Time	10:00	10:30	13:50		
		Client ID	W3	W17	MC1	DUP	
Grouping	Analyte						
WATER							
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Total (mg/L)	0.00505	0.00642	0.00187	0.00188		
	Nickel (Ni)-Total (mg/L)	0.00103	0.00067	0.00179	0.00173		
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050		
	Potassium (K)-Total (mg/L)	2.44	3.66	1.48	1.46		
	Selenium (Se)-Total (mg/L)	0.000300	0.000507	0.000156	0.000174		
	Silicon (Si)-Total (mg/L)	6.15	5.49	7.14	6.92		
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010		
	Sodium (Na)-Total (mg/L)	20.0	14.7	11.2	11.3		
	Strontium (Sr)-Total (mg/L)	0.783	0.669	0.477	0.469		
	Sulfur (S)-Total (mg/L)	20.1	21.6	7.63	7.55		
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010		
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010		
	Titanium (Ti)-Total (mg/L)	<0.00030	<0.00030	0.0191	0.0161		
	Uranium (U)-Total (mg/L)	0.00286	0.00190	0.00189	0.00191		
	Vanadium (V)-Total (mg/L)	<0.00050	0.00050	0.00221	0.00206		
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	0.0034	<0.0030		
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030		
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD		
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD		
	Aluminum (Al)-Dissolved (mg/L)	0.0040	0.0022	0.0060	0.0067		
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	0.00011	<0.00010		
	Arsenic (As)-Dissolved (mg/L)	0.00024	0.00038	0.00054	0.00056		
	Barium (Ba)-Dissolved (mg/L)	0.0681	0.0697	0.0666	0.0732		
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020		
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050		
	Boron (B)-Dissolved (mg/L)	0.023	0.022	<0.010	<0.010		
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050		
	Calcium (Ca)-Dissolved (mg/L)	60.6	61.5	44.1	46.3		
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	0.00018	<0.00010		
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010		
	Copper (Cu)-Dissolved (mg/L)	0.00332	0.00784	0.00165	0.00185		
	Iron (Fe)-Dissolved (mg/L)	0.016	<0.010	0.067	0.072		
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050		
	Lithium (Li)-Dissolved (mg/L)	0.0031	0.0015	0.0016	0.0016		
	Magnesium (Mg)-Dissolved (mg/L)	29.2	18.4	15.5	17.0		
	Manganese (Mn)-Dissolved (mg/L)	0.0337	0.00391	0.0117	0.0130		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2143384-1 Water 07-AUG-18 10:00 W3	L2143384-2 Water 07-AUG-18 10:30 W17	L2143384-3 Water 07-AUG-18 13:50 MC1	L2143384-4 Water 07-AUG-18 DUP	
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Dissolved (mg/L)	0.00496	0.00640	0.00185	0.00189	
	Nickel (Ni)-Dissolved (mg/L)	0.00100	0.00061	0.00091	0.00104	
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Potassium (K)-Dissolved (mg/L)	2.43	3.50	1.34	1.48	
	Selenium (Se)-Dissolved (mg/L)	0.000298	0.000474	0.000177	0.000186	
	Silicon (Si)-Dissolved (mg/L)	5.76	5.14	5.73	6.04	
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Sodium (Na)-Dissolved (mg/L)	18.7	13.6	10.2	11.3	
	Strontium (Sr)-Dissolved (mg/L)	0.809	0.681	0.471	0.494	
	Sulfur (S)-Dissolved (mg/L)	18.3	19.5	6.39	6.89	
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	0.00036	0.00058	
	Uranium (U)-Dissolved (mg/L)	0.00291	0.00191	0.00184	0.00191	
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	0.00076	0.00080	
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	
Radiological Parameters	Ra-226 (Bq/L)	0.014				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Iron (Fe)-Total	MB-LOR	L2143384-1, -2, -3, -4
Method Blank	Manganese (Mn)-Total	MB-LOR	L2143384-1, -2, -3, -4
Matrix Spike	Dissolved Organic Carbon	MS-B	L2143384-2, -3, -4
Matrix Spike	Dissolved Organic Carbon	MS-B	L2143384-1
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2143384-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2143384-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2143384-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2143384-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2143384-1, -2, -3, -4

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLB	Detection Limit Raised. Analyte detected at comparable level in Method Blank.
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-WR	Water	Nitrite & Nitrate Nitrogen	EPA 300.1
Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance.			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-WR	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			

Reference Information

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-WR Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

RA226-MMER-FC Water Ra226 by Alpha Scint, MDC=0.01 Bq/L EPA 903.1

SO4-IC-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
FC	ALS ENVIRONMENTAL - FORT COLLINS, COLORADO, USA
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-08-08 A

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Thursday, September 06, 2018

Shane Stack
ALS Environmental
8081 Lougheed Hwy, Suite 100
Burnaby, BC V5A 1W9

Re: ALS Workorder: 1808254
Project Name:
Project Number: L2143384

Dear Mr. Stack:

One water sample was received from ALS Environmental, on 8/14/2018. The sample was scheduled for the following analysis:

Radium-226

The results for these analyses are contained in the enclosed reports.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, ALS certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

Thank you for your confidence in ALS Environmental. Should you have any questions, please call.

Sincerely,

ALS Environmental
Katie M. O'Brien
Project Manager

ALS Environmental – Fort Collins is accredited by the following accreditation bodies for various testing scopes in accordance with requirements of each accreditation body. All testing is performed under the laboratory management system, which is maintained to meet these requirement and regulations. Please contact the laboratory or accreditation body for the current scope testing parameters.

ALS Environmental – Fort Collins	
Accreditation Body	License or Certification Number
AIHA	214884
Alaska (AK)	UST-086
Arizona (AZ)	AZ0742
California (CA)	06251CA
Colorado (CO)	CO01099
Florida (FL)	E87914
Idaho (ID)	CO01099
Kansas (KS)	E-10381
Kentucky (KY)	90137
PJ-LA (DoD ELAP/ISO 170250)	95377
Maryland (MD)	285
Missouri (MO)	175
Nebraska(NE)	NE-OS-24-13
Nevada (NV)	CO000782008A
New York (NY)	12036
North Dakota (ND)	R-057
Oklahoma (OK)	1301
Pennsylvania (PA)	68-03116
Tennessee (TN)	2976
Texas (TX)	T104704241
Utah (UT)	CO01099
Washington (WA)	C1280



1808254

Radium-226:

The sample was prepared and analyzed according to the current revision of SOP 783.

All acceptance criteria were met.

ALS -- Fort Collins

Sample Number(s) Cross-Reference Table

OrderNum: 1808254

Client Name: ALS Environmental

Client Project Name:

Client Project Number: L2143384

Client PO Number: L2143384

Client Sample Number	Lab Sample Number	COC Number	Matrix	Date Collected	Time Collected
L2143384-1	1808254-1		WATER	07-Aug-18	

**L2143384**

VANCOUVER

1808254

Subcontract Request Form**Subcontract To:****ALS ENVIRONMENTAL - FORT COLLINS, COLORADO, USA**225 COMMERCE DRIVE
FORT COLLINS, CO 80524**NOTES:** Please reference on final report and invoice: PO# L2143384
ALS requires QC data to be provided with your final results.Please see enclosed **1** sample(s) in **1** Container(s)**SAMPLE
NUMBER****ANALYTICAL REQUIRED****DATE SAMPLED****DUE DATE****Priority
Flag**

L2143384-1 W3

8/7/2018

Ra226 by Alpha Scint, MDC=0.01 Bq/L (RA226-MMER-FC 1) 8/22/2018

Subcontract Info Contact:

Walter Lin (604) 253-4188

Analysis and reporting info contact:

Shane Stack

8081 LOUGHEED HWY

SUITE 100

BURNABY, BC V5A 1W9

Phone: (604) 253-4188

Email: Shane.Stack@alsglobal.com

Please email confirmation of receipt to:**Shane.Stack@alsglobal.com**

Shipped By: _____

Date Shipped: _____

Received By: C. JumbleDate Received: 8-14-18 0945

Verified By: _____

Date Verified: _____

Temperature: _____

Sample Integrity Issues: _____

NEW Reporting Contacts:
1. Account Manager Listed Below
2. ALSEVDataSubler@ALSGlobal.com (PDF / EXCEL)
3. ALSE.CASDG@ALSGlobal.com (EDD/Database Formats)



ALS Environmental - Fort Collins
CONDITION OF SAMPLE UPON RECEIPT FORM

Client: ALS Burnaby

Workorder No: 1808254

Project Manager: LMO

Initials: ABD

Date: 8/14/18

1	Are airbills / shipping documents present and/or removable?	DROP OFF	☒ YES	☐ NO
2	Are custody seals on shipping containers intact?	☒ NONE	☐ YES	☐ NO
3	Are custody seals on sample containers intact?	☒ NONE	☐ YES	☐ NO
4	Is there a COC (chain-of-custody) present?		☒ YES	☐ NO
5	Is the COC in agreement with samples received? (IDs, dates, times, # of samples, # of containers, matrix, requested analyses, etc.)		☒ YES	☐ NO
6	Are short-hold samples present?		☐ YES	☒ NO
7	Are all samples within holding times for the requested analyses?		☒ YES	☐ NO
8	Were all sample containers received intact? (not broken or leaking)		☒ YES	☐ NO
9	Is there sufficient sample for the requested analyses?		☒ YES	☐ NO
10	Are all samples in the proper containers for the requested analyses?		☒ YES	☐ NO
11	Are all aqueous samples preserved correctly, if required? (excluding volatiles)	☒ N/A	☐ YES	☐ NO
12	Are all aqueous non-preserved samples pH 4-9?	☒ N/A	☒ YES	☐ NO
13	Are all samples requiring no headspace (VOC, GRO, RSK/MEE, Rx CN/S, radon) free of bubbles > 6 mm (1/4 inch) diameter? (i.e. size of green pea)	☒ N/A	☐ YES	☐ NO
14	Were the samples shipped on ice?		☒ YES	☐ NO
15	Were cooler temperatures measured at 0.1-6.0°C?	IR gun used*: #1 #3 #4	☒ RAD ONLY	☐ YES ☐ NO
Cooler #: <u>1</u>				
Temperature (°C): <u>11</u>				
No. of custody seals on cooler: <u>0</u>				
DOT Survey Acceptance Information	External µR/hr reading: <u>10</u>			
	Background µR/hr reading: <u>10</u>			
Were external µR/hr readings ≤ two times background and within DOT acceptance criteria? YES / NO / NA (If no, see Form 008.)				

Additional Information: Please provide details here for any NO responses to gray-shaded boxes above, or any other issues noted:

If applicable, was the client contacted? YES / NO / NA Contact: _____ Date/Time: _____

Project Manager Signature / Date: [Signature] 8/15/18

SHIP DATE: 13AUG18
ACTWTGT: 20.00 LB MAN
CAD: 0347419/CAFE3210

BILL SENDER

ORIGIN ID: YBYA (604) 253-4188
HARJIT GILL
AL'S ENVIRONMENTAL LAB GROUP
LOUGHEED HIGHWAY

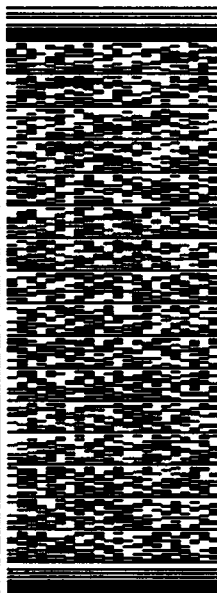
BURNABY, BC V5A1W9
CANADA CA

ALS ENVIRONMENTAL
225 COMMERCE DRIVE

FORT COLLINS CO 80524
(970) 490-1511

REF: SUBLETS

DEPT. SUPPLY ET

FedEx.
Express

10:30A

INTL PRIORITY

TRK# 4432 4287 7009

0430

80524
DEN
CO-US

XHETCA



After printing this label:

CONSIGNEE COPY - PLEASE PLACE IN FRONT OF POUCH

1. Fold the printed page along the horizontal line.
2. Place label in shipping pouch and affix it to your shipment.

[illegible]

Client: ALS Environmental

Date: 06-Sep-18

Project: L2143384

Work Order: 1808254

Sample ID: L2143384-1

Lab ID: 1808254-1

Legal Location:

Matrix: WATER

Collection Date: 8/7/2018

Percent Moisture:

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Radium-226 by Radon Emanation - Method 903.1			SOP 783		Prep Date: 8/27/2018	PrepBy: CXW
Ra-226	0.014 (+/- 0.0072)		0.0061	BQ/l	NA	9/4/2018 12:39
Carr: <i>BARIUM</i>	97		40-110	%REC	DL = NA	9/4/2018 12:39

Client: ALS Environmental

Date: 06-Sep-18

Project: L2143384

Work Order: 1808254

Sample ID: L2143384-1

Lab ID: 1808254-1

Legal Location:

Matrix: WATER

Collection Date: 8/7/2018

Percent Moisture:

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
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Explanation of Qualifiers**Radiochemistry:**

- "Report Limit" is the MDC

U or ND - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.

Y2 - Chemical Yield outside default limits.

W - DER is greater than Warning Limit of 1.42

* - Aliquot Basis is 'As Received' while the Report Basis is 'Dry Weight'.

- Aliquot Basis is 'Dry Weight' while the Report Basis is 'As Received'.

G - Sample density differs by more than 15% of LCS density.

D - DER is greater than Control Limit

M - Requested MDC not met.

LT - Result is less than requested MDC but greater than achieved MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

L - LCS Recovery below lower control limit.

H - LCS Recovery above upper control limit.

P - LCS, Matrix Spike Recovery within control limits.

N - Matrix Spike Recovery outside control limits

NC - Not Calculated for duplicate results less than 5 times MDC

B - Analyte concentration greater than MDC.

B3 - Analyte concentration greater than MDC but less than Requested MDC.

Inorganics:

B - Result is less than the requested reporting limit but greater than the instrument method detection limit (MDL).

U or ND - Indicates that the compound was analyzed for but not detected.

E - The reported value is estimated because of the presence of interference. An explanatory note may be included in the narrative.

M - Duplicate injection precision was not met.

N - Spiked sample recovery not within control limits. A post spike is analyzed for all ICP analyses when the matrix spike and or spike duplicate fail and the native sample concentration is less than four times the spike added concentration.

Z - Spiked recovery not within control limits. An explanatory note may be included in the narrative.

* - Duplicate analysis (relative percent difference) not within control limits.

S - SAR value is estimated as one or more analytes used in the calculation were not detected above the detection limit.

Organics:

U or ND - Indicates that the compound was analyzed for but not detected.

B - Analyte is detected in the associated method blank as well as in the sample. It indicates probable blank contamination and warns the data user.

E - Analyte concentration exceeds the upper level of the calibration range.

J - Estimated value. The result is less than the reporting limit but greater than the instrument method detection limit (MDL).

A - A tentatively identified compound is a suspected aldol-condensation product.

X - The analyte was diluted below an accurate quantitation level.

* - The spike recovery is equal to or outside the control criteria used.

+ - The relative percent difference (RPD) equals or exceeds the control criteria.

G - A pattern resembling gasoline was detected in this sample.

D - A pattern resembling diesel was detected in this sample.

M - A pattern resembling motor oil was detected in this sample.

C - A pattern resembling crude oil was detected in this sample.

4 - A pattern resembling JP-4 was detected in this sample.

5 - A pattern resembling JP-5 was detected in this sample.

H - Indicates that the fuel pattern was in the heavier end of the retention time window for the analyte of interest.

L - Indicates that the fuel pattern was in the lighter end of the retention time window for the analyte of interest.

Z - This flag indicates that a significant fraction of the reported result did not resemble the patterns of any of the following petroleum hydrocarbon products:

- gasoline

- JP-8

- diesel

- mineral spirits

- motor oil

- Stoddard solvent

- bunker C

ALS -- Fort Collins

Date: 9/6/2018 9:22:3

Client: ALS Environmental

QC BATCH REPORT

Work Order: 1808254

Project: L2143384

Batch ID: RE180827-1-1

Instrument ID Alpha Scin

Method: Radium-226 by Radon Emanation

LCS	Sample ID: RE180827-1				Units: BQ/I		Analysis Date: 9/5/2018 12:42				
Client ID:	Run ID: RE180827-1A				Prep Date: 8/27/2018			DF: NA			
Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	DER Ref	DER	DER Limit	Qual
Ra-226	1.81 (+/- 0.454)	0.0111	1.771		102	67-120					P,M3
Carr: BARIUM	15800		16150		98	40-110					

LCSD	Sample ID: RE180827-1				Units: BQ/I		Analysis Date: 9/5/2018 12:42				
Client ID:	Run ID: RE180827-1A				Prep Date: 8/27/2018			DF: NA			
Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	DER Ref	DER	DER Limit	Qual
Ra-226	1.49 (+/- 0.374)	0.0142	1.771		84.1	67-120		1.81	0.5	2.1	P,Y1,M3
Carr: BARIUM	16700		16150		103	40-110		15800			Y1

MB	Sample ID: RE180827-1				Units: BQ/I		Analysis Date: 9/5/2018 12:42				
Client ID:		Run ID: RE180827-1A				Prep Date: 8/27/2018			DF: NA		
Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	DER Ref	DER	DER Limit	Qual
Ra-226	-0.0010 (+/- 0.0025)	0.0062									U
Carr: BARIUM	16000		16150		99.2	40-110					

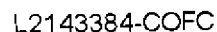
The following samples were analyzed in this batch:

1808254-1



Canada Toll Free: 1 800 668 9878

www.alsqglobal.com



COC Number: 2018 - 08 - 08 A

Page 1 of 1

REFER TO BACK PAGE FOR ALL LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

WHITE - LABORATORY COPY

YELLOW - CLIENT COPY

OCTOBER 2015 (CONT.)



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 09-AUG-18
Report Date: 20-AUG-18 15:54 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2144122
Project P.O. #: 228617
Job Reference:
C of C Numbers: 2018-08-07 C
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2144122-1 Water 06-AUG-18 07:30 W15	L2144122-2 Water 06-AUG-18 09:05 W8A	L2144122-3 Water 06-AUG-18 09:40 W16	L2144122-4 Water 06-AUG-18 10:40 W10	L2144122-5 Water 06-AUG-18 16:15 W12
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	760	1160	445	433	2570
	Hardness (as CaCO3) (mg/L)	420	623	221	217	1310
	pH (pH)	8.40	8.10	8.40	8.17	8.17
	Total Suspended Solids (mg/L)	11.6	121	3.4	13.4	12.2
	TDS (Calculated) (mg/L)	514	812	272	260	2240
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	258	418	164	220	186
	Alkalinity, Carbonate (as CaCO3) (mg/L)	12.8	<1.0	6.6	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	271	418	171	220	186
	Ammonia, Total (as N) (mg/L)	0.0237	0.149	0.0094	0.0704	4.74
	Chloride (Cl) (mg/L)	2.66	9.3	5.13	<0.50	32.0
	Nitrate and Nitrite (as N) (mg/L)	5.09	4.52	1.54	6.52	11.0
	Nitrate (as N) (mg/L)	5.05	4.32	1.53	6.49	5.60
	Nitrite (as N) (mg/L)	0.0350	0.201	0.0111	0.0220	5.36
	Sulfate (SO4) (mg/L)	161	260	66.3	9.10	1390
	Anion Sum (meq/L)	9.20	14.3	5.05	5.06	34.3
	Cation Sum (meq/L)	9.15	14.6	5.02	4.87	33.8
	Cation - Anion Balance (%)	-0.3	1.0	-0.3	-1.9	-0.7
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	16.5		17.3		
Total Metals	Aluminum (Al)-Total (mg/L)	0.0831	0.787	0.0232	0.0442	0.0704
	Antimony (Sb)-Total (mg/L)	0.00014	0.00025	0.00012	<0.00010	0.00038
	Arsenic (As)-Total (mg/L)	0.00056	0.00117	0.00047	0.00040	0.00046
	Barium (Ba)-Total (mg/L)	0.106	0.152	0.0723	0.256	0.0762
	Beryllium (Be)-Total (mg/L)	<0.000020	0.000054	<0.000020	<0.000020	<0.000040 ^{DLA}
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.00010 ^{DLA}
	Boron (B)-Total (mg/L)	<0.010	0.029	0.014	0.013	0.303 ^{DLM}
	Cadmium (Cd)-Total (mg/L)	0.0000122	0.000224	0.0000060	<0.0000050	<0.000070
	Calcium (Ca)-Total (mg/L)	114	175	59.5	63.3	402 ^{DLA}
	Chromium (Cr)-Total (mg/L)	0.00025	0.00170	0.00022	0.00016	<0.00020
	Cobalt (Co)-Total (mg/L)	0.00016	0.00133	<0.00010	0.00038	0.00084
	Copper (Cu)-Total (mg/L)	0.0413	0.291	0.0299	0.00472	0.0292
	Iron (Fe)-Total (mg/L)	0.345	3.91	0.086	1.34	0.173
	Lead (Pb)-Total (mg/L)	0.000321	0.000570	<0.000050	<0.000050	0.00011
	Lithium (Li)-Total (mg/L)	0.0012	0.0043	0.0013	<0.0010	0.0198
	Magnesium (Mg)-Total (mg/L)	32.7	48.0	17.9	14.7	70.5
	Manganese (Mn)-Total (mg/L)	0.0656	2.25	0.0237	0.287	0.819

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2144122-6 Water 06-AUG-18 11:20 W30	L2144122-7 Water 06-AUG-18 14:10 W62	L2144122-8 Water 06-AUG-18 15:55 W45		
Grouping	Analyte						
WATER							
Physical Tests	Conductivity (uS/cm)		389	1050	2960		
	Hardness (as CaCO3) (mg/L)		181	569	1610		
	pH (pH)		8.31	8.40	8.04		
	Total Suspended Solids (mg/L)		5.2	16.0	32.2		
	TDS (Calculated) (mg/L)		240	724	2730		
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)		116	339	119		
	Alkalinity, Carbonate (as CaCO3) (mg/L)		3.0	16.6	<1.0		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)		<1.0	<1.0	<1.0		
	Alkalinity, Total (as CaCO3) (mg/L)		119	356	119		
	Ammonia, Total (as N) (mg/L)		0.0070	0.0084	6.62		
	Chloride (Cl) (mg/L)		1.13	23.6	28.5		
	Nitrate and Nitrite (as N) (mg/L)		<0.0051	7.61	15.9		
	Nitrate (as N) (mg/L)		<0.0050	7.57	12.4		
	Nitrite (as N) (mg/L)		<0.0010	0.0427	3.45		
	Sulfate (SO4) (mg/L)		91.9	219	1750		
	Anion Sum (meq/L)		4.31	12.9	40.7		
	Cation Sum (meq/L)		4.29	12.8	40.9		
	Cation - Anion Balance (%)		-0.3	-0.4	0.2		
	Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)					
Total Metals	Aluminum (Al)-Total (mg/L)		0.0924	0.215	0.315 ^{DLA}		
	Antimony (Sb)-Total (mg/L)		0.00012	0.00016	<0.00050 ^{DLA}		
	Arsenic (As)-Total (mg/L)		0.00102	0.00070	<0.00050 ^{DLA}		
	Barium (Ba)-Total (mg/L)		0.0544	0.108	0.0837 ^{DLA}		
	Beryllium (Be)-Total (mg/L)		<0.000020	<0.000020	<0.00010 ^{DLA}		
	Bismuth (Bi)-Total (mg/L)		<0.000050	<0.000050	<0.00025 ^{DLA}		
	Boron (B)-Total (mg/L)		0.017	0.025	0.400		
	Cadmium (Cd)-Total (mg/L)		0.0000081	0.0000344	0.000063		
	Calcium (Ca)-Total (mg/L)		37.4	151	471 ^{DLA}		
	Chromium (Cr)-Total (mg/L)		0.00012	0.00055	<0.00050		
	Cobalt (Co)-Total (mg/L)		<0.00010	0.00032	0.00060		
	Copper (Cu)-Total (mg/L)		0.0232	0.0886	0.0221		
	Iron (Fe)-Total (mg/L)		0.269	0.416	0.695 ^{DLA}		
	Lead (Pb)-Total (mg/L)		<0.000050	0.000202	<0.00025 ^{DLA}		
	Lithium (Li)-Total (mg/L)		0.0026	0.0035	0.0234		
	Magnesium (Mg)-Total (mg/L)		20.5	40.7	83.1		
	Manganese (Mn)-Total (mg/L)		0.0333	0.0587	0.504		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2144122-1 Water 06-AUG-18 07:30 W15	L2144122-2 Water 06-AUG-18 09:05 W8A	L2144122-3 Water 06-AUG-18 09:40 W16	L2144122-4 Water 06-AUG-18 10:40 W10	L2144122-5 Water 06-AUG-18 16:15 W12
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	0.0000085	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.00315	0.0126	0.00298	0.000600	0.0755
	Nickel (Ni)-Total (mg/L)	0.00092	0.00228	0.00092	0.00078	0.0058
	Phosphorus (P)-Total (mg/L)	<0.050	0.180	<0.050	0.065	<0.10 ^{DLA}
	Potassium (K)-Total (mg/L)	3.00	6.81	2.62	1.45	48.9
	Selenium (Se)-Total (mg/L)	0.00144	0.00492	0.000787	0.000092	0.00647
	Silicon (Si)-Total (mg/L)	3.23	8.77	3.34	2.06	4.31
	Silver (Ag)-Total (mg/L)	0.000011	0.000100	<0.000010	<0.000010	<0.000020 ^{DLA}
	Sodium (Na)-Total (mg/L)	15.2	42.9	11.8	10.3	130
	Strontium (Sr)-Total (mg/L)	1.06	2.30	0.560	0.438	6.42
	Sulfur (S)-Total (mg/L)	60.6	100	24.1	3.56	519
	Thallium (Tl)-Total (mg/L)	<0.000010	0.000013	<0.000010	<0.000010	<0.000020 ^{DLA}
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020 ^{DLA}
	Titanium (Ti)-Total (mg/L)	0.00382	0.0479	0.00131	0.00191	<0.0036 ^{DLM}
	Uranium (U)-Total (mg/L)	0.00339	0.00329	0.00136	0.000289	0.00679
	Vanadium (V)-Total (mg/L)	0.00084	0.00615	0.00051	0.00053	<0.0010 ^{DLA}
	Zinc (Zn)-Total (mg/L)	<0.0030	0.538	<0.0030	<0.0030	<0.0060 ^{DLA}
	Zirconium (Zr)-Total (mg/L)	<0.00030	0.00051	<0.00030	<0.00030	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0089	0.0144	0.0041	0.0079	0.0081
	Antimony (Sb)-Dissolved (mg/L)	0.00011	<0.00010	<0.00010	<0.00010	0.00039
	Arsenic (As)-Dissolved (mg/L)	0.00055	0.00051	0.00048	0.00037	0.00044
	Barium (Ba)-Dissolved (mg/L)	0.108	0.132	0.0748	0.254	0.0771
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	0.000024	<0.000020	<0.000020	<0.000040 ^{DLA}
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.00010 ^{DLA}
	Boron (B)-Dissolved (mg/L)	<0.010	0.030	0.015	0.014	0.305
	Cadmium (Cd)-Dissolved (mg/L)	0.0000056	0.000181	0.0000068	<0.0000050	<0.000060 ^{DLM}
	Calcium (Ca)-Dissolved (mg/L)	114	171	59.0	62.4	403
	Chromium (Cr)-Dissolved (mg/L)	0.00016	0.00046	0.00012	0.00012	<0.00020 ^{DLA}
	Cobalt (Co)-Dissolved (mg/L)	0.00011	0.00080	<0.00010	0.00031	0.00081
	Copper (Cu)-Dissolved (mg/L)	0.0257	0.0627	0.0275	0.00328	0.0168
	Iron (Fe)-Dissolved (mg/L)	0.136	0.526	0.016	0.512	<0.020 ^{DLA}
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.00010 ^{DLA}
	Lithium (Li)-Dissolved (mg/L)	0.0012	0.0041	0.0013	<0.0010	0.0215
	Magnesium (Mg)-Dissolved (mg/L)	32.7	47.3	18.0	14.9	73.7
	Manganese (Mn)-Dissolved (mg/L)	0.0570	2.15	0.00179	0.238	0.829

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2144122-6 Water 06-AUG-18 11:20 W30	L2144122-7 Water 06-AUG-18 14:10 W62	L2144122-8 Water 06-AUG-18 15:55 W45		
Grouping	Analyte						
WATER							
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050			
	Molybdenum (Mo)-Total (mg/L)	0.00484	0.00998	0.0884			
	Nickel (Ni)-Total (mg/L)	0.00052	0.00158	0.0076			
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.25 ^{DLA}			
	Potassium (K)-Total (mg/L)	3.09	5.82	63.1			
	Selenium (Se)-Total (mg/L)	0.000970	0.00314	0.00659			
	Silicon (Si)-Total (mg/L)	3.44	7.27	4.21			
	Silver (Ag)-Total (mg/L)	<0.000010	0.000014	<0.000050 ^{DLA}			
	Sodium (Na)-Total (mg/L)	12.9	27.1	142			
	Strontium (Sr)-Total (mg/L)	0.592	1.71	7.19			
	Sulfur (S)-Total (mg/L)	32.9	80.1	634			
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000050 ^{DLA}			
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00050 ^{DLA}			
	Titanium (Ti)-Total (mg/L)	0.00477	0.00909	0.0145			
	Uranium (U)-Total (mg/L)	0.000574	0.00480	0.00495			
	Vanadium (V)-Total (mg/L)	0.00074	0.00150	<0.0025 ^{DLA}			
	Zinc (Zn)-Total (mg/L)	<0.0030	0.0340	<0.015 ^{DLA}			
	Zirconium (Zr)-Total (mg/L)	<0.00030	0.00031	<0.00030			
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD			
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD			
	Aluminum (Al)-Dissolved (mg/L)	0.0081	0.0062	0.0098			
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	0.00011	0.00046			
	Arsenic (As)-Dissolved (mg/L)	0.00106	0.00060	0.00037			
	Barium (Ba)-Dissolved (mg/L)	0.0564	0.110	0.0830			
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000040 ^{DLA}			
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.00010 ^{DLA}			
	Boron (B)-Dissolved (mg/L)	0.016	0.025	0.413 ^{DLM}			
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	0.0000344	<0.000060			
	Calcium (Ca)-Dissolved (mg/L)	37.3	158	501			
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00021	<0.00020 ^{DLA}			
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00016	0.00043			
	Copper (Cu)-Dissolved (mg/L)	0.0189	0.0711	0.00489			
	Iron (Fe)-Dissolved (mg/L)	0.165	0.057	<0.020 ^{DLA}			
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.00010 ^{DLA}			
	Lithium (Li)-Dissolved (mg/L)	0.0027	0.0036	0.0259			
	Magnesium (Mg)-Dissolved (mg/L)	21.3	42.5	86.9			
	Manganese (Mn)-Dissolved (mg/L)	0.0295	0.0536	0.539			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2144122-1 Water 06-AUG-18 07:30 W15	L2144122-2 Water 06-AUG-18 09:05 W8A	L2144122-3 Water 06-AUG-18 09:40 W16	L2144122-4 Water 06-AUG-18 10:40 W10	L2144122-5 Water 06-AUG-18 16:15 W12
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00316	0.0131	0.00289	0.000617	0.0770
	Nickel (Ni)-Dissolved (mg/L)	0.00085	0.00152	0.00092	0.00066	0.0058
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.10 ^{DLA}
	Potassium (K)-Dissolved (mg/L)	3.04	6.71	2.65	1.47	50.9
	Selenium (Se)-Dissolved (mg/L)	0.00152	0.00562	0.000831	0.000076	0.00724
	Silicon (Si)-Dissolved (mg/L)	3.05	7.32	3.32	1.92	4.37
	Silver (Ag)-Dissolved (mg/L)	<0.000010	0.000012	<0.000010	<0.000010	<0.000020 ^{DLA}
	Sodium (Na)-Dissolved (mg/L)	15.5	43.4	12.0	10.4	137
	Strontium (Sr)-Dissolved (mg/L)	1.02	2.21	0.540	0.413	6.42
	Sulfur (S)-Dissolved (mg/L)	56.2	97.4	23.4	3.31	536
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020 ^{DLA}
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020 ^{DLA}
	Titanium (Ti)-Dissolved (mg/L)	0.00057	0.00079	<0.00030	<0.00030	<0.00060 ^{DLA}
	Uranium (U)-Dissolved (mg/L)	0.00339	0.00313	0.00137	0.000291	0.00702
	Vanadium (V)-Dissolved (mg/L)	<0.00050	0.00134 ^{DTC}	<0.00050	<0.00050	<0.0010 ^{DLA}
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	0.768	<0.0010	<0.0010	0.0041
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	0.00046	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2144122-6 Water 06-AUG-18 11:20 W30	L2144122-7 Water 06-AUG-18 14:10 W62	L2144122-8 Water 06-AUG-18 15:55 W45		
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Dissolved (mg/L)	0.00489	0.0106	0.0961		
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	0.00131	0.0079		
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.10 ^{DLA}		
	Potassium (K)-Dissolved (mg/L)	3.31	6.14	66.6		
	Selenium (Se)-Dissolved (mg/L)	0.000983	0.00341	0.00771		
	Silicon (Si)-Dissolved (mg/L)	3.41	6.95	4.01		
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000020 ^{DLA}		
	Sodium (Na)-Dissolved (mg/L)	13.3	28.2	150		
	Strontium (Sr)-Dissolved (mg/L)	0.584	1.73	7.33		
	Sulfur (S)-Dissolved (mg/L)	32.4	75.6	683		
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000020 ^{DLA}		
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00020 ^{DLA}		
	Titanium (Ti)-Dissolved (mg/L)	0.00045	<0.00060 ^{DLM}	<0.00060 ^{DLA}		
	Uranium (U)-Dissolved (mg/L)	0.000558	0.00492	0.00512		
	Vanadium (V)-Dissolved (mg/L)	0.00053	0.00078	<0.0010 ^{DLA}		
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	0.0281	<0.0020 ^{DLA}		
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Dissolved Organic Carbon	MS-B	L2144122-1, -3
Matrix Spike	Dissolved Organic Carbon	MS-B	L2144122-1, -3
Matrix Spike	Dissolved Organic Carbon	MS-B	L2144122-1, -3
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2144122-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2144122-2
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2144122-2
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2144122-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2144122-2
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2144122-2
Matrix Spike	Copper (Cu)-Dissolved	MS-B	L2144122-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Copper (Cu)-Dissolved	MS-B	L2144122-2
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2144122-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2144122-2
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2144122-2
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2144122-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2144122-2
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2144122-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2144122-2
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2144122-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2144122-2
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2144122-2
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2144122-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2144122-2
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2144122-2
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2144122-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2144122-2
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2144122-2
Matrix Spike	Zinc (Zn)-Dissolved	MS-B	L2144122-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Zinc (Zn)-Dissolved	MS-B	L2144122-2

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DTC	Dissolved concentration exceeds total. Results were confirmed by re-analysis.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-WR	Water	Nitrite & Nitrate Nitrogen	EPA 300.1
Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance.			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B

Reference Information

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.

CL-IC-N-WR Water Chloride in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

EC-PCT-VA Water Conductivity (Automated) APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-SCREEN-VA Water Conductivity Screen (Internal Use Only) APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 µm), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-WR Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

Reference Information

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-08-07 C

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com



L2144122-COFC

COC Number: 2018 - 08 - 07 C

Page 1 of 1

Report To		Report Format / Distribution		Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply																
Company:	Minto Explorations Ltd.	Select Report Format:	☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)	Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply																
Contact:	Minto Environment - Coordinator	Quality Control (QC) Report with Report	☒ YES ☐ NO	PRIORITY (Business Days)	4 day [P4] ☐				EMERGENCY	1 Business day [E1] ☐										
Phone:	1-804-759-4659	☒ Compare Results to Criteria on Report - provide details below if box checked	3 day [P3] ☐				Same Day, Weekend or Statutory holiday [E0] ☐													
Company address below will appear on the final report		Select Distribution:	☒ EMAIL ☐ MAIL ☐ FAX		2 day [P2] ☐															
Street:	2100-510 West Georgia St.	Email 1 or Fax	minto_environment@mintomine.com	Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm																
City/Province:	Vancouver, British Columbia	Email 2		For tests that can not be performed according to the service level selected, you will be contacted.																
Postal Code:	V6B 0M3	Email 3		Analysis Request																
Invoice To	Same as Report To ☐ YES ☒ NO	Invoice Distribution		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below																
	Copy of Invoice with Report ☐ YES ☒ NO	Select Invoice Distribution:	☒ EMAIL ☐ MAIL ☐ FAX				P	F/P	P	F/P	P	F/P								
Company:	Minto Explorations Ltd.	Email 1 or Fax	ap@mintomine.com	pH / Conductivity / Alkalinity / Anions	Total Suspended Solids (TSS)	Total Dissolved Solids (TDS)	Total Metals (TM), Hardness	Dissolved Metals (DM) (Filtered and preserved)	Total Mercury, Hardness	Dissolved Mercury (1) (Filtered + preserved)	Total Nutrients (Ammonia)	Dissolved Organic Carbon (DOC)								Number of Containers
Contact:	Ruth Cayetano	Email 2																		
Project Information		Oil and Gas Required Fields (client use)																		
ALS Account # / Quote #:	AFE/Cost Center:	PO#																		
Job #:	Major/Minor Code:	Routing Code:																		
PO / AFE:	228617 (WUL)	Requisitioner:																		
LSD:		Location:																		
ALS Lab Work Order # (lab use only)		ALS Contact:	Shane Stack	Sampler:	SMB/DF/EB															
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type																
	W15	6-Aug-18	7:30	Water	R	R	R	R	R	R	R	R	R	R						7
	W8A	6-Aug-18	9:05	Water	R	R	R	R	R	R	R	R	R	R						6
	W16	6-Aug-18	9:40	Water	R	R	R	R	R	R	R	R	R	R						7
	W10	6-Aug-18	10:40	Water	R	R	R	R	R	R	R	R	R	R						6
	W12	6-Aug-18	16:15	Water	R	R	R	R	R	R	R	R	R	R						6
	W30	6-Aug-18	11:20	Water	R	R	R	R	R	R	R	R	R	R						6
	W62	6-Aug-18	14:10	Water	R	R	R	R	R	R	R	R	R	R						6
	W45	6-Aug-18	15:55	Water	R	R	R	R	R	R	R	R	R	R						6
Drinking Water (DW) Samples ¹ (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)		SAMPLE CONDITION AS RECEIVED (lab use only)																
Are samples taken from a Regulated DW System?				Frozen ☐ SIF Observations Yes ☐ No ☐																
☐ YES ☒ NO				Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐																
Are samples for human drinking water use?				Cooling Initiated ☒																
☐ YES ☒ NO				INITIAL COOLER TEMPERATURES °C: 9.0 FINAL COOLER TEMPERATURES °C: 9																
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)		FINAL SHIPMENT RECEPTION (lab use only)																
Released by: SMB	Date: 8/7/2018	Time:	Received by: EHF	Date: 9 Aug 2018	Time: 13:00	Received by: HA	Date: 8/10	Time: 14:50												

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 09-AUG-18
Report Date: 20-AUG-18 16:32 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2144130
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-08-07 D
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2144130-1 Water 06-AUG-18 10:40 F-BL	L2144130-2 Water 06-AUG-18 15:00 W33S	L2144130-3 Water 06-AUG-18 DUP	L2144130-4 Water 03-AUG-18 15:50 BC1	
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	<2.0	1800	393	220	
	Hardness (as CaCO3) (mg/L)	<0.50	827	182	108	
	pH (pH)	5.60	8.11	8.30	8.27	
	Total Suspended Solids (mg/L)	<3.0	101	10.1	8.9	
	TDS (Calculated) (mg/L)	<1.0	1350	240	126	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	<1.0	175	117	106	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	2.2	<1.0	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Total (as CaCO3) (mg/L)	<1.0	175	119	106	
	Ammonia, Total (as N) (mg/L)	<0.0050	0.416	0.0069	0.0118	
	Chloride (Cl) (mg/L)	<0.50	5.8	1.14	0.60	
	Nitrate and Nitrite (as N) (mg/L)	<0.0051	140	<0.0051	0.0138	
	Nitrate (as N) (mg/L)	<0.0050	139	<0.0050	0.0138	
	Nitrite (as N) (mg/L)	<0.0010	1.28	<0.0010	<0.0010	
	Sulfate (SO4) (mg/L)	<0.30	280	91.6	17.0	
	Anion Sum (meq/L)	<0.10	19.5	4.32	2.49	
	Cation Sum (meq/L)	<0.10	19.2	4.31	2.51	
	Cation - Anion Balance (%)	0.0	-0.8	-0.1	0.5	
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	<0.50			6.22	
Total Metals	Aluminum (Al)-Total (mg/L)	<0.0030	0.0067	0.0663	0.0261	
	Antimony (Sb)-Total (mg/L)	<0.00010	0.00013	0.00011	0.00019	
	Arsenic (As)-Total (mg/L)	<0.00010	0.00062	0.00102	0.00078	
	Barium (Ba)-Total (mg/L)	<0.00010	0.218	0.0561	0.0730	
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Total (mg/L)	<0.010	0.125	0.017	<0.010	
	Cadmium (Cd)-Total (mg/L)	<0.0000050	0.0000701	0.0000072	0.0000052	
	Calcium (Ca)-Total (mg/L)	<0.050	177	37.2	24.8	
	Chromium (Cr)-Total (mg/L)	<0.00010	0.00018	<0.00010	0.00016	
	Cobalt (Co)-Total (mg/L)	<0.00010	0.00029	<0.00010	<0.00010	
	Copper (Cu)-Total (mg/L)	<0.00050	0.0356	0.0236	0.00190	
	Iron (Fe)-Total (mg/L)	<0.010	0.020	0.267	0.034	
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Total (mg/L)	<0.0010	0.0057	0.0027	0.0015	
	Magnesium (Mg)-Total (mg/L)	<0.10	79.9	20.6	9.80	
	Manganese (Mn)-Total (mg/L)	0.00034 ^{RRV}	0.202	0.0352	0.0115	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2144130-1 Water 06-AUG-18 10:40 F-BL	L2144130-2 Water 06-AUG-18 15:00 W33S	L2144130-3 Water 06-AUG-18 DUP	L2144130-4 Water 03-AUG-18 15:50 BC1	
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	0.0000064	0.0000084	<0.0000050	
	Molybdenum (Mo)-Total (mg/L)	<0.000050	0.0141	0.00501	0.00153	
	Nickel (Ni)-Total (mg/L)	<0.00050	0.00084	0.00051	0.00075	
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Potassium (K)-Total (mg/L)	<0.10	9.09	3.13	1.03	
	Selenium (Se)-Total (mg/L)	<0.000050	0.00335	0.000906	0.000072	
	Silicon (Si)-Total (mg/L)	<0.10	5.84	3.57	5.80	
	Silver (Ag)-Total (mg/L)	<0.000010	0.000010	<0.000010	<0.000010	
	Sodium (Na)-Total (mg/L)	<0.050	50.0	12.9	7.13	
	Strontium (Sr)-Total (mg/L)	<0.00020	3.63	0.596	0.278	
	Sulfur (S)-Total (mg/L)	<0.50	105	34.5	6.27	
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Total (mg/L)	<0.00030	<0.00060 ^{DLM}	0.00245	<0.00060 ^{DLM}	
	Uranium (U)-Total (mg/L)	<0.000010	0.00205	0.000584	0.00269	
	Vanadium (V)-Total (mg/L)	<0.00050	0.00055	0.00067	0.00080	
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	<0.0010	1.13 ^{DTC}	0.0064	0.0104	
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	0.00013 ^{DTC}	<0.00010	0.00016	
	Arsenic (As)-Dissolved (mg/L)	<0.00010	0.00094 ^{DTC}	0.00100	0.00077	
	Barium (Ba)-Dissolved (mg/L)	<0.00010	0.264	0.0563	0.0781	
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	0.000059	<0.000020	<0.000020	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	<0.010	0.120 ^{DTC}	0.017	<0.010	
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	0.000103 ^{DTC}	<0.0000050	0.0000065	
	Calcium (Ca)-Dissolved (mg/L)	<0.050	198 ^{DTC}	38.1	26.3	
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00089 ^{DTC}	<0.00010	0.00016	
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00118 ^{DTC}	<0.00010	<0.00010	
	Copper (Cu)-Dissolved (mg/L)	<0.00020	0.136 ^{DTC}	0.0190	0.00186	
	Iron (Fe)-Dissolved (mg/L)	<0.010	1.40 ^{DTC}	0.154	0.014	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	0.000834 ^{DTC}	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	<0.0010	0.0064	0.0027	0.0016	
	Magnesium (Mg)-Dissolved (mg/L)	<0.10	81.0 ^{DTC}	21.1	10.3	
	Manganese (Mn)-Dissolved (mg/L)	0.00023	0.319 ^{DTC}	0.0289	0.00970	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2144130-1 Water 06-AUG-18 10:40 F-BL	L2144130-2 Water 06-AUG-18 15:00 W33S	L2144130-3 Water 06-AUG-18 DUP	L2144130-4 Water 03-AUG-18 15:50 BC1	
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Dissolved (mg/L)	<0.000050	0.0101	0.00493	0.00150	
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	0.00159 ^{DTC}	<0.00050	0.00076	
	Phosphorus (P)-Dissolved (mg/L)	<0.050	0.170	<0.050	<0.050	
	Potassium (K)-Dissolved (mg/L)	<0.10	8.60	3.32	1.12	
	Selenium (Se)-Dissolved (mg/L)	<0.000050	0.00317	0.000967	0.000059	
	Silicon (Si)-Dissolved (mg/L)	<0.050	7.12	3.26	5.63	
	Silver (Ag)-Dissolved (mg/L)	<0.000010	0.000024	<0.000010	<0.000010	
	Sodium (Na)-Dissolved (mg/L)	<0.050	49.8	13.3	7.50	
	Strontium (Sr)-Dissolved (mg/L)	<0.00020	3.56	0.594	0.287	
	Sulfur (S)-Dissolved (mg/L)	<0.50	93.0	31.2	5.52	
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	0.000010	<0.000010	<0.000010	
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010 ^{DTC}	<0.00010	<0.00010	
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	0.0533 ^{DTC}	<0.00030	<0.00030	
	Uranium (U)-Dissolved (mg/L)	<0.000010	0.00191 ^{DTC}	0.000573	0.00283	
	Vanadium (V)-Dissolved (mg/L)	<0.00050	0.00476 ^{DTC}	<0.00050	0.00077	
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	0.0099 ^{DTC}	<0.0010	<0.0010	
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	0.00057	<0.00030	<0.00030	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Laboratory Control Sample	Sulfur (S)-Dissolved	MES	L2144130-1
Matrix Spike	Dissolved Organic Carbon	MS-B	L2144130-4
Matrix Spike	Dissolved Organic Carbon	MS-B	L2144130-1
Matrix Spike	Dissolved Organic Carbon	MS-B	L2144130-1
Matrix Spike	Dissolved Organic Carbon	MS-B	L2144130-1
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2144130-1, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2144130-1, -3, -4
Matrix Spike	Copper (Cu)-Dissolved	MS-B	L2144130-1, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2144130-1, -3, -4
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2144130-1, -3, -4
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2144130-1, -3, -4
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2144130-1, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2144130-1, -3, -4
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2144130-1, -3, -4
Matrix Spike	Zinc (Zn)-Dissolved	MS-B	L2144130-1, -3, -4

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DTC	Dissolved concentration exceeds total. Results were confirmed by re-analysis.
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-WR	Water	Nitrite & Nitrate Nitrogen	EPA 300.1
Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance.			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-WR	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			

Reference Information

HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NO2-L-IC-N-WR	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-WR	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
SO4-IC-WR	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)
This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".			
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.			
TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.			
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
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WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
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VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
----	---

Chain of Custody Numbers:

Reference Information

2018-08-07 D

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com



L2144130-COFC

COC Number: 2018 - 08 - 07 D

Page 1 of 1

Report To		Report Format / Distribution		Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply													
Company:	Minto Explorations Ltd.	Select Report Format:	☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)	Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply													
Contact:	Minto Environment - Coordinator	Quality Control (QC) Report with Report	☒ YES ☐ NO	PRIORITY (Business Days)	4 day [P4] ☐				EMERGENCY	1 Business day [E1] ☐							
Phone:	1-604-759-4659	☒ Compare Results to Criteria on Report - provide details below if box checked	3 day [P3] ☐				Same Day, Weekend or Statutory holiday [E0] ☐										
Company address below will appear on the final report		Select Distribution:	☒ EMAIL ☐ MAIL ☐ FAX		2 day [P2] ☐												
Street:	2100-510 West Georgia St.	Email 1 or Fax	minto_environment@mintomine.com	Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm													
City/Province:	Vancouver, British Columbia	Email 2		For tests that can not be performed according to the service level selected, you will be contacted.													
Postal Code:	V6B 0M3	Email 3		Analysis Request													
Invoice To	Same as Report To ☐ YES ☒ NO	Invoice Distribution		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below													
	Copy of Invoice with Report ☐ YES ☒ NO	Select Invoice Distribution:	☒ EMAIL ☐ MAIL ☐ FAX														
Company:	Minto Explorations Ltd.	Email 1 or Fax	ap@mintomine.com														
Contact:	Ruth Cayetano	Email 2															
Project Information		Oil and Gas Required Fields (client use)															
ALS Account # / Quote #:		AFE/Cost Center:	PO#														
Job #:		Major/Minor Code:	Routing Code:														
PO / AFE:	229096 (WUL)	Requisitioner:															
LSD:		Location:															
ALS Lab Work Order # (lab use only)		ALS Contact:	Shane Stack	Sampler:	SMB/DF/EB												
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	pH / Conductivity / Alkalinity / Anions	Total Suspended Solids (TSS)	Total Dissolved Solids (TDS)	Total Metals (TM), Hardness	Dissolved Metals (DM) (filtered + preserved)	Total Mercury, Hardness	Dissolved Mercury [1] (Filtered + preserved)	Total Nutrients (Ammonia)	Dissolved Organic Carbon (DOC)	Number of Containers			
	F-BL	6-Aug-18	10:40	Water	R	R	R	R	R	R	R	R	R	7			
	W33S	6-Aug-18	15:00	Water	R	R	R	R	R	R	R	R	R	6			
	Dup	6-Aug-18		Water	R	R	R	R	R	R	R	R	R	6			
	BCI	3-Aug-18	15:50	WATER	R	R	R	R	R	R	R	R	R	7			
Drinking Water (DW) Samples ¹ (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)			SAMPLE CONDITION AS RECEIVED (lab use only)												
Are samples taken from a Regulated DW System?					Frozen ☐ SIF Observations Yes ☐ No ☐												
☐ YES ☒ NO					Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐												
Are samples for human drinking water use?					Cooling Initiated ☒												
☐ YES ☒ NO					INITIAL COOLER TEMPERATURES °C: 9.0 FINAL COOLER TEMPERATURES °C: 9												
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)												
Released by: SMB	Date: 8/7/2018	Time:	Received by: EHF	Date: 9 Aug 2018	Time: 13:00	Received by: HA	Date: 8/10	Time: 11:50									

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2016 PRINT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 15-AUG-18
Report Date: 24-AUG-18 15:45 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2147363
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-08-15 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2147363-1 Water 11-AUG-18 09:05 W16A	L2147363-2 Water 11-AUG-18 09:40 W55	L2147363-3 Water 11-AUG-18 10:05 W35	L2147363-4 Water 11-AUG-18 15:45 W2	L2147363-5 Water 12-AUG-18 08:20 W50
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	474	463	401	348	472
	Hardness (as CaCO3) (mg/L)	236	219	187	175	241
	pH (pH)	8.32	7.94	7.95	8.31	8.26
	Total Suspended Solids (mg/L)	<3.0	<3.0	12.6	4.4	<3.0
	TDS (Calculated) (mg/L)	278	279	243	197	283
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	160	125	106	158	168
	Alkalinity, Carbonate (as CaCO3) (mg/L)	4.6	<1.0	<1.0	4.6	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	165	125	106	162	168
	Ammonia, Total (as N) (mg/L)	0.0138	0.0077	0.0112	<0.0050	0.0089
	Chloride (Cl) (mg/L)	5.22	1.32	0.96	1.83	5.39
	Nitrate and Nitrite (as N) (mg/L)	1.63	15.4	14.8	0.175	1.59
	Nitrate (as N) (mg/L)	1.62	15.4	14.7	0.175	1.58
	Nitrite (as N) (mg/L)	0.0111	0.0066	0.0256	<0.0010	0.0051
	Sulfate (SO4) (mg/L)	69.6	43.6	37.0	25.2	70.5
	Anion Sum (meq/L)	5.00	4.54	3.96	3.83	5.09
	Cation Sum (meq/L)	5.35	5.00	4.25	4.00	5.46
	Cation - Anion Balance (%)	3.4	4.9	3.5	2.2	3.4
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	16.8	21.7	24.5	10.8	16.7
Total Metals	Aluminum (Al)-Total (mg/L)	0.0540	0.0312	0.213	0.0486	0.0233
	Antimony (Sb)-Total (mg/L)	<0.00010	0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00051	0.00056	0.00041	0.00062	0.00048
	Barium (Ba)-Total (mg/L)	0.0732	0.0930	0.0779	0.0620	0.0683
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.014	0.018	0.016	<0.010	0.014
	Cadmium (Cd)-Total (mg/L)	0.0000067	0.0000083	0.0000148	<0.0000050	0.0000065
	Calcium (Ca)-Total (mg/L)	60.4	54.6	44.6	42.4	60.2
	Chromium (Cr)-Total (mg/L)	0.00022	0.00031	0.00051	0.00033	0.00061
	Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	0.00019	<0.00010	<0.00010
	Copper (Cu)-Total (mg/L)	0.0351	0.0297	0.0461	0.00285	0.0265
	Iron (Fe)-Total (mg/L)	0.106	0.055	0.389	0.139	0.050
	Lead (Pb)-Total (mg/L)	0.000197	<0.000050	0.000098	<0.000050	0.000148
	Lithium (Li)-Total (mg/L)	0.0013	0.0016	0.0012	0.0016	0.0012
	Magnesium (Mg)-Total (mg/L)	18.6	16.2	14.7	15.1	17.8
	Manganese (Mn)-Total (mg/L)	0.0216	0.00515	0.0166	0.0116	0.0234

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2147363-6 Water 13-AUG-18 09:50 W55	L2147363-7 Water 13-AUG-18 13:50 W16	L2147363-8 Water 13-AUG-18 10:20 W8A	L2147363-9 Water 14-AUG-18 10:35 MC1	L2147363-10 Water 14-AUG-18 11:45 W2
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	422	467	812	352	370
	Hardness (as CaCO3) (mg/L)	199	247	416	180	185
	pH (pH)	8.00	8.31	7.83	8.32	8.19
	Total Suspended Solids (mg/L)	<3.0	5.2	139	10.8	<3.0
	TDS (Calculated) (mg/L)	261	285	523	195	204
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	117	162	267	161	168
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	4.4	<1.0	4.8	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	117	167	267	166	168
	Ammonia, Total (as N) (mg/L)	0.0082	0.0119	0.0595	0.0073	0.0074
	Chloride (Cl) (mg/L)	1.14	5.31	4.36	1.44	1.96
	Nitrate and Nitrite (as N) (mg/L)	14.8	1.71	7.73	0.0749	0.0878
	Nitrate (as N) (mg/L)	14.8	1.70	7.63	0.0749	0.0878
	Nitrite (as N) (mg/L)	0.0109	0.0107	0.0993	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	40.9	70.9	143	20.6	25.3
	Anion Sum (meq/L)	4.28	5.08	9.00	3.79	3.94
	Cation Sum (meq/L)	4.55	5.58	9.76	4.11	4.21
	Cation - Anion Balance (%)	3.1	4.7	4.1	4.0	3.3
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	23.2	17.1		9.38	8.54
Total Metals	Aluminum (Al)-Total (mg/L)	0.0124	0.0664	1.50	0.348	0.0121
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	0.00078	0.00013	0.00010
	Arsenic (As)-Total (mg/L)	0.00057	0.00046	0.00149	0.00079	0.00043
	Barium (Ba)-Total (mg/L)	0.0836	0.0695	0.125	0.0661	0.0653
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	0.000098	0.000021	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	0.000066	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.016	0.013	0.020	<0.010	<0.010
	Cadmium (Cd)-Total (mg/L)	0.0000082	0.0000066	0.000275	0.0000102	<0.0000050
	Calcium (Ca)-Total (mg/L)	50.3	59.4	106	42.2	43.6
	Chromium (Cr)-Total (mg/L)	0.00041	0.00019	0.00208	0.00081	0.00026
	Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	0.00169	0.00029	<0.00010
	Copper (Cu)-Total (mg/L)	0.0417	0.0340	0.540	0.00317	0.00222
	Iron (Fe)-Total (mg/L)	0.028	0.121	4.33	0.626	0.045
	Lead (Pb)-Total (mg/L)	0.000243	<0.000050	0.00256	0.000161	<0.000050
	Lithium (Li)-Total (mg/L)	0.0015	0.0012	0.0037	0.0017	0.0018
	Magnesium (Mg)-Total (mg/L)	15.7	17.2	29.7	15.0	14.2
	Manganese (Mn)-Total (mg/L)	0.00172	0.0202	0.983	0.0459	0.00914

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2147363-1 Water 11-AUG-18 09:05 W16A	L2147363-2 Water 11-AUG-18 09:40 W55	L2147363-3 Water 11-AUG-18 10:05 W35	L2147363-4 Water 11-AUG-18 15:45 W2	L2147363-5 Water 12-AUG-18 08:20 W50
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.00282	0.00215	0.00139	0.00184	0.00298
	Nickel (Ni)-Total (mg/L)	0.00093	0.00095	0.00126	0.00104	0.00086
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	2.60	2.47	1.29	1.22	2.40
	Selenium (Se)-Total (mg/L)	0.000840	0.000581	0.000352	0.000171	0.000790
	Silicon (Si)-Total (mg/L)	3.43	4.93	5.13	5.51	3.26
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	0.000011	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	12.2	11.3	10.2	10.1	11.4
	Strontium (Sr)-Total (mg/L)	0.542	0.455	0.405	0.421	0.549
	Sulfur (S)-Total (mg/L)	24.4	15.2	12.6	8.34	23.5
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	0.00300	0.00130	0.0128	0.00216	<0.0012 ^{DLM}
	Uranium (U)-Total (mg/L)	0.00134	0.000184	0.000281	0.00170	0.00134
	Vanadium (V)-Total (mg/L)	0.00075	0.00057	0.00125	0.00114	0.00061
	Zinc (Zn)-Total (mg/L)	<0.0030	0.0041	0.0041	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	0.00033	<0.00030	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0133	0.0184	0.0198	0.0077	0.0040
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00047	0.00051	0.00034	0.00054	0.00045
	Barium (Ba)-Dissolved (mg/L)	0.0799	0.105	0.0819	0.0666	0.0754
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.014	0.019	0.017	<0.010	0.014
	Cadmium (Cd)-Dissolved (mg/L)	0.0000065	0.0000089	0.0000071	<0.0000050	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	62.2	58.2	48.3	43.7	63.1
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00028	0.00035	0.00022	0.00013
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.0299	0.0302	0.0291	0.00257	0.0256
	Iron (Fe)-Dissolved (mg/L)	0.043	0.039	0.041	0.049	0.018
	Lead (Pb)-Dissolved (mg/L)	0.000126	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0012	0.0016	0.0011	0.0015	0.0012
	Magnesium (Mg)-Dissolved (mg/L)	19.6	17.9	16.1	16.0	20.2
	Manganese (Mn)-Dissolved (mg/L)	0.00494	0.00308	0.00593	0.00377	0.0162

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2147363-6 Water 13-AUG-18 09:50 W55	L2147363-7 Water 13-AUG-18 13:50 W16	L2147363-8 Water 13-AUG-18 10:20 W8A	L2147363-9 Water 14-AUG-18 10:35 MC1	L2147363-10 Water 14-AUG-18 11:45 W2
Grouping	Analyte						
WATER							
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	0.0000148	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Total (mg/L)	0.00223	0.00286	0.00953	0.00173	0.00137	
	Nickel (Ni)-Total (mg/L)	0.00100	0.00085	0.00268	0.00159	0.00098	
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	0.242	<0.050	<0.050	
	Potassium (K)-Total (mg/L)	2.36	2.42	5.12	1.24	1.37	
	Selenium (Se)-Total (mg/L)	0.000537	0.000700	0.00300	0.000156	0.000127	
	Silicon (Si)-Total (mg/L)	4.97	3.23	8.60	6.12	5.33	
	Silver (Ag)-Total (mg/L)	<0.000010	0.000013	0.000159	<0.000010	<0.000010	
	Sodium (Na)-Total (mg/L)	11.1	11.4	26.7	9.67	9.65	
	Strontium (Sr)-Total (mg/L)	0.422	0.536	1.33	0.422	0.444	
	Sulfur (S)-Total (mg/L)	13.9	23.0	51.1	6.73	8.40	
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	0.000028	<0.000010	<0.000010	
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	0.00017	<0.00010	<0.00010	
	Titanium (Ti)-Total (mg/L)	0.00062	0.00355	0.0806	0.0157	0.00045	
	Uranium (U)-Total (mg/L)	0.000277	0.00135	0.00169	0.00158	0.00181	
	Vanadium (V)-Total (mg/L)	0.00061	0.00080	0.00779	0.00194	0.00074	
	Zinc (Zn)-Total (mg/L)	0.0055	<0.0030	0.873	<0.0030	<0.0030	
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	0.00047	<0.00030	<0.00030	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0218 ^{DTMF}	0.0042	0.0209	0.0066	0.0044	
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	0.00011	<0.00010	<0.00010	
	Arsenic (As)-Dissolved (mg/L)	0.00050	0.00047	0.00061	0.00057	0.00044	
	Barium (Ba)-Dissolved (mg/L)	0.0897	0.0812	0.105	0.0679	0.0752	
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	0.000026	<0.000020	<0.000020	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	0.016	0.014	0.020	<0.010	<0.010	
	Cadmium (Cd)-Dissolved (mg/L)	0.0000092	<0.0000050	0.000168	<0.0000050	<0.0000050	
	Calcium (Ca)-Dissolved (mg/L)	52.1	64.7	113	44.4	47.0	
	Chromium (Cr)-Dissolved (mg/L)	0.00027	0.00010	0.00036	0.00017	<0.00010	
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	0.00060	<0.00010	<0.00010	
	Copper (Cu)-Dissolved (mg/L)	0.0333	0.0312	0.130	0.00211	0.00211	
	Iron (Fe)-Dissolved (mg/L)	0.041	0.020	0.217	0.093	0.030	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.0014	0.0012	0.0030	0.0015	0.0018	
	Magnesium (Mg)-Dissolved (mg/L)	16.6	20.6	32.5	16.8	16.5	
Manganese (Mn)-Dissolved (mg/L)	0.00251 ^{DTMF}	0.00318	1.07	0.00981	0.00929		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2147363-1 Water 11-AUG-18 09:05 W16A	L2147363-2 Water 11-AUG-18 09:40 W55	L2147363-3 Water 11-AUG-18 10:05 W35	L2147363-4 Water 11-AUG-18 15:45 W2	L2147363-5 Water 12-AUG-18 08:20 W50
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00295	0.00223	0.00141	0.00190	0.00301
	Nickel (Ni)-Dissolved (mg/L)	0.00089	0.00098	0.00119	0.00099	0.00082
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	2.86	2.91	1.33	1.35	2.83
	Selenium (Se)-Dissolved (mg/L)	0.000863	0.000607	0.000376	0.000153	0.000741
	Silicon (Si)-Dissolved (mg/L)	3.31	5.08	4.90	5.56	3.29
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	12.6	12.5	11.0	10.6	13.0
	Strontium (Sr)-Dissolved (mg/L)	0.595	0.491	0.420	0.452	0.588
	Sulfur (S)-Dissolved (mg/L)	22.9	14.0	11.6	7.83	22.1
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00142	0.00130	0.00062	0.00045	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00131	0.000182	0.000259	0.00155	0.00129
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	0.00076	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	0.0016	<0.0010	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	0.00032	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2147363-6 Water 13-AUG-18 09:50 W55	L2147363-7 Water 13-AUG-18 13:50 W16	L2147363-8 Water 13-AUG-18 10:20 W8A	L2147363-9 Water 14-AUG-18 10:35 MC1	L2147363-10 Water 14-AUG-18 11:45 W2
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00220	0.00296	0.00990	0.00188	0.00140
	Nickel (Ni)-Dissolved (mg/L)	0.00100	0.00097	0.00125	0.00105	0.00096
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	2.49	2.91	5.29	1.36	1.61
	Selenium (Se)-Dissolved (mg/L)	0.000575	0.000789	0.00280	0.000121	0.000146
	Silicon (Si)-Dissolved (mg/L)	5.06	3.24	6.25	5.92	5.70
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	0.000025	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	11.7	13.3	28.8	10.8	10.8
	Strontium (Sr)-Dissolved (mg/L)	0.441	0.605	1.49	0.465	0.480
	Sulfur (S)-Dissolved (mg/L)	13.0	22.3	47.0	6.68	8.34
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00096	<0.00030	0.00192	0.00033	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.000245	0.00127	0.00162	0.00153	0.00175
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	0.00092	0.00083	0.00063
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	0.344	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Dissolved Organic Carbon	MS-B	L2147363-1, -10, -2, -3, -4, -5, -6, -7, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2147363-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2147363-1
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2147363-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2147363-1
Matrix Spike	Copper (Cu)-Dissolved	MS-B	L2147363-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2147363-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2147363-1
Matrix Spike	Molybdenum (Mo)-Dissolved	MS-B	L2147363-1
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2147363-1
Matrix Spike	Silicon (Si)-Dissolved	MS-B	L2147363-1
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2147363-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2147363-1
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2147363-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2147363-1
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2147363-1
Matrix Spike	Aluminum (Al)-Total	MS-B	L2147363-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Total	MS-B	L2147363-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L2147363-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Copper (Cu)-Total	MS-B	L2147363-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Iron (Fe)-Total	MS-B	L2147363-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2147363-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Total	MS-B	L2147363-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Potassium (K)-Total	MS-B	L2147363-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Total	MS-B	L2147363-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L2147363-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sulfur (S)-Total	MS-B	L2147363-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Titanium (Ti)-Total	MS-B	L2147363-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Zinc (Zn)-Total	MS-B	L2147363-1, -10, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DTMF	Dissolved concentration exceeds total for field-filtered metals sample. Metallic contaminants may have been introduced to dissolved sample during field filtration.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-WR	Water	Nitrite & Nitrate Nitrogen	EPA 300.1
Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance.			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B

Reference Information

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.

CL-IC-N-WR Water Chloride in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

EC-PCT-VA Water Conductivity (Automated) APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-SCREEN-VA Water Conductivity Screen (Internal Use Only) APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = \frac{[\text{Cation Sum} - \text{Anion Sum}]}{[\text{Cation Sum} + \text{Anion Sum}]}$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-WR Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

Reference Information

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

**** ALS test methods may incorporate modifications from specified reference methods to improve performance.**

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-08-15 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2147363-COFC

COC Number: 2018-08-15 A

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Company:	Minto Explorations Ltd.			Select Report Format: ☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)		Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply																																																																																																																									
Contact:	Minto Environment - Coordinator			Quality Control (QC) Report with Report ☒ YES ☐ NO		PRIORITY (Business Days)		4 day [P4] ☐		3 day [P3] ☐		2 day [P2] ☐		EMERGENCY		1 Business day [E1] ☐		Same Day, Weekend or Statutory holiday [E0] ☐																																																																																																													
Phone:	1-804-759-4659			☒ Compare Results to Criteria on Report - provide details below if box checked		Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX		Date and Time Required for all E&P TATs: 30-days by Minto																																																																																																																							
Company address below will appear on the final report					Street: 2100-510 West Georgia St.		Email 1 or Fax minto_environment@mintomine.com		For tests that can not be performed according to the service level selected, you will be contacted.																																																																																																																						
City/Province: Vancouver, British Columbia					Email 2		Analysis Request																																																																																																																								
Postal Code: V6B 0M3					Email 3		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below																																																																																																																								
Invoice To: Same as Report To ☐ YES ☒ NO					Invoice Distribution		<table border="1"> <tr> <td></td><td></td><td></td><td></td><td>P</td><td>F/P</td><td>P</td><td>F/P</td><td>P</td><td>F/P</td><td>P</td><td>F/P</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td rowspan="5">pH / Conductivity / Alkalinity / Anions</td> <td rowspan="5">Total Suspended Solids (TSS)</td> <td rowspan="5">Total Dissolved Solids (TDS)</td> <td rowspan="5">Total Metals (TM), Hardness</td> <td rowspan="5">Dissolved Metals (DM) (filtered and preserved)</td> <td rowspan="5">Total Mercury, Hardness</td> <td rowspan="5">Dissolved Mercury (1) (Filtered + preserved)</td> <td rowspan="5">Total Nutrients (Ammonia)</td> <td rowspan="5">Dissolved Organic Carbon (DOC)</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> </table>														P	F/P	P	F/P	P	F/P	P	F/P									pH / Conductivity / Alkalinity / Anions	Total Suspended Solids (TSS)	Total Dissolved Solids (TDS)	Total Metals (TM), Hardness	Dissolved Metals (DM) (filtered and preserved)	Total Mercury, Hardness	Dissolved Mercury (1) (Filtered + preserved)	Total Nutrients (Ammonia)	Dissolved Organic Carbon (DOC)																																																																																		
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Company: Minto Explorations Ltd.					Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX																																																																																																																										
Contact: Ruth Cayetano					Email 1 or Fax ap@mintomine.com																																																																																																																										
Project Information					Oil and Gas Required Fields (client use)																																																																																																																										
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ALS Lab Work Order # (lab use only)					ALS Contact: Shane Stack		Sampler: CR/SB																																																																																																																								
ALS Sample # (lab use only)		Sample Identification and/or Coordinates (This description will appear on the report)			Date (dd-mm-yy)		Time (hh:mm)		Sample Type		Number of Containers																																																																																																																				
		W16A ✓			11-Aug-18		9:05		Water		7																																																																																																																				
		W55 ✓			11-Aug-18		9:40		Water		7																																																																																																																				
		W35 ✓			11-Aug-18		10:05		Water		7																																																																																																																				
		W2 ✓			11-Aug-18		15:45		Water		7																																																																																																																				
		W50 ✓			12-Aug-18		8:20		Water		7																																																																																																																				
		W55 ✓			13-Aug-18		9:50		Water		7																																																																																																																				
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		W8A ✓			13-Aug-18		10:20		Water		6																																																																																																																				
		MC1 ✓			14-Aug-18		10:35		Water		7																																																																																																																				
		W2 ✓			14-Aug-18		11:45		Water		7																																																																																																																				
Drinking Water (DW) Samples ¹ (client use)					Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)					SAMPLE CONDITION AS RECEIVED (lab use only)																																																																																																																					
Are samples taken from a Regulated DW System? ☐ YES ☒ NO										Frozen ☐ SIF Observations Yes ☐ No ☐																																																																																																																					
Are samples for human drinking water use? ☐ YES ☒ NO										Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐																																																																																																																					
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Released by: Corey Roberts Date: 2018-08-15					Received by: [Signature] Date: Aug 15 / 18					Received by: [Signature] Date: 13:00																																																																																																																					

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY

YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 15-AUG-18
Report Date: 24-AUG-18 16:42 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2147434
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-08-15 E
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2147434-1 Water 14-AUG-18 15:55 C4	L2147434-2 Water 14-AUG-18 16:40 W46	L2147434-3 Water 14-AUG-18 17:10 W6	L2147434-4 Water 14-AUG-18 09:00 W3	L2147434-5 Water 14-AUG-18 09:20 W17
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	297	343	226	565	502
	Hardness (as CaCO3) (mg/L)	151	164	112	276	240
	pH (pH)	8.25	8.29	8.20	8.34	8.27
	Total Suspended Solids (mg/L)	<3.0	24.1	<3.0	<3.0	<3.0
	TDS (Calculated) (mg/L)	162	188	119	325	290
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	150	162	118	243	201
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	2.4	<1.0	5.8	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	150	165	118	248	201
	Ammonia, Total (as N) (mg/L)	0.0066	0.0100	<0.0050	<0.0050	0.0059
	Chloride (Cl) (mg/L)	<0.50	1.53	0.52	4.82	5.61
	Nitrate and Nitrite (as N) (mg/L)	0.0314	0.0845	<0.0051	0.112	0.139
	Nitrate (as N) (mg/L)	0.0314	0.0845	<0.0050	0.112	0.139
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	11.3	20.1	1.87	57.8	61.6
	Anion Sum (meq/L)	3.23	3.76	2.42	6.31	5.47
	Cation Sum (meq/L)	3.38	3.76	2.47	6.41	5.51
	Cation - Anion Balance (%)	2.3	0.1	1.1	0.8	0.4
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	12.5	9.00	10.9	6.62	9.73
Total Metals	Aluminum (Al)-Total (mg/L)	0.0241	0.539	0.0228	0.0152	0.0053
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00083	0.00070	0.00049	0.00028	0.00040
	Barium (Ba)-Total (mg/L)	0.0625	0.0736	0.0466	0.0599	0.0631
	Beryllium (Be)-Total (mg/L)	<0.000020	0.000026	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	<0.010	<0.010	<0.010	0.020	0.021
	Cadmium (Cd)-Total (mg/L)	<0.0000050	0.0000065	<0.0000050	<0.0000050	<0.0000050
	Calcium (Ca)-Total (mg/L)	37.9	37.8	29.8	58.0	60.6
	Chromium (Cr)-Total (mg/L)	0.00036	0.00102	0.00022	<0.00010	<0.00010
	Cobalt (Co)-Total (mg/L)	0.00021	0.00045	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Total (mg/L)	0.00122	0.00317	0.00151	0.00533	0.00735
	Iron (Fe)-Total (mg/L)	0.505	0.805	0.095	0.035	<0.010
	Lead (Pb)-Total (mg/L)	<0.000050	0.000323	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	0.0012	0.0015	<0.0010	0.0027	0.0014
	Magnesium (Mg)-Total (mg/L)	10.2	13.5	7.07	24.5	16.8
	Manganese (Mn)-Total (mg/L)	0.0877	0.0530	0.0229	0.0314	0.0140

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2147434-6 Water 14-AUG-18 DUP				
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	496				
	Hardness (as CaCO3) (mg/L)	239				
	pH (pH)	8.22				
	Total Suspended Solids (mg/L)	<3.0				
	TDS (Calculated) (mg/L)	288				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	199				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Total (as CaCO3) (mg/L)	199				
	Ammonia, Total (as N) (mg/L)	<0.0050				
	Chloride (Cl) (mg/L)	5.61				
	Nitrate and Nitrite (as N) (mg/L)	0.139				
	Nitrate (as N) (mg/L)	0.139				
	Nitrite (as N) (mg/L)	<0.0010				
	Sulfate (SO4) (mg/L)	61.8				
	Anion Sum (meq/L)	5.43				
	Cation Sum (meq/L)	5.49				
	Cation - Anion Balance (%)	0.6				
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	9.71				
Total Metals	Aluminum (Al)-Total (mg/L)	<0.0030				
	Antimony (Sb)-Total (mg/L)	<0.00010				
	Arsenic (As)-Total (mg/L)	0.00041				
	Barium (Ba)-Total (mg/L)	0.0650				
	Beryllium (Be)-Total (mg/L)	<0.000020				
	Bismuth (Bi)-Total (mg/L)	<0.000050				
	Boron (B)-Total (mg/L)	0.021				
	Cadmium (Cd)-Total (mg/L)	<0.0000050				
	Calcium (Ca)-Total (mg/L)	60.1				
	Chromium (Cr)-Total (mg/L)	<0.00010				
	Cobalt (Co)-Total (mg/L)	<0.00010				
	Copper (Cu)-Total (mg/L)	0.00710				
	Iron (Fe)-Total (mg/L)	<0.010				
	Lead (Pb)-Total (mg/L)	<0.000050				
	Lithium (Li)-Total (mg/L)	0.0014				
	Magnesium (Mg)-Total (mg/L)	17.7				
	Manganese (Mn)-Total (mg/L)	0.00413				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2147434-1 Water 14-AUG-18 15:55 C4	L2147434-2 Water 14-AUG-18 16:40 W46	L2147434-3 Water 14-AUG-18 17:10 W6	L2147434-4 Water 14-AUG-18 09:00 W3	L2147434-5 Water 14-AUG-18 09:20 W17
Grouping	Analyte						
WATER							
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Total (mg/L)	0.000800	0.00184	0.000445	0.00461	0.00616	
	Nickel (Ni)-Total (mg/L)	0.00152	0.00172	0.00126	0.00089	0.00062	
	Phosphorus (P)-Total (mg/L)	<0.050	0.115	<0.050	<0.050	<0.050	
	Potassium (K)-Total (mg/L)	0.85	1.10	0.35	1.91	3.11	
	Selenium (Se)-Total (mg/L)	0.000093	0.000151	0.000070	0.000263	0.000447	
	Silicon (Si)-Total (mg/L)	5.57	5.99	6.42	5.19	4.79	
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	
	Sodium (Na)-Total (mg/L)	5.93	8.84	4.34	16.1	12.5	
	Strontium (Sr)-Total (mg/L)	0.254	0.422	0.133	0.714	0.633	
	Sulfur (S)-Total (mg/L)	3.62	6.10	0.60	18.2	19.9	
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Total (mg/L)	0.00112	0.0207	0.00125	0.00081	<0.00030	
	Uranium (U)-Total (mg/L)	0.000690	0.00136	0.000186	0.00263	0.00178	
	Vanadium (V)-Total (mg/L)	0.00066	0.00236	0.00066	<0.00050	0.00053	
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0082	0.0074	0.0064	0.0024	0.0078	
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
	Arsenic (As)-Dissolved (mg/L)	0.00078	0.00047	0.00054	0.00026	0.00038	
	Barium (Ba)-Dissolved (mg/L)	0.0720	0.0715	0.0536	0.0705	0.0724	
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	<0.010	<0.010	<0.010	0.022	0.022	
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	0.0000052	
	Calcium (Ca)-Dissolved (mg/L)	40.0	40.2	31.2	62.3	64.9	
	Chromium (Cr)-Dissolved (mg/L)	0.00035	0.00020	0.00025	<0.00010	0.00010	
	Cobalt (Co)-Dissolved (mg/L)	0.00021	<0.00010	<0.00010	<0.00010	<0.00010	
	Copper (Cu)-Dissolved (mg/L)	0.00120	0.00206	0.00122	0.00383	0.00875	
	Iron (Fe)-Dissolved (mg/L)	0.422	0.092	0.073	0.015	0.015	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.0013	0.0014	<0.0010	0.0029	0.0015	
	Magnesium (Mg)-Dissolved (mg/L)	12.4	15.4	8.23	29.2	18.9	
Manganese (Mn)-Dissolved (mg/L)	0.0980	0.0351	0.0239	0.0326	0.00337		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID				
		L2147434-6 Water 14-AUG-18 DUP				
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050				
	Molybdenum (Mo)-Total (mg/L)	0.00643				
	Nickel (Ni)-Total (mg/L)	0.00062				
	Phosphorus (P)-Total (mg/L)	<0.050				
	Potassium (K)-Total (mg/L)	3.27				
	Selenium (Se)-Total (mg/L)	0.000446				
	Silicon (Si)-Total (mg/L)	5.02				
	Silver (Ag)-Total (mg/L)	<0.000010				
	Sodium (Na)-Total (mg/L)	13.1				
	Strontium (Sr)-Total (mg/L)	0.650				
	Sulfur (S)-Total (mg/L)	20.7				
	Thallium (Tl)-Total (mg/L)	<0.000010				
	Tin (Sn)-Total (mg/L)	<0.00010				
	Titanium (Ti)-Total (mg/L)	<0.00030				
	Uranium (U)-Total (mg/L)	0.00180				
	Vanadium (V)-Total (mg/L)	0.00055				
	Zinc (Zn)-Total (mg/L)	<0.0030				
	Zirconium (Zr)-Total (mg/L)	<0.00030				
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD				
	Dissolved Metals Filtration Location	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	0.0062				
	Antimony (Sb)-Dissolved (mg/L)	<0.00010				
	Arsenic (As)-Dissolved (mg/L)	0.00036				
	Barium (Ba)-Dissolved (mg/L)	0.0738				
	Beryllium (Be)-Dissolved (mg/L)	<0.000020				
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050				
	Boron (B)-Dissolved (mg/L)	0.022				
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050				
	Calcium (Ca)-Dissolved (mg/L)	64.2				
	Chromium (Cr)-Dissolved (mg/L)	<0.00010				
	Cobalt (Co)-Dissolved (mg/L)	<0.00010				
	Copper (Cu)-Dissolved (mg/L)	0.00821				
	Iron (Fe)-Dissolved (mg/L)	<0.010				
	Lead (Pb)-Dissolved (mg/L)	<0.000050				
	Lithium (Li)-Dissolved (mg/L)	0.0015				
	Magnesium (Mg)-Dissolved (mg/L)	19.1				
	Manganese (Mn)-Dissolved (mg/L)	0.00321				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2147434-1 Water 14-AUG-18 15:55 C4	L2147434-2 Water 14-AUG-18 16:40 W46	L2147434-3 Water 14-AUG-18 17:10 W6	L2147434-4 Water 14-AUG-18 09:00 W3	L2147434-5 Water 14-AUG-18 09:20 W17
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.000817	0.00198	0.000454	0.00469	0.00648
	Nickel (Ni)-Dissolved (mg/L)	0.00175	0.00102	0.00139	0.00101	0.00068
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	1.11	1.28	0.44	2.47	3.72
	Selenium (Se)-Dissolved (mg/L)	0.000072	0.000192	0.000098	0.000313	0.000502
	Silicon (Si)-Dissolved (mg/L)	6.69	6.15	7.62	6.31	5.58
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	7.13	10.3	5.13	19.2	14.3
	Strontium (Sr)-Dissolved (mg/L)	0.281	0.444	0.142	0.786	0.695
	Sulfur (S)-Dissolved (mg/L)	3.57	6.74	0.66	20.3	21.7
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00060 ^{DLM}	<0.00030	0.00037	<0.00030	0.00077
	Uranium (U)-Dissolved (mg/L)	0.000742	0.00139	0.000202	0.00279	0.00189
	Vanadium (V)-Dissolved (mg/L)	<0.00050	0.00078	0.00054	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2147434-6 Water 14-AUG-18 DUP				
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050				
	Molybdenum (Mo)-Dissolved (mg/L)	0.00649				
	Nickel (Ni)-Dissolved (mg/L)	0.00062				
	Phosphorus (P)-Dissolved (mg/L)	<0.050				
	Potassium (K)-Dissolved (mg/L)	3.67				
	Selenium (Se)-Dissolved (mg/L)	0.000443				
	Silicon (Si)-Dissolved (mg/L)	5.66				
	Silver (Ag)-Dissolved (mg/L)	<0.000010				
	Sodium (Na)-Dissolved (mg/L)	14.2				
	Strontium (Sr)-Dissolved (mg/L)	0.691				
	Sulfur (S)-Dissolved (mg/L)	21.7				
	Thallium (Tl)-Dissolved (mg/L)	<0.000010				
	Tin (Sn)-Dissolved (mg/L)	<0.00010				
	Titanium (Ti)-Dissolved (mg/L)	0.00033				
	Uranium (U)-Dissolved (mg/L)	0.00189				
	Vanadium (V)-Dissolved (mg/L)	<0.00050				
	Zinc (Zn)-Dissolved (mg/L)	<0.0010				
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Mercury (Hg)-Total	MS-B	L2147434-1, -2, -3, -4, -5, -6
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2147434-1, -2, -3, -4, -5, -6
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2147434-1, -2, -3, -4, -5, -6
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2147434-1, -2, -3, -4, -5, -6
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2147434-1, -2, -3, -4, -5, -6
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2147434-1, -2, -3, -4, -5, -6
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2147434-1, -2, -3, -4, -5, -6
Matrix Spike	Barium (Ba)-Total	MS-B	L2147434-1, -2, -3, -4, -5, -6
Matrix Spike	Calcium (Ca)-Total	MS-B	L2147434-1, -2, -3, -4, -5, -6
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2147434-1, -2, -3, -4, -5, -6
Matrix Spike	Sodium (Na)-Total	MS-B	L2147434-1, -2, -3, -4, -5, -6
Matrix Spike	Strontium (Sr)-Total	MS-B	L2147434-1, -2, -3, -4, -5, -6

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-WR	Water	Nitrite & Nitrate Nitrogen	EPA 300.1
Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance.			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-WR	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E

Reference Information

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Weston et al.

NO2-L-IC-N-WR Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-08-15 E

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lw - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

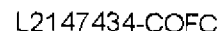
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Canada Toll Free: 1 800 668 9878

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COC Number: 2018-08-15 E

Page 2 of 2

REFER TO BACK PAGE FOR ALL LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 EPO



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 27-AUG-18
Report Date: 06-SEP-18 17:43 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2153562
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-08-22 A
Legal Site Desc:

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2153562-1 Water 20-AUG-18 10:00 W16	L2153562-2 Water 20-AUG-18 11:00 W8A	L2153562-3 Water 21-AUG-18 09:30 W3	L2153562-4 Water 21-AUG-18 10:05 W17	L2153562-5 Water 21-AUG-18 11:15 W7
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	476	943	556	495	283
	Hardness (as CaCO3) (mg/L)	230	443	275	233	141
	pH (pH)	8.27	7.59	8.18	8.12	8.14
	Total Suspended Solids (mg/L)	<3.0	37.1	<3.0	<3.0	<3.0
	TDS (Calculated) (mg/L)	279	545	281	263	154
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	168	243	177	159	145
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	168	243	177	159	145
	Ammonia, Total (as N) (mg/L)	0.0181	0.0833	<0.0050	<0.0050	0.0116
	Chloride (Cl) (mg/L)	5.11	5.43	4.60	5.62	<0.50
	Nitrate and Nitrite (as N) (mg/L)	1.73	6.04	0.114	0.188	0.118
	Nitrate (as N) (mg/L)	1.72	5.82	0.114	0.188	0.118
	Nitrite (as N) (mg/L)	0.0091	0.221	<0.0010	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	70.1	174	57.2	62.4	9.91
	Anion Sum (meq/L)	5.08	9.05	4.87	4.65	3.10
	Cation Sum (meq/L)	5.21	10.5	6.41	5.35	3.21
	Cation - Anion Balance (%)	1.3	7.3	13.7	6.9	1.7
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	16.4		6.15	9.86	8.34
Total Metals	Aluminum (Al)-Total (mg/L)	0.0698	0.0119	0.0055	<0.0030	0.0243
	Antimony (Sb)-Total (mg/L)	<0.00010	0.00011	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00048	0.00058	0.00023	0.00039	0.00044
	Barium (Ba)-Total (mg/L)	0.0705	0.0986	0.0603	0.0614	0.0699
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.013	0.022	0.022	0.022	<0.010
	Cadmium (Cd)-Total (mg/L)	0.0000089	0.000171	0.0000053	<0.0000050	<0.0000050
	Calcium (Ca)-Total (mg/L)	58.8	113	56.6	61.0	34.2
	Chromium (Cr)-Total (mg/L)	0.00018	0.00045	<0.00010	0.00011	0.00026
	Cobalt (Co)-Total (mg/L)	<0.00010	0.00056	<0.00010	<0.00010	0.00010
	Copper (Cu)-Total (mg/L)	0.0319	0.107	0.00300	0.00722	0.00102
	Iron (Fe)-Total (mg/L)	0.125	0.309	0.021	<0.010	0.129
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	0.0013	0.0032	0.0032	0.0015	0.0011
	Magnesium (Mg)-Total (mg/L)	18.3	32.2	28.2	18.0	12.4
	Manganese (Mn)-Total (mg/L)	0.0229	1.11	0.0354	0.00537	0.0345

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2153562-6 Water 20-AUG-18 DUP	L2153562-7 Water 21-AUG-18 DUP	L2153562-8 Water 21-AUG-18 14:10 MC1	L2153562-9 Water 21-AUG-18 16:40 MN	
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	470	287	361	524	
	Hardness (as CaCO3) (mg/L)	233	137	181	184	
	pH (pH)	8.26	8.12	8.29	7.86	
	Total Suspended Solids (mg/L)	<3.0	<3.0	37.7	55.9	
	TDS (Calculated) (mg/L)	280	153	200	314	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	168	144	171	142	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Total (as CaCO3) (mg/L)	168	144	171	142	
	Ammonia, Total (as N) (mg/L)	0.0187	0.0120	<0.0050	7.10	
	Chloride (Cl) (mg/L)	5.11	<0.50	1.51	2.22	
	Nitrate and Nitrite (as N) (mg/L)	1.73	0.119	0.0847	8.03	
	Nitrate (as N) (mg/L)	1.72	0.119	0.0847	7.71	
	Nitrite (as N) (mg/L)	0.0094	<0.0010	<0.0010	0.318	
	Sulfate (SO4) (mg/L)	70.1	9.91	21.0	86.3	
	Anion Sum (meq/L)	5.08	3.09	3.90	5.26	
	Cation Sum (meq/L)	5.28	3.16	4.15	5.34	
	Cation - Anion Balance (%)	1.9	1.0	3.0	0.8	
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	16.3	8.35	8.58		
Total Metals	Aluminum (Al)-Total (mg/L)	0.0803	0.0437	0.109	0.367	
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	0.00057	
	Arsenic (As)-Total (mg/L)	0.00048	0.00045	0.00062	0.00046	
	Barium (Ba)-Total (mg/L)	0.0750	0.0689	0.0609	0.0335	
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Total (mg/L)	0.013	<0.010	<0.010	0.079	
	Cadmium (Cd)-Total (mg/L)	0.0000105	<0.0000050	<0.0000050	0.0000704	
	Calcium (Ca)-Total (mg/L)	60.7	34.3	43.8	58.2	
	Chromium (Cr)-Total (mg/L)	0.00019	0.00029	0.00035	0.00041	
	Cobalt (Co)-Total (mg/L)	<0.00010	0.00012	0.00013	0.00027	
	Copper (Cu)-Total (mg/L)	0.0354	0.00112	0.00207	0.0646	
	Iron (Fe)-Total (mg/L)	0.142	0.159	0.263	0.649	
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	0.000055	0.000375	
	Lithium (Li)-Total (mg/L)	0.0013	0.0012	0.0017	0.0050	
	Magnesium (Mg)-Total (mg/L)	18.4	12.7	15.4	9.02	
	Manganese (Mn)-Total (mg/L)	0.0234	0.0370	0.0220	0.0658	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2153562-1 Water 20-AUG-18 10:00 W16	L2153562-2 Water 20-AUG-18 11:00 W8A	L2153562-3 Water 21-AUG-18 09:30 W3	L2153562-4 Water 21-AUG-18 10:05 W17	L2153562-5 Water 21-AUG-18 11:15 W7
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	0.0000063	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.00292	0.0109	0.00497	0.00658	0.00157
	Nickel (Ni)-Total (mg/L)	0.00105	0.00139	0.00094	0.00060	0.00099
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	2.44	4.95	2.07	3.28	0.93
	Selenium (Se)-Total (mg/L)	0.000678	0.00317	0.000271	0.000469	0.000193
	Silicon (Si)-Total (mg/L)	3.48	6.39	5.91	5.23	5.92
	Silver (Ag)-Total (mg/L)	<0.000010	0.000020	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	11.2	28.6	16.9	12.8	7.34
	Strontium (Sr)-Total (mg/L)	0.566	1.58	0.793	0.675	0.389
	Sulfur (S)-Total (mg/L)	25.0	63.3	20.8	22.6	3.43
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	<0.0048 ^{DLM}	<0.00054 ^{DLM}	<0.00030	<0.00030	0.00094
	Uranium (U)-Total (mg/L)	0.00143	0.00204	0.00296	0.00203	0.00139
	Vanadium (V)-Total (mg/L)	0.00081	0.00116	<0.00050	0.00058	0.00100
	Zinc (Zn)-Total (mg/L)	<0.0030	0.132	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	<0.00030	0.00033	<0.00030	<0.00030	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0040	0.0107	0.0021	0.0044	0.0092
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00045	0.00062	0.00025	0.00040	0.00044
	Barium (Ba)-Dissolved (mg/L)	0.0744	0.105	0.0692	0.0682	0.0769
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	0.000026	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.017	0.025	0.026	0.024	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	0.0000062	0.000145	0.0000056	<0.0000050	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	60.7	119	58.4	61.8	34.3
	Chromium (Cr)-Dissolved (mg/L)	0.00029	0.00040	<0.00010	<0.00010	0.00021
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00056	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.0289	0.112	0.00307	0.00764	0.00145
	Iron (Fe)-Dissolved (mg/L)	0.024	0.340	0.016	<0.010	0.105
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0012	0.0033	0.0032	0.0015	0.0011
	Magnesium (Mg)-Dissolved (mg/L)	19.1	35.5	31.3	19.0	13.4
	Manganese (Mn)-Dissolved (mg/L)	0.00144	1.20	0.0372	0.00346	0.0353

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2153562-6 Water 20-AUG-18 DUP	L2153562-7 Water 21-AUG-18 DUP	L2153562-8 Water 21-AUG-18 14:10 MC1	L2153562-9 Water 21-AUG-18 16:40 MN	
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	0.0000336	
	Molybdenum (Mo)-Total (mg/L)	0.00291	0.00155	0.00183	0.0179	
	Nickel (Ni)-Total (mg/L)	0.00089	0.00099	0.00108	<0.00050	
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	0.533	
	Potassium (K)-Total (mg/L)	2.42	0.95	1.24	4.19	
	Selenium (Se)-Total (mg/L)	0.000704	0.000178	0.000114	0.00949	
	Silicon (Si)-Total (mg/L)	3.50	6.03	6.22	2.98	
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	0.000017	
	Sodium (Na)-Total (mg/L)	11.7	7.58	9.96	22.0	
	Strontium (Sr)-Total (mg/L)	0.553	0.389	0.464	1.62	
	Sulfur (S)-Total (mg/L)	25.7	3.47	7.69	31.2	
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Total (mg/L)	0.00503	0.00194	0.00527	0.0212	
	Uranium (U)-Total (mg/L)	0.00143	0.00140	0.00183	0.000817	
	Vanadium (V)-Total (mg/L)	0.00085	0.00105	0.00128	0.00165	
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	0.0072	
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0129	0.0198	0.0043	0.0196	
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00038	
	Arsenic (As)-Dissolved (mg/L)	0.00046	0.00048	0.00054	0.00035	
	Barium (Ba)-Dissolved (mg/L)	0.0780	0.0789	0.0680	0.0337	
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	0.014	<0.010	<0.010	0.083	
	Cadmium (Cd)-Dissolved (mg/L)	0.0000116	<0.0000050	<0.0000050	0.0000312	
	Calcium (Ca)-Dissolved (mg/L)	61.1	32.1	44.5	58.7	
	Chromium (Cr)-Dissolved (mg/L)	0.00012	0.00030	0.00020	<0.00010	
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Copper (Cu)-Dissolved (mg/L)	0.0301	0.00299 ^{DTC}	0.00171	0.00837	
	Iron (Fe)-Dissolved (mg/L)	0.034	0.126	0.087	0.046	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.0012	0.0010	0.0016	0.0047	
	Magnesium (Mg)-Dissolved (mg/L)	19.5	13.8	17.0	9.19	
	Manganese (Mn)-Dissolved (mg/L)	0.00198	0.0376	0.00975	0.0493	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2153562-1 Water 20-AUG-18 10:00 W16	L2153562-2 Water 20-AUG-18 11:00 W8A	L2153562-3 Water 21-AUG-18 09:30 W3	L2153562-4 Water 21-AUG-18 10:05 W17	L2153562-5 Water 21-AUG-18 11:15 W7
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00306	0.0106	0.00494	0.00639	0.00151
	Nickel (Ni)-Dissolved (mg/L)	0.00087	0.00130	0.00092	0.00058	0.00097
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	2.69	5.53	2.43	3.55	1.09
	Selenium (Se)-Dissolved (mg/L)	0.000793	0.00370	0.000328	0.000475	0.000178
	Silicon (Si)-Dissolved (mg/L)	3.36	6.88	6.08	5.09	5.97
	Silver (Ag)-Dissolved (mg/L)	<0.000010	0.000016	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	12.4	32.2	19.8	13.9	8.34
	Strontium (Sr)-Dissolved (mg/L)	0.585	1.67	0.805	0.691	0.392
	Sulfur (S)-Dissolved (mg/L)	24.9	63.3	20.2	20.5	3.41
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00060 ^{DLM}	<0.00030	<0.00030	0.00044
	Uranium (U)-Dissolved (mg/L)	0.00137	0.00195	0.00278	0.00186	0.00131
	Vanadium (V)-Dissolved (mg/L)	<0.00050	0.00109	<0.00050	<0.00050	0.00078
	Zinc (Zn)-Dissolved (mg/L)	0.0010	0.134	<0.0010	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	0.00033	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2153562-6 Water 20-AUG-18 DUP	L2153562-7 Water 21-AUG-18 DUP	L2153562-8 Water 21-AUG-18 14:10 MC1	L2153562-9 Water 21-AUG-18 16:40 MN	
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	0.0000083	
	Molybdenum (Mo)-Dissolved (mg/L)	0.00289	0.00146	0.00189	0.0165	
	Nickel (Ni)-Dissolved (mg/L)	0.00086	0.00104	0.00093	<0.00050	
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	0.528	
	Potassium (K)-Dissolved (mg/L)	2.77	1.12	1.46	4.48	
	Selenium (Se)-Dissolved (mg/L)	0.000848	0.000180	0.000169	0.00957	
	Silicon (Si)-Dissolved (mg/L)	3.43	5.89	6.18	2.38	
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Sodium (Na)-Dissolved (mg/L)	12.7	8.62	11.2	23.7	
	Strontium (Sr)-Dissolved (mg/L)	0.596	0.364	0.485	1.64	
	Sulfur (S)-Dissolved (mg/L)	24.4	3.43	7.25	29.8	
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Dissolved (mg/L)	0.00102	0.00093	<0.00030	0.00077	
	Uranium (U)-Dissolved (mg/L)	0.00140	0.00115	0.00173	0.000733	
	Vanadium (V)-Dissolved (mg/L)	<0.00050	0.00089	0.00082	<0.00050	
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Dissolved Organic Carbon	MS-B	L2153562-7, -8
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2153562-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2153562-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Copper (Cu)-Dissolved	MS-B	L2153562-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2153562-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2153562-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2153562-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2153562-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2153562-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2153562-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Total	MS-B	L2153562-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L2153562-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Copper (Cu)-Total	MS-B	L2153562-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2153562-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Total	MS-B	L2153562-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Potassium (K)-Total	MS-B	L2153562-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Total	MS-B	L2153562-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L2153562-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sulfur (S)-Total	MS-B	L2153562-1, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DTC	Dissolved concentration exceeds total. Results were confirmed by re-analysis.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-WR	Water	Nitrite & Nitrate Nitrogen	EPA 300.1
Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance.			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-WR	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Reference Information

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 µm), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-WR Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
----------------------------	---------------------

WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
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	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
--	---

Reference Information

VA

Chain of Custody Numbers:

2018-08-22 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

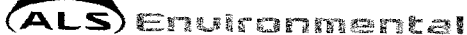
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

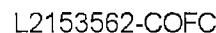
Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Canada Toll Free: 1 800 668 9878



Page 1 of 1

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OCTOBER 2016 FROM

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an **Authorized DW COC form**.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 29-AUG-18
Report Date: 17-SEP-18 15:01 (MT)
Version: FINAL REV. 3

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2155519
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-08-29 A
Legal Site Desc:

Comments: 17-SEP-2018 This report has been revised to remove sample L2155519-5 (AMP-1B).

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2155519-1 Water 27-AUG-18 09:40 W55	L2155519-2 Water 27-AUG-18 10:20 W8A	L2155519-3 Water 27-AUG-18 11:00 W16	L2155519-4 Water 27-AUG-18 13:50 MC1	L2155519-6 Water 28-AUG-18 09:10 W50
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	402	808	451	307	445
	Hardness (as CaCO3) (mg/L)	202	416	199	162	232
	pH (pH)	7.99	7.59	8.24	8.21	8.14
	Total Suspended Solids (mg/L)	3.2	200	6.6	17.2	<3.0
	TDS (Calculated) (mg/L)	266	542	264	182	280
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	116	266	162	160	170
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	116	266	162	160	170
	Ammonia, Total (as N) (mg/L)	0.0067	0.0656	0.0102	0.0057	0.0063
	Chloride (Cl) (mg/L)	1.43	5.40	5.30	1.19	5.32
	Nitrate and Nitrite (as N) (mg/L)	15.6	6.43	1.66	0.0668	1.59
	Nitrate (as N) (mg/L)	15.6	6.33	1.66	0.0668	1.58
	Nitrite (as N) (mg/L)	0.0023	0.0976	0.0084	<0.0010	0.0035
	Sulfate (SO4) (mg/L)	40.0	164	70.5	17.8	69.8
	Anion Sum (meq/L)	4.31	9.34	4.98	3.61	5.10
	Cation Sum (meq/L)	4.65	9.92	4.62	3.70	5.27
	Cation - Anion Balance (%)	3.8	3.0	-3.7	1.2	1.6
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)			16.0	11.4	15.7
Total Metals	Aluminum (Al)-Total (mg/L)	0.0588	3.46	0.0809	0.333	0.0194
	Antimony (Sb)-Total (mg/L)	0.00011	0.00256	<0.00010	0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00050	0.00180	0.00046	0.00077	0.00049
	Barium (Ba)-Total (mg/L)	0.0943	0.173	0.0781	0.0707	0.0745
	Beryllium (Be)-Total (mg/L)	<0.000020	0.000128	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	0.000233	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.025	0.025	0.014	<0.010	0.014
	Cadmium (Cd)-Total (mg/L)	0.0000145	0.00163	0.0000092	0.0000078	<0.0000050
	Calcium (Ca)-Total (mg/L)	52.4	116	60.7	40.4	60.6
	Chromium (Cr)-Total (mg/L)	0.00043	0.00453	0.00023	0.00088	0.00018
	Cobalt (Co)-Total (mg/L)	<0.00010	0.00298	<0.00010	0.00028	<0.00010
	Copper (Cu)-Total (mg/L)	0.0360	1.35	0.0361	0.00459	0.0279
	Iron (Fe)-Total (mg/L)	0.086	7.87	0.143	0.631	0.040
	Lead (Pb)-Total (mg/L)	0.000053	0.00356	0.000052	0.000139	0.000104
	Lithium (Li)-Total (mg/L)	0.0015	0.0051	0.0013	0.0016	0.0012
	Magnesium (Mg)-Total (mg/L)	17.3	37.3	20.0	15.6	20.0
	Manganese (Mn)-Total (mg/L)	0.00472	1.32	0.0299	0.0509	0.0202

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2155519-7 Water 28-AUG-18 09:55 W16A	L2155519-8 Water 28-AUG-18 10:15 W17	L2155519-9 Water 28-AUG-18 12:45 W3	L2155519-10 Water 28-AUG-18 14:15 W4	L2155519-11 Water 28-AUG-18 14:15 T-BL
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	437	458	456	146	<2.0
	Hardness (as CaCO3) (mg/L)	234	238	208	72.4	<0.50 ^{HTC}
	pH (pH)	8.27	8.13	8.14	8.03	5.40
	Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0	19.4	<3.0
	TDS (Calculated) (mg/L)	277	282	258	81.2	<1.0
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	162	184	162	67.5	<1.0
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	162	184	162	67.5	<1.0
	Ammonia, Total (as N) (mg/L)	0.0081	<0.0050	<0.0050	<0.0050	<0.0050
	Chloride (Cl) (mg/L)	5.30	5.66	5.15	<0.50	<0.50
	Nitrate and Nitrite (as N) (mg/L)	1.65	0.222	1.00	0.0319	<0.0051
	Nitrate (as N) (mg/L)	1.65	0.222	1.00	0.0319	<0.0050
	Nitrite (as N) (mg/L)	0.0074	<0.0010	<0.0010	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	70.2	63.6	65.1	11.0	<0.30
	Anion Sum (meq/L)	4.96	5.19	4.81	1.58	<0.10
	Cation Sum (meq/L)	5.32	5.46	4.78	1.62	<0.10
	Cation - Anion Balance (%)	3.5	2.6	-0.3	1.3	0.0
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	16.0	9.69	13.1	5.93	
Total Metals	Aluminum (Al)-Total (mg/L)	0.0360	<0.0030	0.0166	0.507	<0.0030
	Antimony (Sb)-Total (mg/L)	<0.00010	0.00012	<0.00010	0.00014	<0.00010
	Arsenic (As)-Total (mg/L)	0.00047	0.00042	0.00041	0.00094	<0.00010
	Barium (Ba)-Total (mg/L)	0.0790	0.0727	0.0709	0.0527	<0.00010
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	0.000024	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.014	0.023	0.018	<0.010	<0.010
	Cadmium (Cd)-Total (mg/L)	0.0000057	<0.0000050	<0.0000050	0.0000111	<0.0000050
	Calcium (Ca)-Total (mg/L)	60.6	62.4	59.9	19.7	<0.050
	Chromium (Cr)-Total (mg/L)	0.00022	0.00019	0.00021	0.00133	<0.00010
	Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	<0.00010	0.00034	<0.00010
	Copper (Cu)-Total (mg/L)	0.0328	0.00804	0.0153	0.00300	<0.00050
	Iron (Fe)-Total (mg/L)	0.081	<0.010	0.037	0.663	<0.010
	Lead (Pb)-Total (mg/L)	0.000168	<0.000050	<0.000050	0.000268	<0.000050
	Lithium (Li)-Total (mg/L)	0.0012	0.0015	0.0019	0.0013	<0.0010
	Magnesium (Mg)-Total (mg/L)	19.8	20.2	23.4	6.40	<0.10
	Manganese (Mn)-Total (mg/L)	0.0262	0.00637	0.0223	0.0252	<0.00010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2155519-12 Water 28-AUG-18 DUP	L2155519-13 Water 28-AUG-18 14:30 W2	L2155519-14 Water 28-AUG-18 15:20 W5	L2155519-15 Water 28-AUG-18 13:55 BC1	
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	324	324	151	159	
	Hardness (as CaCO3) (mg/L)	166	165	72.6	77.4	
	pH (pH)	8.25	8.29	8.02	7.88	
	Total Suspended Solids (mg/L)	4.2	14.2	28.0	96.6	
	TDS (Calculated) (mg/L)	187	188	82.3	89.3	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	158	159	68.9	75.8	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	1.6	<1.0	<1.0	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Total (as CaCO3) (mg/L)	158	161	68.9	75.8	
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	0.0062	
	Chloride (Cl) (mg/L)	1.63	1.62	<0.50	<0.50	
	Nitrate and Nitrite (as N) (mg/L)	0.0642	0.0650	0.0268	0.0746	
	Nitrate (as N) (mg/L)	0.0642	0.0650	0.0268	0.0746	
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Sulfate (SO4) (mg/L)	22.0	22.1	11.4	10.7	
	Anion Sum (meq/L)	3.67	3.72	1.62	1.74	
	Cation Sum (meq/L)	3.79	3.77	1.61	1.83	
	Cation - Anion Balance (%)	1.6	0.7	-0.2	2.5	
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	10.4	10.5	5.07	11.3	
Total Metals	Aluminum (Al)-Total (mg/L)	0.0712	0.741	0.349	2.68	
	Antimony (Sb)-Total (mg/L)	<0.00010	0.00010	0.00014	0.00025	
	Arsenic (As)-Total (mg/L)	0.00060	0.00088	0.00082	0.00265	
	Barium (Ba)-Total (mg/L)	0.0680	0.0791	0.0488	0.0982	
	Beryllium (Be)-Total (mg/L)	<0.000020	0.000027	<0.000020	0.000094	
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	0.000081	
	Boron (B)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	
	Cadmium (Cd)-Total (mg/L)	<0.0000050	0.0000148	0.0000092	0.0000426	
	Calcium (Ca)-Total (mg/L)	42.7	42.4	20.4	19.0	
	Chromium (Cr)-Total (mg/L)	0.00037	0.00133	0.00072	0.00494	
	Cobalt (Co)-Total (mg/L)	0.00010	0.00051	0.00021	0.00156	
	Copper (Cu)-Total (mg/L)	0.00276	0.0336	0.00188	0.00746	
	Iron (Fe)-Total (mg/L)	0.174	1.13	0.428	3.28	
	Lead (Pb)-Total (mg/L)	<0.000050	0.000293	0.000168	0.00127	
	Lithium (Li)-Total (mg/L)	0.0016	0.0020	0.0012	0.0025	
	Magnesium (Mg)-Total (mg/L)	15.9	15.7	6.31	8.61	
	Manganese (Mn)-Total (mg/L)	0.0117	0.0613	0.0227	0.0937	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2155519-1 Water 27-AUG-18 09:40 W55	L2155519-2 Water 27-AUG-18 10:20 W8A	L2155519-3 Water 27-AUG-18 11:00 W16	L2155519-4 Water 27-AUG-18 13:50 MC1	L2155519-6 Water 28-AUG-18 09:10 W50
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.000050 ^{DLM}	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.00206	0.0109	0.00295	0.00162	0.00298
	Nickel (Ni)-Total (mg/L)	0.00111	0.00579	0.00093	0.00180	0.00085
	Phosphorus (P)-Total (mg/L)	<0.050	0.326	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	2.32	6.60	2.76	1.24	2.70
	Selenium (Se)-Total (mg/L)	0.000473	0.00333	0.000743	0.000134	0.000731
	Silicon (Si)-Total (mg/L)	5.17	12.2	3.55	6.74	3.43
	Silver (Ag)-Total (mg/L)	<0.000010	0.000559	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	13.2	33.1	13.2	10.1	13.0
	Strontium (Sr)-Total (mg/L)	0.478	1.60	0.587	0.422	0.586
	Sulfur (S)-Total (mg/L)	13.8	56.1	23.5	6.14	23.3
	Thallium (Tl)-Total (mg/L)	<0.000010	0.000048	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	0.00033	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	0.00206	0.192	0.00410	0.0148	<0.0012 ^{DLM}
	Uranium (U)-Total (mg/L)	0.000319	0.00209	0.00148	0.00154	0.00144
	Vanadium (V)-Total (mg/L)	0.00066	0.0146	0.00076	0.00183	<0.00050
	Zinc (Zn)-Total (mg/L)	<0.0030	0.357	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	<0.00030	0.00063	<0.00030	0.00031	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0116	0.0118	0.0122	0.0143	0.0034
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	0.00015	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00044	0.00067	0.00045	0.00058	0.00043
	Barium (Ba)-Dissolved (mg/L)	0.0983	0.109	0.0799	0.0655	0.0751
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	0.000021	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.023	0.022	<0.010	<0.010	0.013
	Cadmium (Cd)-Dissolved (mg/L)	0.0000101	0.000288	0.0000090	<0.0000050	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	54.3	112	48.6	40.8	61.7
	Chromium (Cr)-Dissolved (mg/L)	0.00024	0.00040	0.00012	0.00023	0.00017
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00061	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.0322	0.133	0.0288	0.00200	0.0244
	Iron (Fe)-Dissolved (mg/L)	0.023	0.202	0.023	0.134	0.017
	Lead (Pb)-Dissolved (mg/L)	<0.000050	0.000067	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0013	0.0032	<0.0010	0.0014	0.0012
	Magnesium (Mg)-Dissolved (mg/L)	16.0	33.0	18.9	14.5	19.0
	Manganese (Mn)-Dissolved (mg/L)	0.00095	1.12	0.00247	0.0162	0.00884

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2155519-7 Water 28-AUG-18 09:55 W16A	L2155519-8 Water 28-AUG-18 10:15 W17	L2155519-9 Water 28-AUG-18 12:45 W3	L2155519-10 Water 28-AUG-18 14:15 W4	L2155519-11 Water 28-AUG-18 14:15 T-BL
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.00300	0.00670	0.00440	0.00125	<0.000050
	Nickel (Ni)-Total (mg/L)	0.00090	0.00074	0.00123	0.00285	<0.00050
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	2.71	3.69	2.67	0.84	<0.10
	Selenium (Se)-Total (mg/L)	0.000722	0.000464	0.000478	0.000134	<0.000050
	Silicon (Si)-Total (mg/L)	3.57	5.44	4.36	4.93	<0.10
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	12.9	14.9	15.3	3.76	<0.050
	Strontium (Sr)-Total (mg/L)	0.590	0.690	0.650	0.149	<0.00020
	Sulfur (S)-Total (mg/L)	23.9	22.2	21.7	3.27	<0.50
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	0.00180	<0.00030	<0.00060 ^{DLM}	0.0186	<0.00030
	Uranium (U)-Total (mg/L)	0.00146	0.00196	0.00187	0.00121	<0.000010
	Vanadium (V)-Total (mg/L)	0.00058	<0.00050	<0.00050	0.00196	<0.00050
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0019	0.0017	0.0032	0.0255	
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00011	
	Arsenic (As)-Dissolved (mg/L)	0.00049	0.00041	0.00036	0.00054	
	Barium (Ba)-Dissolved (mg/L)	0.0807	0.0717	0.0649	0.0440	
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	0.013	0.022	0.014	<0.010	
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Calcium (Ca)-Dissolved (mg/L)	62.0	64.2	51.3	19.5	
	Chromium (Cr)-Dissolved (mg/L)	0.00015	0.00010	0.00012	0.00017	
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Copper (Cu)-Dissolved (mg/L)	0.0288	0.00722	0.0119	0.00148	
	Iron (Fe)-Dissolved (mg/L)	0.016	<0.010	0.018	0.044	
	Lead (Pb)-Dissolved (mg/L)	0.000112	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.0012	0.0014	0.0015	<0.0010	
	Magnesium (Mg)-Dissolved (mg/L)	19.3	18.9	19.5	5.74	
	Manganese (Mn)-Dissolved (mg/L)	0.00207	0.00289	0.0129	0.00556	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2155519-12 Water 28-AUG-18 DUP	L2155519-13 Water 28-AUG-18 14:30 W2	L2155519-14 Water 28-AUG-18 15:20 W5	L2155519-15 Water 28-AUG-18 13:55 BC1	
Grouping	Analyte						
WATER							
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050 ^{DLM}		
	Molybdenum (Mo)-Total (mg/L)	0.00169	0.00166	0.00120	0.00104		
	Nickel (Ni)-Total (mg/L)	0.00124	0.00211	0.00106	0.00459		
	Phosphorus (P)-Total (mg/L)	<0.050	0.057	<0.050	0.105		
	Potassium (K)-Total (mg/L)	1.36	1.48	0.87	1.07		
	Selenium (Se)-Total (mg/L)	0.000147	0.000170	0.000099	0.000110		
	Silicon (Si)-Total (mg/L)	6.09	6.84	4.22	10.5		
	Silver (Ag)-Total (mg/L)	<0.000010	0.000021	<0.000010	0.000020		
	Sodium (Na)-Total (mg/L)	10.6	10.4	3.41	6.12		
	Strontium (Sr)-Total (mg/L)	0.455	0.444	0.147	0.214		
	Sulfur (S)-Total (mg/L)	7.97	7.04	3.57	3.36		
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	0.000028		
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010 ^{DLM}	<0.00010		
	Titanium (Ti)-Total (mg/L)	0.00309	0.0329	<0.014	0.100		
	Uranium (U)-Total (mg/L)	0.00174	0.00172	0.00116	0.00178		
	Vanadium (V)-Total (mg/L)	0.00105	0.00300	0.00143	0.00830		
	Zinc (Zn)-Total (mg/L)	<0.0030	0.0040	<0.0030	0.0108		
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	0.00034		
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD		
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD		
	Aluminum (Al)-Dissolved (mg/L)	0.0091	0.0072	0.0329	0.0738		
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	0.00011	0.00024		
	Arsenic (As)-Dissolved (mg/L)	0.00054	0.00051	0.00053	0.00070		
	Barium (Ba)-Dissolved (mg/L)	0.0658	0.0668	0.0425	0.0531		
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020		
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050		
	Boron (B)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010		
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	0.0000050	0.0000126	0.0000194		
	Calcium (Ca)-Dissolved (mg/L)	42.5	42.0	20.0	18.5		
	Chromium (Cr)-Dissolved (mg/L)	0.00011	0.00023	0.00017	0.00038		
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010		
	Copper (Cu)-Dissolved (mg/L)	0.00283	0.00267	0.00360	0.00410		
	Iron (Fe)-Dissolved (mg/L)	0.066	0.057	0.076	0.139		
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	0.000074	0.000116		
	Lithium (Li)-Dissolved (mg/L)	0.0015	0.0015	<0.0010	0.0012		
	Magnesium (Mg)-Dissolved (mg/L)	14.6	14.7	5.52	7.56		
	Manganese (Mn)-Dissolved (mg/L)	0.00416	0.00371	0.0110	0.0102		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2155519-1 Water 27-AUG-18 09:40 W55	L2155519-2 Water 27-AUG-18 10:20 W8A	L2155519-3 Water 27-AUG-18 11:00 W16	L2155519-4 Water 27-AUG-18 13:50 MC1	L2155519-6 Water 28-AUG-18 09:10 W50
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00205	0.00984	0.00227	0.00160	0.00283
	Nickel (Ni)-Dissolved (mg/L)	0.00087	0.00114	0.00080	0.00108	0.00070
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	2.43	5.55	2.82	1.22	2.76
	Selenium (Se)-Dissolved (mg/L)	0.000570	0.00362	0.000767	0.000141	0.000781
	Silicon (Si)-Dissolved (mg/L)	5.05	6.71	3.51	6.16	3.52
	Silver (Ag)-Dissolved (mg/L)	<0.000010	0.000020	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	12.8	32.1	12.9	9.78	12.7
	Strontium (Sr)-Dissolved (mg/L)	0.466	1.52	0.445	0.403	0.559
	Sulfur (S)-Dissolved (mg/L)	13.8	58.0	25.1	5.95	24.0
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00062	0.00062	<0.00030	0.00135	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.000298	0.00183	0.000999	0.00138	0.00134
	Vanadium (V)-Dissolved (mg/L)	<0.00050	0.00089	<0.00050	0.00079	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0012	0.131	<0.0010	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	0.00032	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2155519-7 Water 28-AUG-18 09:55 W16A	L2155519-8 Water 28-AUG-18 10:15 W17	L2155519-9 Water 28-AUG-18 12:45 W3	L2155519-10 Water 28-AUG-18 14:15 W4	L2155519-11 Water 28-AUG-18 14:15 T-BL
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Dissolved (mg/L)	0.00280	0.00638	0.00361	0.00109	
	Nickel (Ni)-Dissolved (mg/L)	0.00079	0.00052	0.00083	0.00055	
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Potassium (K)-Dissolved (mg/L)	2.85	3.67	2.36	0.74	
	Selenium (Se)-Dissolved (mg/L)	0.000672	0.000494	0.000626	0.000125	
	Silicon (Si)-Dissolved (mg/L)	3.04	5.39	4.25	4.12	
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Sodium (Na)-Dissolved (mg/L)	12.9	14.0	12.8	3.45	
	Strontium (Sr)-Dissolved (mg/L)	0.560	0.673	0.537	0.142	
	Sulfur (S)-Dissolved (mg/L)	21.0	22.0	22.0	3.49	
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00060 ^{DLM}	
	Uranium (U)-Dissolved (mg/L)	0.00131	0.00184	0.00149	0.00108	
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	0.00051	
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	0.0014	<0.0010	
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2155519-12 Water 28-AUG-18 DUP	L2155519-13 Water 28-AUG-18 14:30 W2	L2155519-14 Water 28-AUG-18 15:20 W5	L2155519-15 Water 28-AUG-18 13:55 BC1	
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Dissolved (mg/L)	0.00160	0.00158	0.00113	0.000982	
	Nickel (Ni)-Dissolved (mg/L)	0.00090	0.00088	<0.00050	0.00107	
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Potassium (K)-Dissolved (mg/L)	1.34	1.35	0.80	0.71	
	Selenium (Se)-Dissolved (mg/L)	0.000129	0.000141	0.000128	0.000087	
	Silicon (Si)-Dissolved (mg/L)	5.57	5.42	3.57	6.26	
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Sodium (Na)-Dissolved (mg/L)	9.81	9.90	3.03	5.80	
	Strontium (Sr)-Dissolved (mg/L)	0.428	0.412	0.135	0.206	
	Sulfur (S)-Dissolved (mg/L)	7.23	7.06	3.59	3.73	
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Dissolved (mg/L)	<0.00060 ^{DLM}	<0.00060 ^{DLM}	0.00193	0.00235	
	Uranium (U)-Dissolved (mg/L)	0.00154	0.00149	0.00102	0.00149	
	Vanadium (V)-Dissolved (mg/L)	0.00069	0.00066	<0.00050	0.00101	
	Zinc (Zn)-Dissolved (mg/L)	0.0026	<0.0010	0.0019	0.0073	
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	0.00046	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Selenium (Se)-Dissolved	B	L2155519-14
Matrix Spike	Dissolved Organic Carbon	MS-B	L2155519-10, -12, -13, -14, -15, -3, -4, -6, -7, -8, -9
Matrix Spike	Dissolved Organic Carbon	MS-B	L2155519-10, -12, -13, -14, -15, -3, -4, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2155519-1, -10, -12, -13, -14, -2, -3, -4, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2155519-15
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2155519-14
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2155519-1, -10, -12, -13, -14, -2, -3, -4, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2155519-15
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2155519-14
Matrix Spike	Copper (Cu)-Dissolved	MS-B	L2155519-1, -10, -12, -13, -14, -2, -3, -4, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2155519-1, -10, -12, -13, -14, -2, -3, -4, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2155519-15
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2155519-14
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2155519-1, -10, -12, -13, -14, -2, -3, -4, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2155519-15
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2155519-1, -10, -12, -13, -14, -2, -3, -4, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2155519-1, -10, -12, -13, -14, -2, -3, -4, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2155519-15
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2155519-14
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2155519-1, -10, -12, -13, -14, -2, -3, -4, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2155519-15
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2155519-14
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2155519-1, -10, -12, -13, -14, -2, -3, -4, -6, -7, -8, -9
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2155519-15
Matrix Spike	Uranium (U)-Dissolved	MS-B	L2155519-15
Matrix Spike	Calcium (Ca)-Total	MS-B	L2155519-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2155519-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Total	MS-B	L2155519-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L2155519-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
HTC	Hardness was calculated from Total Ca and/or Mg concentrations and may be biased high (dissolved Ca/Mg results unavailable).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
ANIONS-N+N-CALC-WR	Water	Nitrite & Nitrate Nitrogen	EPA 300.1
Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance.			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Reference Information

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

BE-T-L-CCMS-VA Water Total Be (Low) in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

CARBONS-DOC-VA Water Dissolved organic carbon by combustion APHA 5310B

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.

CL-IC-N-VA Water Chloride in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

CL-IC-N-WR Water Chloride in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

EC-PCT-VA Water Conductivity (Automated) APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-SCREEN-VA Water Conductivity Screen (Internal Use Only) APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = \frac{[\text{Cation Sum} - \text{Anion Sum}]}{[\text{Cation Sum} + \text{Anion Sum}]}$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO2-L-IC-N-WR Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

Reference Information

NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-WR	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
SO4-IC-N-VA	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
SO4-IC-WR	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)
This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".			
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.			
TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.			
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-08-29 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com



L2155519-COFC

COC Number: 2018-08-29 A

Page 1 of 2

Report To		Report Format / Distribution		Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply	
Company:	Minto Explorations Ltd.	Select Report Format:	☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)	Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply	
Contact:	Minto Environment - Coordinator	Quality Control (QC) Report with Report	☒ YES ☐ NO	PRIORITY (Business Day) 4 day [P4] ☐ 3 day [P3] ☐ 2 day [P2] ☐	EMERGENCY 1 Business day [E1] ☐ Same Day, Weekend or Statutory holiday [E0] ☐
Phone:	1-604-759-4659	☒ Compare Results to Criteria on Report - provide details below if box checked			
Company address below will appear on the final report		Select Distribution:	☒ EMAIL ☐ MAIL ☐ FAX		
Street:	2100-510 West Georgia St.	Email 1 or Fax	mintoenvironment@mintomine.com	Date and Time Required for all E&P TATs: dd-mm-yy hh:mm	
City/Province:	Vancouver, British Columbia	Email 2		For tests that can not be performed according to the service level selected, you will be contacted.	
Postal Code:	V6B 0M3	Email 3		Analysis Request	
Invoice To	Same as Report To ☐ YES ☒ NO	Invoice Distribution		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below	
	Copy of Invoice with Report ☐ YES ☒ NO	Select Invoice Distribution:	☒ EMAIL ☐ MAIL ☐ FAX		
Company:	Minto Explorations Ltd.	Email 1 or Fax	ap@mintomine.com		
Contact:	Ruth Cayetano	Email 2			
Project Information		Oil and Gas Required Fields (client use)			
ALS Account # / Quote #:		AFE/Cost Center:	PO#		
Job #:		Major/Minor Code:	Routing Code:		
PO / AFE:	229096 (WUL)	Requisitioner:			
LSD:		Location:			
ALS Lab Work Order # (lab use only)		ALS Contact:	Shane Stack	Sampler:	CH/CR
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mm-yy)	Time (hh:mm)	Sample Type	
	W55	27-Aug-18	9:40	Water	
	W8A	27-Aug-18	10:20	Water	
	W16	27-Aug-18	11:00	Water	
	MC1	27-Aug-18	13:50	Water	
	AMP-1B	28-Aug-18	8:55	Water	
	W50	28-Aug-18	9:10	Water	
	W16A	28-Aug-18	9:55	Water	
	W17	28-Aug-18	10:15	Water	
	W3	28-Aug-18	12:45	Water	
	W4	28-Aug-18	14:15	Water	
Drinking Water (DW) Samples ¹ (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)		SAMPLE CONDITION AS RECEIVED (lab use only)	
Are samples taken from a Regulated DW System? ☐ YES ☒ NO				Frozen ☐ SIF Observations Yes ☐ No ☐	
Are samples for human drinking water use? ☐ YES ☒ NO				Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐	
				Cooling Initiated ☒	
				INITIAL COOLER TEMPERATURES °C: 7° 6° 6° 7°	
				FINAL COOLER TEMPERATURES °C: 7°	
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)		FINAL SHIPMENT RECEPTION (lab use only)	
Released by: Chris Harry	Date: 2018-08-29 9:30	Time:	Received by: [Signature]	Date: Aug 29/18	Time: 14:47
				Date: 8/30	Time: 12:00

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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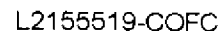
OCTOBER 2016 PRINT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



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If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

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Chain of Custody (COC) / Analytical Request Form

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12155519-COFC

COC Number: 2018-08-15 C

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1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 05-SEP-18
Report Date: 14-SEP-18 16:17 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2158981
Project P.O. #: 229096 (WUL)
Job Reference:
C of C Numbers: 2018-09-05 C
Legal Site Desc:

Shane Stack
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2158981-1 Water 29-AUG-18 14:15 MN-4.5	L2158981-2 Water 29-AUG-18 15:30 MN-2.5	L2158981-3 Water 29-AUG-18 16:00 MN-0.5	L2158981-4 Water 29-AUG-18 17:20 MN-1.5	L2158981-5 Water 30-AUG-18 15:35 MN-0.2
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	182	175	168	80.8	78.4
	Hardness (as CaCO3) (mg/L)	84.4	82.8	78.0	37.6	36.8
	pH (pH)	8.00	7.95	7.94	7.42	7.34
	Total Suspended Solids (mg/L)	3.1	55.9	8.9	<3.0	5.9
	TDS (Calculated) (mg/L)	93.8	89.7	87.8	42.0	41.6
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	84.5	87.8	76.1	35.3	29.4
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	84.5	87.8	76.1	35.3	29.4
	Ammonia, Total (as N) (mg/L)	0.0074	0.0106	<0.0050	0.0062	0.0064
	Chloride (Cl) (mg/L)	0.52	0.71	<0.50	<0.50	<0.50
	Nitrate and Nitrite (as N) (mg/L)	0.0312	0.0086	0.0306	<0.0051	<0.0051
	Nitrate (as N) (mg/L)	0.0312	0.0086	0.0306	<0.0050	<0.0050
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	7.63	2.58	9.34	4.36	7.35
	Anion Sum (meq/L)	1.86	1.83	1.72	0.80	0.74
	Cation Sum (meq/L)	1.90	1.85	1.78	0.90	0.92
	Cation - Anion Balance (%)	1.0	0.6	1.7	6.3	10.5
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	16.0	14.9	17.9	19.4	24.3
Total Metals	Aluminum (Al)-Total (mg/L)	0.0808	0.881	0.0790	0.154	0.333
	Antimony (Sb)-Total (mg/L)	<0.00010	0.00012	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00042	0.00080	0.00045	0.00048	0.00084
	Barium (Ba)-Total (mg/L)	0.0402	0.0516	0.0418	0.0301	0.0405
	Beryllium (Be)-Total (mg/L)	<0.000020	0.000034	<0.000020	<0.000020	0.000022
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)-Total (mg/L)	<0.0000050	0.0000106	<0.0000050	<0.0000050	0.0000074
	Calcium (Ca)-Total (mg/L)	23.4	22.7	22.1	10.3	10.4
	Chromium (Cr)-Total (mg/L)	0.00049	0.00194	0.00051	0.00102	0.00102
	Cobalt (Co)-Total (mg/L)	<0.00010	0.00084	0.00012	0.00033	0.00065
	Copper (Cu)-Total (mg/L)	0.00238	0.00377	0.00252	0.00708	0.00344
	Iron (Fe)-Total (mg/L)	0.155	1.36	0.183	0.548	1.42
	Lead (Pb)-Total (mg/L)	<0.000050	0.000426	<0.000050	0.000135	0.000094
	Lithium (Li)-Total (mg/L)	<0.0010	0.0014	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)-Total (mg/L)	5.99	6.44	5.56	3.15	3.24
	Manganese (Mn)-Total (mg/L)	0.00572	0.0443	0.00971	0.0297	0.0864

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2158981-6 Water 29-AUG-18 DUP	L2158981-7 Water 03-SEP-18 09:20 W17	L2158981-8 Water 03-SEP-18 09:35 W16	L2158981-9 Water 03-SEP-18 10:30 W8A	
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	180	501	478	940	
	Hardness (as CaCO3) (mg/L)	83.6	225	222	419	
	pH (pH)	8.01	8.09	8.13	7.42	
	Total Suspended Solids (mg/L)	4.5	<3.0	<3.0	3.3	
	TDS (Calculated) (mg/L)	94.4	286	278	596	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	86.0	198	173	301	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Total (as CaCO3) (mg/L)	86.0	198	173	301	
	Ammonia, Total (as N) (mg/L)	0.0061	<0.0050	0.0248	0.0814	
	Chloride (Cl) (mg/L)	0.52	5.85	5.67	5.9	
	Nitrate and Nitrite (as N) (mg/L)	0.0303	0.248	1.65	6.91	
	Nitrate (as N) (mg/L)	0.0303	0.248	1.64	6.87	
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	0.0097	0.0374	
	Sulfate (SO4) (mg/L)	7.62	65.7	69.8	196	
	Anion Sum (meq/L)	1.89	5.51	5.18	10.8	
	Cation Sum (meq/L)	1.88	5.15	5.04	9.87	
	Cation - Anion Balance (%)	-0.4	-3.4	-1.4	-4.3	
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	16.2	10.1	16.4		
Total Metals	Aluminum (Al)-Total (mg/L)	0.0725	<0.0090 ^{DLB}	<0.030 ^{DLB}	0.445	
	Antimony (Sb)-Total (mg/L)	<0.00010	0.00011	<0.00010	0.00031	
	Arsenic (As)-Total (mg/L)	0.00044	0.00041	0.00044	0.00087	
	Barium (Ba)-Total (mg/L)	0.0403	0.0654	0.0722	0.116	
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	0.000032	
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Total (mg/L)	<0.010	0.022	0.014	0.024	
	Cadmium (Cd)-Total (mg/L)	<0.0000050	<0.0000050	0.0000087	0.000285	
	Calcium (Ca)-Total (mg/L)	25.0	62.4	59.5	120	
	Chromium (Cr)-Total (mg/L)	0.00043	0.00011	0.00016	0.00103	
	Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	<0.00010	0.00091	
	Copper (Cu)-Total (mg/L)	0.00229	0.00756	0.0316	0.276	
	Iron (Fe)-Total (mg/L)	0.144	<0.010	0.076	1.55	
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	0.000498	
	Lithium (Li)-Total (mg/L)	<0.0010	0.0016	0.0013	0.0038	
	Magnesium (Mg)-Total (mg/L)	6.04	18.9	17.9	32.9	
	Manganese (Mn)-Total (mg/L)	0.00569	0.00552	0.167	1.14	

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2158981-1 Water 29-AUG-18 14:15 MN-4.5	L2158981-2 Water 29-AUG-18 15:30 MN-2.5	L2158981-3 Water 29-AUG-18 16:00 MN-0.5	L2158981-4 Water 29-AUG-18 17:20 MN-1.5	L2158981-5 Water 30-AUG-18 15:35 MN-0.2
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.000788	0.000584	0.000826	0.000242	0.000154
	Nickel (Ni)-Total (mg/L)	0.00104	0.00269	0.00124	0.00100	0.00157
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	0.57	0.55	0.49	0.15	0.16
	Selenium (Se)-Total (mg/L)	0.000126	0.000094	0.000141	0.000078	0.000060
	Silicon (Si)-Total (mg/L)	5.65	7.40	6.04	6.38	6.71
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	4.46	4.12	4.46	2.86	3.20
	Strontium (Sr)-Total (mg/L)	0.156	0.119	0.171	0.0496	0.0629
	Sulfur (S)-Total (mg/L)	2.65	1.08	3.31	1.58	2.76
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	0.00344	0.0425	0.00331	0.00767	0.0121
	Uranium (U)-Total (mg/L)	0.000324	0.000172	0.000238	0.000031	0.000045
	Vanadium (V)-Total (mg/L)	0.00085	0.00369	0.00088	0.00103	0.00173
	Zinc (Zn)-Total (mg/L)	<0.0030	0.0043	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	0.00033	0.00049	0.00043	0.00062	0.00077
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0149	0.0170	0.0202	0.0720	0.101
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00038	0.00035	0.00042	0.00036	0.00052
	Barium (Ba)-Dissolved (mg/L)	0.0392	0.0350	0.0395	0.0269	0.0316
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050	0.0000082	<0.0000050	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	23.2	22.7	21.8	10.1	9.59
	Chromium (Cr)-Dissolved (mg/L)	0.00028	0.00030	0.00041	0.00068	0.00064
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00014	<0.00010	0.00017	0.00024
	Copper (Cu)-Dissolved (mg/L)	0.00202	0.00211	0.00203	0.00589	0.00251
	Iron (Fe)-Dissolved (mg/L)	0.051	0.085	0.078	0.279	0.444
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)-Dissolved (mg/L)	6.42	6.37	5.74	3.04	3.13
	Manganese (Mn)-Dissolved (mg/L)	0.00086	0.0206	0.00218	0.0158	0.0324

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ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2158981-6 Water 29-AUG-18 DUP	L2158981-7 Water 03-SEP-18 09:20 W17	L2158981-8 Water 03-SEP-18 09:35 W16	L2158981-9 Water 03-SEP-18 10:30 W8A	
Grouping	Analyte						
WATER							
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	0.0000052		
	Molybdenum (Mo)-Total (mg/L)	0.000830	0.00697	0.00297	0.0113		
	Nickel (Ni)-Total (mg/L)	0.00103	<0.00050	0.00058	0.00144		
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	0.080		
	Potassium (K)-Total (mg/L)	0.57	3.45	2.60	5.77		
	Selenium (Se)-Total (mg/L)	0.000123	0.000548	0.000690	0.00413		
	Silicon (Si)-Total (mg/L)	5.77	5.35	3.73	7.93		
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	0.000083		
	Sodium (Na)-Total (mg/L)	4.45	13.4	12.1	30.6		
	Strontium (Sr)-Total (mg/L)	0.163	0.672	0.574	1.67		
	Sulfur (S)-Total (mg/L)	2.80	22.9	24.4	70.7		
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010		
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010		
	Titanium (Ti)-Total (mg/L)	0.00307	<0.00030	0.00104	0.0286		
	Uranium (U)-Total (mg/L)	0.000324	0.00201	0.00135	0.00204		
	Vanadium (V)-Total (mg/L)	0.00083	<0.00050	<0.00050	0.00305		
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	0.289		
	Zirconium (Zr)-Total (mg/L)	0.00033	<0.00030	<0.00030	0.00043		
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD		
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD		
	Aluminum (Al)-Dissolved (mg/L)	0.0150	0.0011	0.0046	0.0094		
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010		
	Arsenic (As)-Dissolved (mg/L)	0.00037	0.00039	0.00041	0.00062		
	Barium (Ba)-Dissolved (mg/L)	0.0390	0.0666	0.0708	0.103		
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	0.000023		
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050		
	Boron (B)-Dissolved (mg/L)	<0.010	0.022	0.014	0.023		
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050	0.0000068	0.000175		
	Calcium (Ca)-Dissolved (mg/L)	23.2	59.6	59.1	113		
	Chromium (Cr)-Dissolved (mg/L)	0.00029	<0.00010	0.00013	0.00038		
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00053		
	Copper (Cu)-Dissolved (mg/L)	0.00199	0.00698	0.0269	0.109		
	Iron (Fe)-Dissolved (mg/L)	0.051	<0.010	0.023	0.334		
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050		
	Lithium (Li)-Dissolved (mg/L)	<0.0010	0.0015	0.0012	0.0033		
	Magnesium (Mg)-Dissolved (mg/L)	6.21	18.4	18.1	32.9		
	Manganese (Mn)-Dissolved (mg/L)	0.00084	0.00300	0.0739	1.06		

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2158981-1 Water 29-AUG-18 14:15 MN-4.5	L2158981-2 Water 29-AUG-18 15:30 MN-2.5	L2158981-3 Water 29-AUG-18 16:00 MN-0.5	L2158981-4 Water 29-AUG-18 17:20 MN-1.5	L2158981-5 Water 30-AUG-18 15:35 MN-0.2
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.000752	0.000614	0.000776	0.000290	0.000151
	Nickel (Ni)-Dissolved (mg/L)	0.00109	0.00116	0.00124	0.00104	0.00125
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	0.58	0.47	0.50	0.17	0.14
	Selenium (Se)-Dissolved (mg/L)	0.000120	0.000096	0.000167	0.000063	0.000080
	Silicon (Si)-Dissolved (mg/L)	5.53	5.54	5.50	6.09	6.05
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	4.50	4.02	4.54	2.82	3.20
	Strontium (Sr)-Dissolved (mg/L)	0.160	0.109	0.165	0.0542	0.0621
	Sulfur (S)-Dissolved (mg/L)	2.65	1.16	3.13	1.57	2.54
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00050	0.00080	0.00064	0.00143	0.00157
	Uranium (U)-Dissolved (mg/L)	0.000301	0.000109	0.000212	0.000025	0.000023
	Vanadium (V)-Dissolved (mg/L)	0.00059	<0.00050	0.00062	0.00053	0.00056
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	0.00032	<0.00030	0.00038	0.00064	0.00075

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Sample ID Description Sampled Date Sampled Time Client ID		L2158981-6 Water 29-AUG-18 DUP	L2158981-7 Water 03-SEP-18 09:20 W17	L2158981-8 Water 03-SEP-18 09:35 W16	L2158981-9 Water 03-SEP-18 10:30 W8A	
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Dissolved (mg/L)	0.000772	0.00662	0.00284	0.0102	
	Nickel (Ni)-Dissolved (mg/L)	0.00110	0.00053	0.00076	0.00105	
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Potassium (K)-Dissolved (mg/L)	0.56	3.47	2.53	5.25	
	Selenium (Se)-Dissolved (mg/L)	0.000156	0.000527	0.000752	0.00451	
	Silicon (Si)-Dissolved (mg/L)	5.51	5.18	3.52	6.48	
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	0.000015	
	Sodium (Na)-Dissolved (mg/L)	4.39	13.2	12.1	29.8	
	Strontium (Sr)-Dissolved (mg/L)	0.159	0.701	0.554	1.55	
	Sulfur (S)-Dissolved (mg/L)	2.65	21.3	23.0	62.5	
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Dissolved (mg/L)	0.00043	<0.00030	0.00037	0.00045	
	Uranium (U)-Dissolved (mg/L)	0.000297	0.00191	0.00129	0.00189	
	Vanadium (V)-Dissolved (mg/L)	0.00057	<0.00050	<0.00050	0.00096	
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	0.173	
	Zirconium (Zr)-Dissolved (mg/L)	0.00032	<0.00030	<0.00030	<0.00030	

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Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Aluminum (Al)-Total	MB-LOR	L2158981-1, -2, -3, -4, -5, -6, -7, -8, -9
Laboratory Control Sample	Sulfur (S)-Dissolved	MES	L2158981-3
Matrix Spike	Dissolved Organic Carbon	MS-B	L2158981-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2158981-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2158981-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2158981-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2158981-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2158981-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2158981-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Total	MS-B	L2158981-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L2158981-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2158981-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Total	MS-B	L2158981-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L2158981-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sulfur (S)-Total	MS-B	L2158981-1, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLB	Detection Limit Raised. Analyte detected at comparable level in Method Blank.
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)

Reference Information

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
----------------------------	---------------------

VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
----	---

Chain of Custody Numbers:

2018-09-05 C

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lw - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

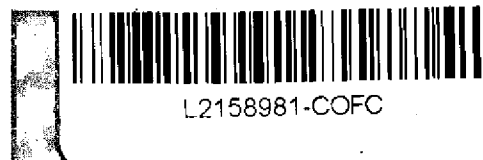
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com



L2158981-COFC

COC Number: 2018-09-05 C

Page 1 of 1

Report To			Report Format / Distribution			Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply																				
Contact and company name below will appear on the final report			Select Report Format: ☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)			Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply																				
Company: Minto Explorations Ltd.			Quality Control (QC) Report with Report ☒ YES ☐ NO			☒ Compare Results to Criteria on Report - provide details below if box checked				1 Business day [E1] ☐				Same Day, Weekend or Statutory holiday [E0] ☐												
Contact: Minto Environment - Coordinator			Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX			Email 1 or Fax: mintoenvironment@mintomine.com				Date and Time Required for all E&P TATs: dd-mm-yy hh:mm																
Phone: 1-604-759-4659			Email 2			Email 3				For tests that can not be performed according to the service level selected, you will be contacted.																
Company address below will appear on the final report			Invoice Distribution			Analysis Request																				
Street: 2100-510 West Georgia St.			Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX			Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below																				
City/Province: Vancouver, British Columbia			Email 1 or Fax: ap@mintomine.com																							
Postal Code: V6B 0M3			Email 2																							
Invoice To: Same as Report To ☐ YES ☒ NO			Email 3																							
Copy of Invoice with Report ☐ YES ☒ NO																										
Company: Minto Explorations Ltd.																										
Contact: Ruth Cayetano																										
Project Information			Oil and Gas Required Fields (client use)																							
ALS Account # / Quote #:			AFE/Cost Center:																							
Job #:			Major/Minor Code:																							
PO / AFE: 229096 (WUL)			Requisitioner:																							
LSD:			Location:																							
ALS Lab Work Order # (lab use only)			ALS Contact: Shane Stack			Sampler:																				
ALS Sample # (lab use only)			Sample Identification and/or Coordinates (This description will appear on the report)			Date (dd-mm-yy)			Time (hh:mm)			Sample Type														
MN-4.5						29-Aug-18			14:15			Water														
MN-2.5						29-Aug-18			15:30			Water														
MN-0.5						29-Aug-18			16:00			Water														
MN-1.5						29-Aug-18			17:20			Water														
MN-0.2						30-Aug-18			15:35			Water														
Dup						29-Aug-18						Water														
W17						3-Sep-18			9:20			Water														
W16						3-Sep-18			9:35			Water														
W8A						3-Sep-18			10:30			Water														
Drinking Water (DW) Samples ¹ (client use)			Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)			SAMPLE CONDITION AS RECEIVED (lab use only)																				
Are samples taken from a Regulated DW System? ☐ YES ☒ NO						Frozen ☐ SIF Observations Yes ☐ No ☐																				
Are samples for human drinking water use? ☐ YES ☒ NO						Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐																				
						Cooling Initiated ☐																				
						INITIAL COOLER TEMPERATURES °C: 8/8/8 FINAL COOLER TEMPERATURES °C: 8 7 7																				
SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)																				
Released by: Emilie Bouchard			Date: Sept 5, 2018			Time: 14:42			Received by: JC			Date: SEP 6 2018			Time: 12pm											

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

3 OCT 2018 10:15 AM

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 11-SEP-18
Report Date: 21-SEP-18 17:37 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2162627
Project P.O. #: 22100
Job Reference:
C of C Numbers: 2018-09-08 A
Legal Site Desc:

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

21-SEP-18 17:37 (MT)

Version: FINAL

Sample ID Description Sampled Date Sampled Time Client ID		L2162627-1 Water 05-SEP-18 10:50 SS36	L2162627-2 Water 05-SEP-18 11:20 SS9	L2162627-3 Water 05-SEP-18 11:35 SS60	L2162627-4 Water 05-SEP-18 14:45 SS101	L2162627-5 Water 05-SEP-18 15:30 SS48
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	154	553	809	1280	1260
	Hardness (as CaCO3) (mg/L)	72.5	230	321	535	562
	pH (pH)	6.24	7.78	7.82	8.15	8.25
	Total Suspended Solids (mg/L)	<3.0	17.4	25.6	5.4	5.4
	TDS (Calculated) (mg/L)	86.7	334	392	889	894
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	7.6	194	60.5	112	177
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	7.6	194	60.5	112	177
	Ammonia, Total (as N) (mg/L)	0.0089	0.233	0.0059	0.292	<0.0050
	Chloride (Cl) (mg/L)	<0.50	0.95	195	6.2	3.8
	Nitrate and Nitrite (as N) (mg/L)	<0.0051	0.0133	<0.0051	85.2	55.5
	Nitrate (as N) (mg/L)	<0.0050	0.0133	<0.0050	84.9	55.5
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	0.293	0.0205
	Sulfate (SO4) (mg/L)	52.7	106	27.8	219	300
	Anion Sum (meq/L)	1.25	6.12	7.29	13.1	13.9
	Cation Sum (meq/L)	1.68	5.84	7.15	12.7	13.4
	Cation - Anion Balance (%)	14.7	-2.3	-1.0	-1.2	-1.8
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.207	0.0183	0.0380	0.0013	0.0012
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	0.00012	<0.00010	0.00069	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00038	0.00058	0.00042	0.00029	0.00047
	Barium (Ba)-Dissolved (mg/L)	0.0266	0.104	0.332	0.0704	0.121
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	0.000025	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	<0.010	<0.010	<0.010	0.234	0.109
	Cadmium (Cd)-Dissolved (mg/L)	0.0000163	0.0000307	0.000317	<0.000050 ^{DLM}	<0.000035 ^{DLM}
	Calcium (Ca)-Dissolved (mg/L)	17.3	62.0	92.1	100	128
	Chromium (Cr)-Dissolved (mg/L)	0.00043	0.00026	0.00039	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	0.00036	0.00034	0.00179	0.00020	0.00010
	Copper (Cu)-Dissolved (mg/L)	0.0355	0.0205	0.0591	0.0604	0.0107
	Iron (Fe)-Dissolved (mg/L)	0.361	0.370	0.039	<0.010	<0.010
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0012	0.0021	0.0012	0.0120	0.0056
	Magnesium (Mg)-Dissolved (mg/L)	7.10	18.2	22.2	69.3	59.1
	Manganese (Mn)-Dissolved (mg/L)	0.00692	0.490	0.562	0.0643	0.00673

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

21-SEP-18 17:37 (MT)

Version: FINAL

Sample ID Description Sampled Date Sampled Time Client ID		L2162627-6 Water 05-SEP-18 15:50 SS63	L2162627-7 Water 05-SEP-18 16:05 SS64	L2162627-8 Water 05-SEP-18 16:20 SS49	L2162627-9 Water 05-SEP-18 16:35 SS50	L2162627-10 Water 05-SEP-18 17:05 SS32
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	622	511	448	550	201
	Hardness (as CaCO3) (mg/L)	285	221	172	225	94.2
	pH (pH)	8.28	8.35	8.30	8.29	8.16
	Total Suspended Solids (mg/L)	19.6	<3.0	4.0	<3.0	<3.0
	TDS (Calculated) (mg/L)	359	304	273	341	109
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	342	210	119	152	104
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	6.4	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	342	216	119	152	104
	Ammonia, Total (as N) (mg/L)	0.0133	0.0163	0.0374	<0.0050	<0.0050
	Chloride (Cl) (mg/L)	1.36	0.97	2.70	0.53	<0.50
	Nitrate and Nitrite (as N) (mg/L)	1.21	0.711	0.0685	2.95	0.324
	Nitrate (as N) (mg/L)	1.20	0.696	0.0672	2.95	0.324
	Nitrite (as N) (mg/L)	0.0162	0.0152	0.0013	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	24.7	65.3	109	128	5.87
	Anion Sum (meq/L)	7.47	5.76	4.74	5.93	2.23
	Cation Sum (meq/L)	6.51	5.63	4.64	5.77	2.07
	Cation - Anion Balance (%)	-6.9	-1.1	-1.1	-1.4	-3.6
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0060	0.0011	0.0115	0.0016	<0.0010
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00149	0.00047	0.00093	0.00058	0.00013
	Barium (Ba)-Dissolved (mg/L)	0.211	0.0841	0.0593	0.0411	0.0169
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.026	0.112	0.162	0.118	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	0.0000282	0.0000137	0.0000088	<0.000020 ^{DLM}	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	83.4	53.7	41.2	53.1	29.0
	Chromium (Cr)-Dissolved (mg/L)	0.00017	<0.00010	<0.00010	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	0.00011	<0.00010	0.00012	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.0157	0.00702	0.0120	0.0130	0.00044
	Iron (Fe)-Dissolved (mg/L)	0.039	0.024	0.078	<0.010	<0.010
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0020	0.0040	0.0044	0.0057	<0.0010
	Magnesium (Mg)-Dissolved (mg/L)	18.7	21.2	16.8	22.5	5.28
	Manganese (Mn)-Dissolved (mg/L)	0.0403	0.00887	0.0224	0.00078	<0.00010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2162627-11 Water 05-SEP-18 DUP 1				
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	817				
	Hardness (as CaCO3) (mg/L)	318				
	pH (pH)	7.78				
	Total Suspended Solids (mg/L)	24.4				
	TDS (Calculated) (mg/L)	393				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	64.4				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Total (as CaCO3) (mg/L)	64.4				
	Ammonia, Total (as N) (mg/L)	0.0074				
	Chloride (Cl) (mg/L)	195				
	Nitrate and Nitrite (as N) (mg/L)	<0.0051				
	Nitrate (as N) (mg/L)	<0.0050				
	Nitrite (as N) (mg/L)	<0.0010				
	Sulfate (SO4) (mg/L)	27.6				
	Anion Sum (meq/L)	7.37				
	Cation Sum (meq/L)	7.06				
	Cation - Anion Balance (%)	-2.1				
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD				
	Dissolved Metals Filtration Location	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	0.0350				
	Antimony (Sb)-Dissolved (mg/L)	<0.00010				
	Arsenic (As)-Dissolved (mg/L)	0.00043				
	Barium (Ba)-Dissolved (mg/L)	0.341				
	Beryllium (Be)-Dissolved (mg/L)	0.000024				
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050				
	Boron (B)-Dissolved (mg/L)	<0.010				
	Cadmium (Cd)-Dissolved (mg/L)	0.000275				
	Calcium (Ca)-Dissolved (mg/L)	91.0				
	Chromium (Cr)-Dissolved (mg/L)	0.00037				
	Cobalt (Co)-Dissolved (mg/L)	0.00220				
	Copper (Cu)-Dissolved (mg/L)	0.0599				
	Iron (Fe)-Dissolved (mg/L)	0.037				
	Lead (Pb)-Dissolved (mg/L)	<0.000050				
	Lithium (Li)-Dissolved (mg/L)	0.0012				
	Magnesium (Mg)-Dissolved (mg/L)	22.0				
	Manganese (Mn)-Dissolved (mg/L)	0.594				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2162627-1 Water 05-SEP-18 10:50 SS36	L2162627-2 Water 05-SEP-18 11:20 SS9	L2162627-3 Water 05-SEP-18 11:35 SS60	L2162627-4 Water 05-SEP-18 14:45 SS101	L2162627-5 Water 05-SEP-18 15:30 SS48
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	0.0000058	0.0000057	<0.0000050	0.0000071	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.000072	0.000364	0.000251	0.0744	0.0332
	Nickel (Ni)-Dissolved (mg/L)	0.00123	0.00086	0.00651	<0.00050	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	0.096	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	<0.10	3.18	5.45	9.02	7.49
	Selenium (Se)-Dissolved (mg/L)	0.000156	0.000462	0.000192	0.0158	0.0293
	Silicon (Si)-Dissolved (mg/L)	3.45	6.85	5.90	3.64	4.01
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	0.000011	<0.000010	0.000013
	Sodium (Na)-Dissolved (mg/L)	4.33	25.7	12.9	41.4	44.9
	Strontium (Sr)-Dissolved (mg/L)	0.0803	1.04	0.494	2.46	5.47
	Sulfur (S)-Dissolved (mg/L)	17.2	34.0	8.72	74.8	99.7
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00267	0.00071	0.00053	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.000015	0.000035	0.000088	0.00229	0.00915
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	0.00054
	Zinc (Zn)-Dissolved (mg/L)	0.0027	0.0018	0.0082	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	0.00033	<0.00030	0.00037	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2162627-6 Water 05-SEP-18 15:50 SS63	L2162627-7 Water 05-SEP-18 16:05 SS64	L2162627-8 Water 05-SEP-18 16:20 SS49	L2162627-9 Water 05-SEP-18 16:35 SS50	L2162627-10 Water 05-SEP-18 17:05 SS32
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	0.0000069	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00514	0.0237	0.0163	0.0373	0.00288
	Nickel (Ni)-Dissolved (mg/L)	0.00129	<0.00050	<0.00050	<0.00050	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	6.08	6.30	9.44	6.90	1.19
	Selenium (Se)-Dissolved (mg/L)	0.000963	0.00397	0.00113	0.0179	0.000142
	Silicon (Si)-Dissolved (mg/L)	4.99	0.306	1.47	3.21	6.09
	Silver (Ag)-Dissolved (mg/L)	0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	14.8	24.0	21.9	25.1	3.64
	Strontium (Sr)-Dissolved (mg/L)	0.559	1.30	1.06	1.59	0.146
	Sulfur (S)-Dissolved (mg/L)	8.69	21.7	37.3	42.8	1.77
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00058	<0.00030	<0.00051 ^{DLM}	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00325	0.00278	0.00203	0.00460	0.000378
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	0.00089	0.00064
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2162627-11 Water 05-SEP-18 DUP 1				
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	0.0000054				
	Molybdenum (Mo)-Dissolved (mg/L)	0.000319				
	Nickel (Ni)-Dissolved (mg/L)	0.00643				
	Phosphorus (P)-Dissolved (mg/L)	<0.050				
	Potassium (K)-Dissolved (mg/L)	5.12				
	Selenium (Se)-Dissolved (mg/L)	0.000195				
	Silicon (Si)-Dissolved (mg/L)	5.94				
	Silver (Ag)-Dissolved (mg/L)	0.000011				
	Sodium (Na)-Dissolved (mg/L)	12.5				
	Strontium (Sr)-Dissolved (mg/L)	0.474				
	Sulfur (S)-Dissolved (mg/L)	9.36				
	Thallium (Tl)-Dissolved (mg/L)	<0.000010				
	Tin (Sn)-Dissolved (mg/L)	<0.00010				
	Titanium (Ti)-Dissolved (mg/L)	0.00047				
	Uranium (U)-Dissolved (mg/L)	0.000111				
	Vanadium (V)-Dissolved (mg/L)	<0.00050				
	Zinc (Zn)-Dissolved (mg/L)	0.0093				
	Zirconium (Zr)-Dissolved (mg/L)	0.00035				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Aluminum (Al)-Dissolved	MS-B	L2162627-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2162627-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2162627-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Copper (Cu)-Dissolved	MS-B	L2162627-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2162627-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2162627-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2162627-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-WR	Water	Nitrite & Nitrate Nitrogen	EPA 300.1
Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance.			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
CL-IC-N-WR	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Weston et al.			

Reference Information

NO2-L-IC-N-WR	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-WR	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
SO4-IC-WR	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)
This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".			
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.			
TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.			
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-09-08 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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Report To Contact and company name below will appear on the final report		Report Format / Distribution		Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply																					
Company:	Minto Explorations Ltd.	Select Report Format: ☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)		Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply																					
Contact:	Minto Environment - Coordinator	Quality Control (QC) Report with Report ☒ YES ☐ NO		PRIORITY (Business Days) 4 day [P4] ☐ 3 day [P3] ☐ 2 day [P2] ☐		EMERGENCY 1 Business day [E1] ☐ Same Day, Weekend or Statutory holiday [E0] ☐																			
Phone:	1-604-759-4659	☒ Compare Results to Criteria on Report - provide details below if box checked																							
Company address below will appear on the final report		Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX																							
Street:	2100-510 West Georgia St.	Email 1 or Fax mintoenvironment@mintomine.com		Date and Time Required for all E&P TATs:																					
City/Province:	Vancouver, British Columbia	Email 2		For tests that can not be performed according to the service level selected, you will be contacted.																					
Postal Code:	V6B 0M3	Email 3		Analysis Request																					
Invoice To	Same as Report To ☐ YES ☒ NO	Invoice Distribution		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below																					
	Copy of Invoice with Report ☐ YES ☒ NO	Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX		P	F/P	P	F/P	P	F/P																
Company:	Minto Explorations Ltd.	Email 1 or Fax ap@mintomine.com		Total Metals(TM)	Dissolved Metals (DM)	Total Mercury, Hardness	Dissolved Mercury	Ammonia (Total Nutrients)	Dissolved Organic Carbon (DOC)	pH, Cond., TSS, TDS, Alkalinity, Anions															
Contact:	Ruth Cayetano	Email 2																							
Project Information		Oil and Gas Required Fields (client use)																							
ALS Account # / Quote #:		AFE/Cost Center:									PO#														
Job #:		Major/Minor Code:									Routing Code:														
PO / AFE: 22100 (Seepage)		Requisitioner:																							
LSD:		Location:																							
ALS Lab Work Order # (lab use only)		ALS Contact:									Sampler: EB														
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mm-yy)	Time (hh:mm)								Sample Type														
	SS36	5-Sep-18	10:50								Water		R		R	R		R							4
	SS9	5-Sep-18	11:20	Water		R		R	R		R							4							
	SS60	5-Sep-18	11:35	Water		R		R	R		R							4							
	SS101	5-Sep-18	14:45	Water		R		R	R		R							4							
	SS48	5-Sep-18	15:30	Water		R		R	R		R							4							
	SS63	5-Sep-18	15:50	Water		R		R	R		R							4							
	SS64	5-Sep-18	16:05	Water		R		R	R		R							4							
	SS49	5-Sep-18	16:20	Water		R		R	R		R							4							
	SS50	5-Sep-18	16:35	Water		R		R	R		R							4							
	SS32	5-Sep-18	17:05	Water		R		R	R		R							4							
	DUP 1	5-Sep-18		Water		R		R	R		R							4							
Drinking Water (DW) Samples¹ (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)		SAMPLE CONDITION AS RECEIVED (lab use only)																					
Are samples taken from a Regulated DW System? ☐ YES ☒ NO				Frozen ☐ SIF Observations Yes ☐ No ☐ Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐ Cooling Initiated ☒																					
Are samples for human drinking water use? ☐ YES ☒ NO				INITIAL COOLER TEMPERATURES °C: 12° FINAL COOLER TEMPERATURES °C: 6 8																					
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)		FINAL SHIPMENT RECEPTION (lab use only)																					
Released by: Emilie Bouchard	Date: Sept 8, 2018	Time:	Received by: EHF	Date: Sept 11/18	Time: 16:50	Received by: HA	Date: 9/13	Time: 12:30																	

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY

YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 11-SEP-18
Report Date: 21-SEP-18 17:40 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2162671
Project P.O. #: 22100
Job Reference:
C of C Numbers: 2018-09-08 B
Legal Site Desc:

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

21-SEP-18 17:40 (MT)

Version: FINAL

Sample ID Description Sampled Date Sampled Time Client ID		L2162671-1 Water 06-SEP-18 08:00 SS33	L2162671-2 Water 06-SEP-18 08:45 SS5	L2162671-3 Water 06-SEP-18 09:55 SS6	L2162671-4 Water 06-SEP-18 10:20 SS7	L2162671-5 Water 06-SEP-18 10:35 SS8
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	1190	1300	1200	1370	1330
	Hardness (as CaCO3) (mg/L)	576	572	568	671	640
	pH (pH)	8.30	8.23	8.20	8.29	8.12
	Total Suspended Solids (mg/L)	69.8	4890	331	5.6	204
	TDS (Calculated) (mg/L)	828	899	832	972	944
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	243	251	243	254	258
	Alkalinity, Carbonate (as CaCO3) (mg/L)	2.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	245	251	243	254	258
	Ammonia, Total (as N) (mg/L)	0.0272	0.0162	0.0074	<0.0050	0.0079
	Chloride (Cl) (mg/L)	20.6	17.7	18.8	16.2	18.8
	Nitrate and Nitrite (as N) (mg/L)	39.5	43.5	39.8	44.9	44.7
	Nitrate (as N) (mg/L)	39.4	43.5	39.8	44.9	44.7
	Nitrite (as N) (mg/L)	0.0576	0.0067	<0.0050 ^{DLDS}	0.0081	0.0165
	Sulfate (SO4) (mg/L)	243	297	250	327	303
	Anion Sum (meq/L)	13.4	14.8	13.4	15.5	15.2
	Cation Sum (meq/L)	13.1	13.0	13.0	15.1	14.5
	Cation - Anion Balance (%)	-1.0	-6.7	-1.6	-1.3	-2.5
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0029	0.0056	0.0019	<0.0010	0.0018
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00021	0.00015
	Arsenic (As)-Dissolved (mg/L)	0.00031	0.00031	0.00035	0.00025	0.00032
	Barium (Ba)-Dissolved (mg/L)	0.102	0.0576	0.0472	0.117	0.0498
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.059	0.057	0.057	0.052	0.061
	Cadmium (Cd)-Dissolved (mg/L)	0.000339	0.000116	0.0000955	0.0000627	0.0000459
	Calcium (Ca)-Dissolved (mg/L)	162	165	160	186	184
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00025	<0.00010	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.219	0.192	0.133	0.141	0.0711
	Iron (Fe)-Dissolved (mg/L)	0.020	0.012	<0.010	<0.010	<0.010
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0043	0.0044	0.0048	0.0046	0.0047
	Magnesium (Mg)-Dissolved (mg/L)	41.3	39.0	40.9	50.5	43.9
	Manganese (Mn)-Dissolved (mg/L)	0.181	0.0644	0.0589	0.0178	0.00714

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

21-SEP-18 17:40 (MT)

Version: FINAL

Sample ID Description Sampled Date Sampled Time Client ID		L2162671-6 Water 06-SEP-18 14:00 SS54	L2162671-7 Water 06-SEP-18 14:12 SS65	L2162671-8 Water 06-SEP-18 14:20 SS56	L2162671-9 Water 06-SEP-18 14:40 SS57	L2162671-10 Water 06-SEP-18 14:50 SS30
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	1070	1160	1250	1170	1040
	Hardness (as CaCO3) (mg/L)	523	574	605	636	578
	pH (pH)	8.30	8.22	8.19	8.33	8.28
	Total Suspended Solids (mg/L)	5.8	3.4	3.6	6.4	216
	TDS (Calculated) (mg/L)	726	798	874	819	716
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	290	302	296	366	359
	Alkalinity, Carbonate (as CaCO3) (mg/L)	2.8	<1.0	<1.0	6.8	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	292	302	296	373	359
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	0.0161	<0.0050	0.0164
	Chloride (Cl) (mg/L)	3.0	2.8	3.1	3.2	3.1
	Nitrate and Nitrite (as N) (mg/L)	22.9	22.7	28.8	19.6	19.7
	Nitrate (as N) (mg/L)	22.9	22.7	28.8	19.6	19.6
	Nitrite (as N) (mg/L)	<0.0050 ^{DLDS}	<0.0050 ^{DLDS}	<0.0050 ^{DLDS}	<0.0050 ^{DLDS}	0.136
	Sulfate (SO4) (mg/L)	233	278	316	256	185
	Anion Sum (meq/L)	12.4	13.5	14.6	14.3	12.5
	Cation Sum (meq/L)	11.6	12.9	13.5	13.6	12.2
	Cation - Anion Balance (%)	-3.4	-2.5	-4.0	-2.3	-1.2
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0078	0.0027	0.0033	0.0017	0.0037
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00040	0.00029	0.00015	0.00022	0.00019
	Barium (Ba)-Dissolved (mg/L)	0.0699	0.0904	0.0569	0.0804	0.0745
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.031	0.030	0.033	0.025	0.017
	Cadmium (Cd)-Dissolved (mg/L)	0.0000238	0.0000113	0.0000070	0.0000070	0.0000100
	Calcium (Ca)-Dissolved (mg/L)	148	158	171	184	173
	Chromium (Cr)-Dissolved (mg/L)	0.00014	<0.00010	<0.00010	0.00021	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.0525	0.0214	0.00316	0.00647	0.0260
	Iron (Fe)-Dissolved (mg/L)	0.018	<0.010	<0.010	<0.010	0.011
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0029	0.0027	0.0030	0.0030	0.0024
	Magnesium (Mg)-Dissolved (mg/L)	37.2	43.7	43.0	42.9	35.6
	Manganese (Mn)-Dissolved (mg/L)	0.00152	0.00610	0.00173	0.00032	0.00068

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2162671-11 Water 06-SEP-18 15:05 SS43	L2162671-12 Water 06-SEP-18 DUP 2		
Grouping	Analyte				
WATER					
Physical Tests	Conductivity (uS/cm)	1020	1190		
	Hardness (as CaCO3) (mg/L)	543	553		
	pH (pH)	8.30	8.28		
	Total Suspended Solids (mg/L)	3.2	154		
	TDS (Calculated) (mg/L)	696	829		
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	343	239		
	Alkalinity, Carbonate (as CaCO3) (mg/L)	4.0	<1.0		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0		
	Alkalinity, Total (as CaCO3) (mg/L)	347	239		
	Ammonia, Total (as N) (mg/L)	<0.0050	0.0056		
	Chloride (Cl) (mg/L)	2.7	19.1		
	Nitrate and Nitrite (as N) (mg/L)	18.9	40.4		
	Nitrate (as N) (mg/L)	18.9	40.4		
	Nitrite (as N) (mg/L)	<0.0050 ^{DLDS}	<0.0050 ^{DLDS}		
	Sulfate (SO4) (mg/L)	189	254		
	Anion Sum (meq/L)	12.3	13.5		
	Cation Sum (meq/L)	11.5	12.5		
	Cation - Anion Balance (%)	-3.3	-3.6		
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD		
	Dissolved Metals Filtration Location	FIELD	FIELD		
	Aluminum (Al)-Dissolved (mg/L)	0.0032	0.0013		
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010		
	Arsenic (As)-Dissolved (mg/L)	0.00023	0.00031		
	Barium (Ba)-Dissolved (mg/L)	0.0993	0.0425		
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020		
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050		
	Boron (B)-Dissolved (mg/L)	0.016	0.056		
	Cadmium (Cd)-Dissolved (mg/L)	0.0000151	0.0000847		
	Calcium (Ca)-Dissolved (mg/L)	162	162		
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010		
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010		
	Copper (Cu)-Dissolved (mg/L)	0.0579	0.120		
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010		
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050		
	Lithium (Li)-Dissolved (mg/L)	0.0022	0.0048		
	Magnesium (Mg)-Dissolved (mg/L)	33.6	35.9		
	Manganese (Mn)-Dissolved (mg/L)	0.00123	0.0529		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2162671-1 Water 06-SEP-18 08:00 SS33	L2162671-2 Water 06-SEP-18 08:45 SS5	L2162671-3 Water 06-SEP-18 09:55 SS6	L2162671-4 Water 06-SEP-18 10:20 SS7	L2162671-5 Water 06-SEP-18 10:35 SS8
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	0.0000072	0.0000056	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.0135	0.0124	0.0115	0.00689	0.0106
	Nickel (Ni)-Dissolved (mg/L)	0.00053	<0.00050	<0.00050	<0.00050	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	5.95	5.57	6.16	5.84	6.39
	Selenium (Se)-Dissolved (mg/L)	0.0235	0.0249	0.0264	0.0333	0.0286
	Silicon (Si)-Dissolved (mg/L)	5.31	5.30	5.60	5.52	5.52
	Silver (Ag)-Dissolved (mg/L)	0.000024	0.000030	0.000028	0.000020	0.000025
	Sodium (Na)-Dissolved (mg/L)	32.9	31.7	34.4	35.9	34.8
	Strontium (Sr)-Dissolved (mg/L)	4.82	4.03	3.68	4.20	4.63
	Sulfur (S)-Dissolved (mg/L)	79.8	83.3	85.8	110	99.6
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00090 ^{DLM}	<0.00030	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00463	0.00513	0.00551	0.00618	0.00527
	Vanadium (V)-Dissolved (mg/L)	0.00054	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0017	0.0048	0.0012	0.0017	0.0016
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2162671-6 Water 06-SEP-18 14:00 SS54	L2162671-7 Water 06-SEP-18 14:12 SS65	L2162671-8 Water 06-SEP-18 14:20 SS56	L2162671-9 Water 06-SEP-18 14:40 SS57	L2162671-10 Water 06-SEP-18 14:50 SS30
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00729	0.00605	0.00764	0.00572	0.00295
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	5.72	5.74	5.20	5.36	4.73
	Selenium (Se)-Dissolved (mg/L)	0.00513	0.00552	0.00585	0.0106	0.00788
	Silicon (Si)-Dissolved (mg/L)	6.79	6.79	6.24	7.24	6.69
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	22.3	28.7	29.9	17.8	12.8
	Strontium (Sr)-Dissolved (mg/L)	2.19	2.55	2.67	1.71	1.20
	Sulfur (S)-Dissolved (mg/L)	76.4	92.7	100	83.4	58.1
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00155	<0.00030	<0.00030	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00261	0.00280	0.00360	0.00517	0.00528
	Vanadium (V)-Dissolved (mg/L)	0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0012	<0.0010	<0.0010	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2162671-11 Water 06-SEP-18 15:05 SS43	L2162671-12 Water 06-SEP-18 DUP 2			
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	0.0000055			
	Molybdenum (Mo)-Dissolved (mg/L)	0.00187	0.0114			
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050			
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050			
	Potassium (K)-Dissolved (mg/L)	4.91	5.71			
	Selenium (Se)-Dissolved (mg/L)	0.00736	0.0243			
	Silicon (Si)-Dissolved (mg/L)	6.45	5.32			
	Silver (Ag)-Dissolved (mg/L)	<0.000010	0.000026			
	Sodium (Na)-Dissolved (mg/L)	12.3	30.5			
	Strontium (Sr)-Dissolved (mg/L)	0.954	3.61			
	Sulfur (S)-Dissolved (mg/L)	61.3	79.4			
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010			
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010			
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030			
	Uranium (U)-Dissolved (mg/L)	0.00418	0.00562			
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050			
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	0.0011			
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Nitrate (as N)	B	L2162671-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2162671-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2162671-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2162671-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2162671-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2162671-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2162671-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-WR	Water	Nitrite & Nitrate Nitrogen	EPA 300.1
Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance.			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
CL-IC-N-WR	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

Reference Information

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-WR Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-09-08 B

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2162671-COFC

COC Number: 2018-09-08 B

Page 1 of 1

Report To						Contact and companyname below will appear on the final report							
Company:						Minto Explorations Ltd.							
Contact:						Minto Environment - Coordinator							
Phone:						1-604-759-4659							
						Company address below will appear on the final report							
Street:						2100-510 West Georgia St.							
City/Province:						Vancouver, British Columbia							
Postal Code:						V6B 0M3							
Invoice To						Same as Report To ☐ YES ☒ NO							
						Copy of Invoice with Report ☐ YES ☒ NO							
Company:						Minto Explorations Ltd.							
Contact:						Ruth Cayetano							
Project Information						Oil and Gas Required Fields (client use)							
ALS Account # / Quote #:						AFE/Cost Center: PO#							
Job #:						Major/Minor Code: Routing Code:							
PO / AFE: 22100 (Seepage)						Requisitioner:							
LSD:						Location:							
ALS Lab Work Order # (lab use only)						ALS Contact:							
						Sampler: EB/TS							
ALS Sample # (lab use only)						Sample Identification and/or Coordinates (This description will appear on the report)							
						Date (dd-mmm-yy)							
						Time (hh:mm)							
						Sample Type							
SS33						6-Sep-18 8:00 Water							
SS5						6-Sep-18 8:45 Water							
SS6						6-Sep-18 9:55 Water							
SS7						6-Sep-18 10:20 Water							
SS8						6-Sep-18 10:35 Water							
SS54						6-Sep-18 14:00 Water							
SS65						6-Sep-18 14:12 Water							
SS56						6-Sep-18 14:20 Water							
SS57						6-Sep-18 14:40 Water							
SS30						6-Sep-18 14:50 Water							
SS43						6-Sep-18 15:05 Water							
Dup 2						6-Sep-18 Water							
Drinking Water (DW) Samples ¹ (client use)						Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)							
Are samples taken from a Regulated DW System? ☐ YES ☒ NO													
Are samples for human drinking water use? ☐ YES ☒ NO													
SHIPMENT RELEASE (client use)						INITIAL SHIPMENT RECEPTION (lab use only)							
Released by: Emilie Bouchard						Received by: EHF							
Date: Sept 8, 2018						Date: Sept 11/18							
Time:						Time: 16:50							
FINAL SHIPMENT RECEPTION (lab use only)						Date: 9/13							
						Time: 12:30P							

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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OCTOBER 2016 ERO

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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 11-SEP-18
Report Date: 01-OCT-18 17:17 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2162688
Project P.O. #: 22100
Job Reference:
C of C Numbers: 2018-09-08 C
Legal Site Desc:

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2162688-1 Water 06-SEP-18 15:15 SS31	L2162688-2 Water 06-SEP-18 15:30 SS51	L2162688-3 Water 06-SEP-18 15:45 SS44	L2162688-4 Water 06-SEP-18 17:00 SS61	L2162688-5 Water 06-SEP-18 DUP 3
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	1040	725	919	1090	1110
	Hardness (as CaCO3) (mg/L)	549	363	409	546	568
	pH (pH)	8.29	8.35	8.24	8.44	8.45
	Total Suspended Solids (mg/L)	<3.0	4.2	13.0	<3.0	<3.0
	TDS (Calculated) (mg/L)	710	463	632	763	804
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	349	145	153	267	275
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	349	145	153	267	275
	Ammonia, Total (as N) (mg/L)	0.0266	0.0072	0.0158	0.0107	0.0130
	Chloride (Cl) (mg/L)	2.7	<2.5 ^{DLDS}	<2.5 ^{DLDS}	4.6	4.4
	Nitrate and Nitrite (as N) (mg/L)	20.5	0.328	1.42	22.1	23.3
	Nitrate (as N) (mg/L)	20.5	0.328	1.42	22.1	23.2
	Nitrite (as N) (mg/L)	0.0281	<0.0050 ^{DLDS}	<0.0050 ^{DLDS}	0.0145	0.0252
	Sulfate (SO4) (mg/L)	191	228	366	279	303
	Anion Sum (meq/L)	12.5	7.66	10.8	12.8	13.6
	Cation Sum (meq/L)	11.7	8.14	9.26	12.0	12.4
	Cation - Anion Balance (%)	-3.4	3.0	-7.7	-3.5	-4.5
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD				
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0014	0.0069	0.0083	0.0089	0.0041
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00019	0.00017
	Arsenic (As)-Dissolved (mg/L)	0.00023	0.00021	0.00017	0.00057	0.00059
	Barium (Ba)-Dissolved (mg/L)	0.111	0.0917	0.0795	0.0873	0.0945
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	0.000033	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.014	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	0.0000377	<0.0000050	<0.0000050	0.0000201	0.0000148
	Calcium (Ca)-Dissolved (mg/L)	161	94.9	106	156	162
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00022	<0.00010	0.00018	0.00024
	Cobalt (Co)-Dissolved (mg/L)	0.00018	0.00017	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.0519	0.00367	0.00176	0.0362	0.0367
	Iron (Fe)-Dissolved (mg/L)	0.068	0.027	0.034	0.016	<0.010
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0019	0.0023	0.0030	0.0025	0.0024
	Magnesium (Mg)-Dissolved (mg/L)	35.5	30.5	34.9	38.2	39.9
	Manganese (Mn)-Dissolved (mg/L)	0.304	0.0528	0.189	0.0312	0.0330

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2162688-1 Water 06-SEP-18 15:15 SS31	L2162688-2 Water 06-SEP-18 15:30 SS51	L2162688-3 Water 06-SEP-18 15:45 SS44	L2162688-4 Water 06-SEP-18 17:00 SS61	L2162688-5 Water 06-SEP-18 DUP 3
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050				
	Molybdenum (Mo)-Dissolved (mg/L)	0.00236	0.000585	0.000106	0.00714	0.00714
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	0.00134	0.00138
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	5.06	3.70	2.87	7.68	8.12
	Selenium (Se)-Dissolved (mg/L)	0.0102	0.00191	0.00242	0.00164	0.00172
	Silicon (Si)-Dissolved (mg/L)	6.37	5.80	3.38	3.79	3.83
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	12.8	18.3	23.1	19.6	19.8
	Strontium (Sr)-Dissolved (mg/L)	0.945	1.74	0.859	0.790	0.833
	Sulfur (S)-Dissolved (mg/L)	63.8	85.3	113	85.8	91.1
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	0.00033	<0.00030	0.00080	0.00033
	Uranium (U)-Dissolved (mg/L)	0.00536	0.000072	0.000023	0.00370	0.00399
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	0.00062	0.00059
	Zinc (Zn)-Dissolved (mg/L)	0.0012	<0.0010	<0.0010	<0.0010	0.0021
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Nitrate (as N)	B	L2162688-1
Matrix Spike	Aluminum (Al)-Dissolved	MS-B	L2162688-1
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2162688-1
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2162688-2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2162688-1
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2162688-2, -3, -4, -5
Matrix Spike	Copper (Cu)-Dissolved	MS-B	L2162688-1
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2162688-1
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2162688-2, -3, -4, -5
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2162688-2, -3, -4, -5
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2162688-1
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2162688-2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2162688-1
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2162688-2, -3, -4, -5
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2162688-2, -3, -4, -5

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
ANIONS-N+N-CALC-WR	Water	Nitrite & Nitrate Nitrogen	EPA 300.1
Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance.			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
CL-IC-N-WR	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			

Reference Information

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO2-L-IC-N-WR Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

SO4-IC-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
----------------------------	---------------------

WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
----	---

VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
----	---

Chain of Custody Numbers:

2018-09-08 C

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lw - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.





Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 13-SEP-18
Report Date: 24-SEP-18 17:47 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2163930
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-09-13 A
Legal Site Desc:

Shane Stack
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2163930-1 Water 12-SEP-18 16:00 W17	L2163930-2 Water 12-SEP-18 16:20 W16	L2163930-3 Water 12-SEP-18 16:50 W8A	L2163930-4 Water 10-SEP-18 09:30 MC1	L2163930-5 Water 10-SEP-18 10:15 W2
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	487	465	1070	347	360
	Hardness (as CaCO3) (mg/L)	244	224	527	175	171
	pH (pH)	8.36	8.37	8.01	8.41	8.37
	Total Suspended Solids (mg/L)	<3.0	<3.0	71.3	<3.0	<3.0
	TDS (Calculated) (mg/L)	294	280	735	201	206
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	193	173	349	172	173
	Alkalinity, Carbonate (as CaCO3) (mg/L)	6.2	5.4	<1.0	7.2	5.6
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	200	178	349	179	179
	Ammonia, Total (as N) (mg/L)	<0.0050	0.0069	0.123	<0.0050	<0.0050
	Chloride (Cl) (mg/L)	5.70	5.51	7.8	1.53	2.04
	Nitrate and Nitrite (as N) (mg/L)	0.237	1.49	6.69	0.0487	0.0659
	Nitrate (as N) (mg/L)	0.237	1.48	6.63	0.0487	0.0659
	Nitrite (as N) (mg/L)	<0.0010	0.0082	0.0609	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	64.3	68.0	256	21.1	25.3
	Anion Sum (meq/L)	5.51	5.24	13.0	4.06	4.16
	Cation Sum (meq/L)	5.61	5.07	12.5	3.96	3.90
	Cation - Anion Balance (%)	0.9	-1.6	-2.2	-1.2	-3.2
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	9.82	15.5		9.22	8.26
Total Metals	Aluminum (Al)-Total (mg/L)	0.0092	0.0234	0.301	0.0276	0.0121
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	0.00017	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00040	0.00045	0.00081	0.00058	0.00039
	Barium (Ba)-Total (mg/L)	0.0687	0.0760	0.123	0.0626	0.0700
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	0.000029	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.023	0.015	0.028	<0.010	<0.010
	Cadmium (Cd)-Total (mg/L)	<0.0000050	0.0000058	0.000233	<0.0000050	<0.0000050
	Calcium (Ca)-Total (mg/L)	61.4	60.0	145	42.9	44.6
	Chromium (Cr)-Total (mg/L)	0.00012	0.00017	0.00074	0.00026	0.00020
	Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	0.00072	<0.00010	<0.00010
	Copper (Cu)-Total (mg/L)	0.00865	0.0280	0.178	0.00182	0.00189
	Iron (Fe)-Total (mg/L)	0.011	0.050	1.71	0.162	0.047
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	0.000280	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	0.0014	0.0012	0.0036	0.0015	0.0018
	Magnesium (Mg)-Total (mg/L)	19.1	18.9	42.5	16.3	15.0
	Manganese (Mn)-Total (mg/L)	0.0105	0.0539	1.40	0.0223	0.0104

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2163930-6 Water 11-SEP-18 13:00 W3				
Grouping	Analyte						
WATER							
Physical Tests	Conductivity (uS/cm)	534					
	Hardness (as CaCO3) (mg/L)	263					
	pH (pH)	8.42					
	Total Suspended Solids (mg/L)	<3.0					
	TDS (Calculated) (mg/L)	321					
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	240					
	Alkalinity, Carbonate (as CaCO3) (mg/L)	10.8					
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0					
	Alkalinity, Total (as CaCO3) (mg/L)	251					
	Ammonia, Total (as N) (mg/L)	<0.0050					
	Chloride (Cl) (mg/L)	4.49					
	Nitrate and Nitrite (as N) (mg/L)	0.112					
	Nitrate (as N) (mg/L)	0.112					
	Nitrite (as N) (mg/L)	<0.0010					
	Sulfate (SO4) (mg/L)	57.9					
	Anion Sum (meq/L)	6.36					
	Cation Sum (meq/L)	6.09					
	Cation - Anion Balance (%)	-2.2					
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	6.16					
Total Metals	Aluminum (Al)-Total (mg/L)	0.0078					
	Antimony (Sb)-Total (mg/L)	<0.00010					
	Arsenic (As)-Total (mg/L)	0.00026					
	Barium (Ba)-Total (mg/L)	0.0671					
	Beryllium (Be)-Total (mg/L)	<0.000020					
	Bismuth (Bi)-Total (mg/L)	<0.000050					
	Boron (B)-Total (mg/L)	0.025					
	Cadmium (Cd)-Total (mg/L)	<0.0000050					
	Calcium (Ca)-Total (mg/L)	57.1					
	Chromium (Cr)-Total (mg/L)	0.00019					
	Cobalt (Co)-Total (mg/L)	<0.00010					
	Copper (Cu)-Total (mg/L)	0.00309					
	Iron (Fe)-Total (mg/L)	0.026					
	Lead (Pb)-Total (mg/L)	<0.000050					
	Lithium (Li)-Total (mg/L)	0.0031					
	Magnesium (Mg)-Total (mg/L)	29.9					
	Manganese (Mn)-Total (mg/L)	0.0423					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2163930-1 Water 12-SEP-18 16:00 W17	L2163930-2 Water 12-SEP-18 16:20 W16	L2163930-3 Water 12-SEP-18 16:50 W8A	L2163930-4 Water 10-SEP-18 09:30 MC1	L2163930-5 Water 10-SEP-18 10:15 W2
Grouping	Analyte						
WATER							
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	0.0000083	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Total (mg/L)	0.00639	0.00294	0.0131	0.00173	0.00137	
	Nickel (Ni)-Total (mg/L)	0.00062	0.00085	0.00130	0.00101	0.00090	
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	0.065	<0.050	<0.050	
	Potassium (K)-Total (mg/L)	3.67	2.57	6.54	1.28	1.50	
	Selenium (Se)-Total (mg/L)	0.000533	0.000729	0.00564	0.000148	0.000141	
	Silicon (Si)-Total (mg/L)	5.37	3.73	7.47	6.38	5.69	
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000050 ^{DLB}	<0.000010	<0.000010	
	Sodium (Na)-Total (mg/L)	13.6	12.4	39.1	10.3	10.7	
	Strontium (Sr)-Total (mg/L)	0.663	0.561	2.01	0.433	0.486	
	Sulfur (S)-Total (mg/L)	22.7	24.2	94.4	7.49	8.67	
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Total (mg/L)	0.00037	<0.00096 ^{DLM}	0.0153	0.00137	0.00052	
	Uranium (U)-Total (mg/L)	0.00189	0.00128	0.00260	0.00158	0.00189	
	Vanadium (V)-Total (mg/L)	<0.00050	0.00051	0.00280	0.00078	0.00059	
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	0.360	<0.0030	<0.0030	
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	0.00034	<0.00030	<0.00030	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0017	0.0019	0.0153	0.0045	0.0038	
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
	Arsenic (As)-Dissolved (mg/L)	0.00035	0.00038	0.00048	0.00047	0.00034	
	Barium (Ba)-Dissolved (mg/L)	0.0730	0.0758	0.119	0.0630	0.0648	
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	0.023	0.014	0.027	<0.010	<0.010	
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050	0.000219	<0.0000050	0.0000058	
	Calcium (Ca)-Dissolved (mg/L)	64.8	60.9	145	44.8	45.6	
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	0.00049	0.00021	0.00017	
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	0.00052	<0.00010	<0.00010	
	Copper (Cu)-Dissolved (mg/L)	0.00811	0.0251	0.0889	0.00157	0.00174	
	Iron (Fe)-Dissolved (mg/L)	<0.010	0.011	0.487	0.119	0.036	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.0016	0.0013	0.0039	0.0016	0.0020	
	Magnesium (Mg)-Dissolved (mg/L)	20.0	17.5	40.2	15.3	13.9	
	Manganese (Mn)-Dissolved (mg/L)	0.00368	0.00191	1.27	0.0177	0.00941	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID				
		Description				
		Sampled Date				
		Sampled Time				
		Client ID				
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050				
	Molybdenum (Mo)-Total (mg/L)	0.00481				
	Nickel (Ni)-Total (mg/L)	0.00097				
	Phosphorus (P)-Total (mg/L)	<0.050				
	Potassium (K)-Total (mg/L)	2.30				
	Selenium (Se)-Total (mg/L)	0.000283				
	Silicon (Si)-Total (mg/L)	6.23				
	Silver (Ag)-Total (mg/L)	<0.000010				
	Sodium (Na)-Total (mg/L)	18.9				
	Strontium (Sr)-Total (mg/L)	0.774				
	Sulfur (S)-Total (mg/L)	20.2				
	Thallium (Tl)-Total (mg/L)	<0.000010				
	Tin (Sn)-Total (mg/L)	<0.00010				
	Titanium (Ti)-Total (mg/L)	0.00034				
	Uranium (U)-Total (mg/L)	0.00269				
	Vanadium (V)-Total (mg/L)	<0.00050				
	Zinc (Zn)-Total (mg/L)	<0.0030				
	Zirconium (Zr)-Total (mg/L)	<0.00030				
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD				
	Dissolved Metals Filtration Location	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	0.0018				
	Antimony (Sb)-Dissolved (mg/L)	<0.00010				
	Arsenic (As)-Dissolved (mg/L)	0.00023				
	Barium (Ba)-Dissolved (mg/L)	0.0682				
	Beryllium (Be)-Dissolved (mg/L)	<0.000020				
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050				
	Boron (B)-Dissolved (mg/L)	0.024				
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050				
	Calcium (Ca)-Dissolved (mg/L)	59.5				
	Chromium (Cr)-Dissolved (mg/L)	0.00012				
	Cobalt (Co)-Dissolved (mg/L)	<0.00010				
	Copper (Cu)-Dissolved (mg/L)	0.00275				
	Iron (Fe)-Dissolved (mg/L)	0.018				
	Lead (Pb)-Dissolved (mg/L)	<0.000050				
	Lithium (Li)-Dissolved (mg/L)	0.0033				
	Magnesium (Mg)-Dissolved (mg/L)	27.7				
	Manganese (Mn)-Dissolved (mg/L)	0.0363				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2163930-1 Water 12-SEP-18 16:00 W17	L2163930-2 Water 12-SEP-18 16:20 W16	L2163930-3 Water 12-SEP-18 16:50 W8A	L2163930-4 Water 10-SEP-18 09:30 MC1	L2163930-5 Water 10-SEP-18 10:15 W2
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00661	0.00296	0.0137	0.00175	0.00137
	Nickel (Ni)-Dissolved (mg/L)	0.00065	0.00090	0.00113	0.00092	0.00087
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	3.80	2.58	6.54	1.34	1.52
	Selenium (Se)-Dissolved (mg/L)	0.000549	0.000571	0.00533	0.000091	0.000159
	Silicon (Si)-Dissolved (mg/L)	5.16	3.32	6.37	5.89	5.19
	Silver (Ag)-Dissolved (mg/L)	<0.000020 ^{DLA}	<0.000010	0.000015	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	14.5	12.0	38.4	9.75	9.98
	Strontium (Sr)-Dissolved (mg/L)	0.718	0.610	2.19	0.466	0.490
	Sulfur (S)-Dissolved (mg/L)	20.2	21.2	81.7	6.97	7.89
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.0015 ^{DLM}	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00203	0.00144	0.00269	0.00166	0.00198
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	0.00119	0.00057	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	0.328	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	0.00037	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2163930-6 Water 11-SEP-18 13:00 W3				
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050				
	Molybdenum (Mo)-Dissolved (mg/L)	0.00505				
	Nickel (Ni)-Dissolved (mg/L)	0.00094				
	Phosphorus (P)-Dissolved (mg/L)	<0.050				
	Potassium (K)-Dissolved (mg/L)	2.36				
	Selenium (Se)-Dissolved (mg/L)	0.000266				
	Silicon (Si)-Dissolved (mg/L)	5.74				
	Silver (Ag)-Dissolved (mg/L)	<0.000010				
	Sodium (Na)-Dissolved (mg/L)	18.0				
	Strontium (Sr)-Dissolved (mg/L)	0.811				
	Sulfur (S)-Dissolved (mg/L)	17.5				
	Thallium (Tl)-Dissolved (mg/L)	<0.000010				
	Tin (Sn)-Dissolved (mg/L)	<0.00010				
	Titanium (Ti)-Dissolved (mg/L)	<0.00030				
	Uranium (U)-Dissolved (mg/L)	0.00286				
	Vanadium (V)-Dissolved (mg/L)	<0.00050				
	Zinc (Zn)-Dissolved (mg/L)	<0.0010				
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Silver (Ag)-Total	MB-LOR	L2163930-1, -2, -3, -4, -5, -6
Matrix Spike	Dissolved Organic Carbon	MS-B	L2163930-1, -2, -4, -5, -6
Matrix Spike	Dissolved Organic Carbon	MS-B	L2163930-1, -2, -4, -5, -6
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2163930-1, -2, -3, -4, -5, -6
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2163930-1, -2, -3, -4, -5, -6
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2163930-1, -2, -3, -4, -5, -6
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2163930-1, -2, -3, -4, -5, -6
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2163930-1, -2, -3, -4, -5, -6
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2163930-1, -2, -3, -4, -5, -6
Matrix Spike	Aluminum (Al)-Total	MS-B	L2163930-1, -2, -3, -4, -5, -6
Matrix Spike	Barium (Ba)-Total	MS-B	L2163930-1, -2, -3, -4, -5, -6
Matrix Spike	Calcium (Ca)-Total	MS-B	L2163930-1, -2, -3, -4, -5, -6
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2163930-1, -2, -3, -4, -5, -6
Matrix Spike	Manganese (Mn)-Total	MS-B	L2163930-1, -2, -3, -4, -5, -6
Matrix Spike	Sodium (Na)-Total	MS-B	L2163930-1, -2, -3, -4, -5, -6
Matrix Spike	Strontium (Sr)-Total	MS-B	L2163930-1, -2, -3, -4, -5, -6
Matrix Spike	Sulfur (S)-Total	MS-B	L2163930-1, -2, -3, -4, -5, -6

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLB	Detection Limit Raised. Analyte detected at comparable level in Method Blank.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-WR	Water	Nitrite & Nitrate Nitrogen	EPA 300.1
Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance.			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-WR	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Reference Information

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 µm), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-WR Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
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WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
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	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
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Reference Information

VA

Chain of Custody Numbers:

2018-09-13 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 17-SEP-18
Report Date: 03-OCT-18 18:13 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2165523
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-09-15 C
Legal Site Desc:

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2165523-1 Water 14-SEP-18 10:00 W35	L2165523-2 Water 14-SEP-18 10:20 W12	L2165523-3 Water 14-SEP-18 10:50 W15	L2165523-4 Water 14-SEP-18 11:30 W45	L2165523-5 Water 14-SEP-18 16:40 W62
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	1340	2320	653	3130	1070
	Hardness (as CaCO3) (mg/L)	649	1120	320	1550	532
	pH (pH)	8.18	8.21	8.24	8.05	8.32
	Total Suspended Solids (mg/L)	10.2	14.0	12.6	25.8	25.0
	TDS (Calculated) (mg/L)	966	1890	412	2740	710
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	148	207	201	115	304
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	5.8
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	148	207	201	115	310
	Ammonia, Total (as N) (mg/L)	0.0070	3.86	0.0136	6.19	0.0171
	Chloride (Cl) (mg/L)	6.0	29.3	4.71	29.6	22.3
	Nitrate and Nitrite (as N) (mg/L)	89.8	9.07	5.50	13.6	10.2
	Nitrate (as N) (mg/L)	89.8	5.59	5.50	11.4	10.1
	Nitrite (as N) (mg/L)	0.0245	3.48	0.0036	2.18	0.0744
	Sulfate (SO4) (mg/L)	193	1130	133	1790	233
	Anion Sum (meq/L)	13.5	29.1	7.32	41.4	12.4
	Cation Sum (meq/L)	15.5	28.9	7.09	39.9	12.1
	Cation - Anion Balance (%)	6.6	-0.3	-1.6	-1.8	-1.1
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	17.2				
Total Metals	Aluminum (Al)-Total (mg/L)	0.387	0.264	0.567	0.367	0.448
	Antimony (Sb)-Total (mg/L)	<0.00010	0.00033	<0.00010	0.00042	0.00017
	Arsenic (As)-Total (mg/L)	0.00043	0.00051	0.00051	0.00040	0.00084
	Barium (Ba)-Total (mg/L)	0.132	0.0736	0.0830	0.0875	0.112
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000040 ^{DLA}	0.000035	<0.000040 ^{DLA}	0.000026
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.00010 ^{DLA}	<0.000050	<0.00010 ^{DLA}	<0.000050
	Boron (B)-Total (mg/L)	0.146	0.249	<0.010	0.366	0.032
	Cadmium (Cd)-Total (mg/L)	0.0000170	<0.00010 ^{DLM}	0.0000141	<0.000070 ^{DLM}	0.0000365
	Calcium (Ca)-Total (mg/L)	163	329	94.8	472	155
	Chromium (Cr)-Total (mg/L)	0.00042	0.00032	0.00050	<0.00020 ^{DLA}	0.00092
	Cobalt (Co)-Total (mg/L)	0.00028	0.00100	0.00041	0.00064	0.00048
	Copper (Cu)-Total (mg/L)	0.0539	0.0910	0.0736	0.0444	0.0656
	Iron (Fe)-Total (mg/L)	0.631	0.506	1.07	0.560	0.769
	Lead (Pb)-Total (mg/L)	0.000192	0.00020	0.000295	0.00020	0.000332
	Lithium (Li)-Total (mg/L)	0.0024	0.0163	0.0014	0.0212	0.0043
	Magnesium (Mg)-Total (mg/L)	47.5	65.7	24.2	84.8	38.8
	Manganese (Mn)-Total (mg/L)	0.0351	0.797	0.0812	0.591	0.0738

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2165523-6 Water 14-SEP-18 DUP				
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	656				
	Hardness (as CaCO3) (mg/L)	315				
	pH (pH)	8.21				
	Total Suspended Solids (mg/L)	9.8				
	TDS (Calculated) (mg/L)	408				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	199				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Total (as CaCO3) (mg/L)	199				
	Ammonia, Total (as N) (mg/L)	0.0142				
	Chloride (Cl) (mg/L)	4.68				
	Nitrate and Nitrite (as N) (mg/L)	5.51				
	Nitrate (as N) (mg/L)	5.50				
	Nitrite (as N) (mg/L)	0.0034				
	Sulfate (SO4) (mg/L)	133				
	Anion Sum (meq/L)	7.26				
	Cation Sum (meq/L)	6.96				
	Cation - Anion Balance (%)	-2.1				
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)					
Total Metals	Aluminum (Al)-Total (mg/L)	0.595				
	Antimony (Sb)-Total (mg/L)	<0.00010				
	Arsenic (As)-Total (mg/L)	0.00059				
	Barium (Ba)-Total (mg/L)	0.0817				
	Beryllium (Be)-Total (mg/L)	0.000029				
	Bismuth (Bi)-Total (mg/L)	<0.000050				
	Boron (B)-Total (mg/L)	<0.010				
	Cadmium (Cd)-Total (mg/L)	0.0000179				
	Calcium (Ca)-Total (mg/L)	95.7				
	Chromium (Cr)-Total (mg/L)	0.00047				
	Cobalt (Co)-Total (mg/L)	0.00040				
	Copper (Cu)-Total (mg/L)	0.0741				
	Iron (Fe)-Total (mg/L)	1.10				
	Lead (Pb)-Total (mg/L)	0.000301				
	Lithium (Li)-Total (mg/L)	0.0014				
	Magnesium (Mg)-Total (mg/L)	23.9				
	Manganese (Mn)-Total (mg/L)	0.0803				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2165523-1 Water 14-SEP-18 10:00 W35	L2165523-2 Water 14-SEP-18 10:20 W12	L2165523-3 Water 14-SEP-18 10:50 W15	L2165523-4 Water 14-SEP-18 11:30 W45	L2165523-5 Water 14-SEP-18 16:40 W62
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.000025 ^{DLM}	<0.0000050	0.0000054
	Molybdenum (Mo)-Total (mg/L)	0.00291	0.0619	0.00276	0.0887	0.0108
	Nickel (Ni)-Total (mg/L)	0.00187	0.0049	0.00107	0.0057	0.00189
	Phosphorus (P)-Total (mg/L)	<0.050	<0.10 ^{DLA}	<0.050	<0.10 ^{DLA}	<0.050
	Potassium (K)-Total (mg/L)	3.69	40.5	3.08	63.8	6.25
	Selenium (Se)-Total (mg/L)	0.00130	0.00610	0.00197	0.00694	0.00357
	Silicon (Si)-Total (mg/L)	5.73	4.76	5.91	4.05	7.56
	Silver (Ag)-Total (mg/L)	<0.000020 ^{DLB}	<0.000020 ^{DLA}	<0.000020 ^{DLB}	<0.000020 ^{DLA}	<0.000020 ^{DLB}
	Sodium (Na)-Total (mg/L)	45.6	114	13.5	151	28.7
	Strontium (Sr)-Total (mg/L)	1.77	5.52	0.873	7.21	1.81
	Sulfur (S)-Total (mg/L)	69.2	404	44.7	682	80.7
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000020 ^{DLA}	<0.000010	<0.000020 ^{DLA}	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00020 ^{DLA}	<0.00010	<0.00020 ^{DLA}	<0.00010
	Titanium (Ti)-Total (mg/L)	0.0199	0.0140	0.0241	<0.018 ^{DLM}	0.0188
	Uranium (U)-Total (mg/L)	0.00164	0.00646	0.00195	0.00422	0.00446
	Vanadium (V)-Total (mg/L)	0.00169	0.0013 ^{DLA}	0.00236	0.0012 ^{DLA}	0.00218
	Zinc (Zn)-Total (mg/L)	0.0042	<0.0060 ^{DLA}	0.0038	<0.0060 ^{DLA}	0.0254
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	0.00030	<0.00030	0.00060
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0099	0.0116	0.0110	0.0155	0.0084
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	0.00030	<0.00010	0.00043	0.00012
	Arsenic (As)-Dissolved (mg/L)	0.00031	0.00043	0.00038	0.00035	0.00057
	Barium (Ba)-Dissolved (mg/L)	0.136	0.0710	0.0738	0.0846	0.114
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.00010 ^{DLA}	<0.000050
	Boron (B)-Dissolved (mg/L)	0.167	0.235	<0.010	0.360	0.028
	Cadmium (Cd)-Dissolved (mg/L)	0.0000159	<0.000080 ^{DLM}	0.0000114	<0.000065 ^{DLM}	0.0000326
	Calcium (Ca)-Dissolved (mg/L)	166	339	87.0	473	145
	Chromium (Cr)-Dissolved (mg/L)	0.00028	<0.00010	0.00019	<0.00020 ^{DLA}	0.00019
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00078	0.00012	0.00051	0.00018
	Copper (Cu)-Dissolved (mg/L)	0.0272	0.0454	0.0302	0.00263	0.0543
	Iron (Fe)-Dissolved (mg/L)	0.023	0.016	0.120	<0.020 ^{DLA}	0.034
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.00010 ^{DLA}	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0021	0.0153	0.0010	0.0207	0.0036
	Magnesium (Mg)-Dissolved (mg/L)	56.7	66.8	25.0	89.5	41.6
	Manganese (Mn)-Dissolved (mg/L)	0.0174	0.775	0.0563	0.599	0.0640

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID				
		L2165523-6 Water 14-SEP-18 DUP				
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050				
	Molybdenum (Mo)-Total (mg/L)	0.00282				
	Nickel (Ni)-Total (mg/L)	0.00102				
	Phosphorus (P)-Total (mg/L)	<0.050				
	Potassium (K)-Total (mg/L)	3.03				
	Selenium (Se)-Total (mg/L)	0.00206				
	Silicon (Si)-Total (mg/L)	6.19				
	Silver (Ag)-Total (mg/L)	<0.000020 ^{DLB}				
	Sodium (Na)-Total (mg/L)	13.4				
	Strontium (Sr)-Total (mg/L)	0.881				
	Sulfur (S)-Total (mg/L)	47.1				
	Thallium (Tl)-Total (mg/L)	<0.000010				
	Tin (Sn)-Total (mg/L)	<0.00010				
	Titanium (Ti)-Total (mg/L)	0.0276				
	Uranium (U)-Total (mg/L)	0.00197				
	Vanadium (V)-Total (mg/L)	0.00245				
	Zinc (Zn)-Total (mg/L)	0.0034				
	Zirconium (Zr)-Total (mg/L)	0.00032				
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD				
	Dissolved Metals Filtration Location	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	0.0123				
	Antimony (Sb)-Dissolved (mg/L)	<0.00010				
	Arsenic (As)-Dissolved (mg/L)	0.00036				
	Barium (Ba)-Dissolved (mg/L)	0.0755				
	Beryllium (Be)-Dissolved (mg/L)	<0.000020				
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050				
	Boron (B)-Dissolved (mg/L)	<0.010				
	Cadmium (Cd)-Dissolved (mg/L)	0.0000108				
	Calcium (Ca)-Dissolved (mg/L)	85.7				
	Chromium (Cr)-Dissolved (mg/L)	0.00022				
	Cobalt (Co)-Dissolved (mg/L)	0.00013				
	Copper (Cu)-Dissolved (mg/L)	0.0303				
	Iron (Fe)-Dissolved (mg/L)	0.126				
	Lead (Pb)-Dissolved (mg/L)	<0.000050				
	Lithium (Li)-Dissolved (mg/L)	<0.0010				
	Magnesium (Mg)-Dissolved (mg/L)	24.5				
	Manganese (Mn)-Dissolved (mg/L)	0.0563				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2165523-1 Water 14-SEP-18 10:00 W35	L2165523-2 Water 14-SEP-18 10:20 W12	L2165523-3 Water 14-SEP-18 10:50 W15	L2165523-4 Water 14-SEP-18 11:30 W45	L2165523-5 Water 14-SEP-18 16:40 W62
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00294	0.0589	0.00248	0.0859	0.0100
	Nickel (Ni)-Dissolved (mg/L)	0.00178	0.00444	0.00077	0.0060	0.00116
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.10 ^{DLA}	<0.050
	Potassium (K)-Dissolved (mg/L)	3.95	41.8	2.85	69.2	6.38
	Selenium (Se)-Dissolved (mg/L)	0.00197 ^{DTMF}	0.00760	0.00215	0.00742	0.00398
	Silicon (Si)-Dissolved (mg/L)	5.18	4.59	5.13	3.67	6.93
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000020 ^{DLA}	<0.000010
	Sodium (Na)-Dissolved (mg/L)	54.9	118	14.0	155	30.7
	Strontium (Sr)-Dissolved (mg/L)	1.79	5.85	0.779	7.17	1.63
	Sulfur (S)-Dissolved (mg/L)	77.9	395	43.5	648	75.1
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000020 ^{DLA}	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00020 ^{DLA}	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00041	<0.00030	0.00051	<0.00060 ^{DLA}	0.00059
	Uranium (U)-Dissolved (mg/L)	0.00199	0.00704	0.00182	0.00444	0.00425
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.0010 ^{DLA}	0.00070
	Zinc (Zn)-Dissolved (mg/L)	0.0011	0.0025	<0.0010	<0.0020 ^{DLA}	0.0358 ^{DTC}
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2165523-6 Water 14-SEP-18 DUP				
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050				
	Molybdenum (Mo)-Dissolved (mg/L)	0.00253				
	Nickel (Ni)-Dissolved (mg/L)	0.00083				
	Phosphorus (P)-Dissolved (mg/L)	<0.050				
	Potassium (K)-Dissolved (mg/L)	2.87				
	Selenium (Se)-Dissolved (mg/L)	0.00212				
	Silicon (Si)-Dissolved (mg/L)	5.17				
	Silver (Ag)-Dissolved (mg/L)	<0.000010				
	Sodium (Na)-Dissolved (mg/L)	13.5				
	Strontium (Sr)-Dissolved (mg/L)	0.783				
	Sulfur (S)-Dissolved (mg/L)	41.6				
	Thallium (Tl)-Dissolved (mg/L)	<0.000010				
	Tin (Sn)-Dissolved (mg/L)	<0.00010				
	Titanium (Ti)-Dissolved (mg/L)	0.00072				
	Uranium (U)-Dissolved (mg/L)	0.00188				
	Vanadium (V)-Dissolved (mg/L)	<0.00050				
	Zinc (Zn)-Dissolved (mg/L)	<0.0010				
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Dissolved Organic Carbon	B	L2165523-1
Method Blank	Silver (Ag)-Total	MB-LOR	L2165523-1, -3, -4, -5, -6
Matrix Spike	Dissolved Organic Carbon	MS-B	L2165523-1
Matrix Spike	Dissolved Organic Carbon	MS-B	L2165523-1
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2165523-1, -2, -3, -4, -5, -6
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2165523-1, -2, -3, -4, -5, -6
Matrix Spike	Copper (Cu)-Dissolved	MS-B	L2165523-1, -2, -3, -4, -5, -6
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2165523-1, -2, -3, -4, -5, -6
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2165523-1, -2, -3, -4, -5, -6
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2165523-1, -2, -3, -4, -5, -6
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2165523-1, -2, -3, -4, -5, -6
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2165523-1, -2, -3, -4, -5, -6
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2165523-1, -2, -3, -4, -5, -6
Matrix Spike	Aluminum (Al)-Total	MS-B	L2165523-2
Matrix Spike	Arsenic (As)-Total	MS-B	L2165523-2
Matrix Spike	Boron (B)-Total	MS-B	L2165523-2
Matrix Spike	Calcium (Ca)-Total	MS-B	L2165523-2
Matrix Spike	Lead (Pb)-Total	MS-B	L2165523-2
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2165523-2
Matrix Spike	Manganese (Mn)-Total	MS-B	L2165523-2
Matrix Spike	Potassium (K)-Total	MS-B	L2165523-2
Matrix Spike	Silicon (Si)-Total	MS-B	L2165523-2
Matrix Spike	Sodium (Na)-Total	MS-B	L2165523-2
Matrix Spike	Strontium (Sr)-Total	MS-B	L2165523-2
Matrix Spike	Sulfur (S)-Total	MS-B	L2165523-2

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
DLA	Detection Limit adjusted for required dilution
DLB	Detection Limit Raised. Analyte detected at comparable level in Method Blank.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DTC	Dissolved concentration exceeds total. Results were confirmed by re-analysis.
DTMF	Dissolved concentration exceeds total for field-filtered metals sample. Metallic contaminants may have been introduced to dissolved sample during field filtration.
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-WR	Water	Nitrite & Nitrate Nitrogen	EPA 300.1
Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance.			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			

Reference Information

CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-WR	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NO2-L-IC-N-WR	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-WR	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
SO4-IC-WR	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)

Reference Information

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-09-15 C

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2165523-COFC

COC Number: 2018- 09 -15 C

Page 1 of 1

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Report To		Report Format / Distribution		Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply	
Company:	Minto Explorations Ltd.	Select Report Format:	☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)	Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply	
Contact:	Minto Environment - Coordinator	Quality Control (QC) Report with Report	☒ YES ☐ NO	PRIORITY (Business Days)	4 day [P4] ☐ 3 day [P3] ☐ 2 day [P2] ☐
Phone:	1-604-759-4659	☒ Compare Results to Criteria on Report - provide details below if box checked		EMERGENCY	1 Business day [E1] ☐ Same Day, Weekend or Statutory holiday [E0] ☐
Company address below will appear on the final report		Select Distribution:	☒ EMAIL ☐ MAIL ☐ FAX	Date and Time Required for all E&P TATs:	
Street:	2100-510 West Georgia St.	Email 1 or Fax	mintoenvironment@mintomine.com	For tests that can not be performed according to the service level selected, you will be contacted.	
City/Province:	Vancouver, British Columbia	Email 2		Analysis Request	
Postal Code:	V6B 0M3	Email 3		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below	
Invoice To	Same as Report To ☐ YES ☒ NO	Invoice Distribution		Number of Containers	
	Copy of Invoice with Report ☐ YES ☒ NO	Select Invoice Distribution:	☒ EMAIL ☐ MAIL ☐ FAX		
Company:	Minto Explorations Ltd.	Email 1 or Fax	ap@mintomine.com		
Contact:	Ruth Cayetano	Email 2			
Project Information		Oil and Gas Required Fields (client use)			
ALS Account # / Quote #:		AFE/Cost Center:	PO#		
Job #:		Major/Minor Code:	Routing Code:		
PO / AFE:	229096 (WUL)	Requisitioner:			
LSD:		Location:			
ALS Lab Work Order # (lab use only)		ALS Contact:	Shane Stack	Sampler:	SB/CH
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mm-yy)	Time (hh:mm)	Sample Type	
	W35	14-Sep-18	10:00	Water	7
	W12	14-Sep-18	10:20	Water	6
	W15	14-Sep-18	10:50	Water	6 X
	W45	14-Sep-18	11:30	Water	6
	W62	14-Sep-18	16:40	Water	6
	DUP	14-Sep-18		Water	6
Drinking Water (DW) Samples ¹ (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)		SAMPLE CONDITION AS RECEIVED (lab use only)	
Are samples taken from a Regulated DW System? ☐ YES ☒ NO				Frozen ☐ SIF Observations Yes ☐ No ☐	
Are samples for human drinking water use? ☐ YES ☒ NO				Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐	
				Cooling Initiated ☒	
				INITIAL COOLER TEMPERATURES °C 1°C	
				FINAL COOLER TEMPERATURES °C 5	
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)		FINAL SHIPMENT RECEPTION (lab use only)	
Released by: Shaheen Baker	Date: 9/15/2018	Time:	Received by:	Date: 9/17/18	Time: 12:01
				Received by: HA	Date: 9/18
					Time: 2:30 PM

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY

YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 19-SEP-18
Report Date: 28-SEP-18 17:51 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2166950
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-09-18 A
Legal Site Desc:

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2166950-1 Water 15-SEP-18 11:30 W10	L2166950-2 Water 15-SEP-18 11:30 F-BL	L2166950-3 Water 16-SEP-18 10:45 W30	L2166950-4 Water 16-SEP-18 11:00 W33S	L2166950-5 Water 16-SEP-18 17:00 W14
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	484	<2.0	385	225	3330
	Hardness (as CaCO3) (mg/L)	220	<0.50	169	109	1740
	pH (pH)	8.14	5.55	8.28	8.11	8.06
	Total Suspended Solids (mg/L)	119	<3.0	<3.0	8.4	63.4
	TDS (Calculated) (mg/L)	286	<1.0	228	126	3050
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	205	<1.0	114	96.4	123
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	205	<1.0	115	96.4	123
	Ammonia, Total (as N) (mg/L)	0.0098	<0.0050	0.0058	0.0270	6.85
	Chloride (Cl) (mg/L)	0.72	<0.50	1.31	0.92	35.2
	Nitrate and Nitrite (as N) (mg/L)	14.0	<0.0051	0.0094	2.73	19.5
	Nitrate (as N) (mg/L)	14.0	<0.0050	0.0094	2.67	15.9
	Nitrite (as N) (mg/L)	0.0217	<0.0010	<0.0010	0.0525	3.58
	Sulfate (SO4) (mg/L)	10.0	<0.30	88.0	11.6	1950
	Anion Sum (meq/L)	5.31	<0.10	4.16	2.39	45.4
	Cation Sum (meq/L)	4.88	<0.10	4.00	2.42	45.2
	Cation - Anion Balance (%)	-4.3	0.0	-2.0	0.6	-0.2
Organic / Inorganic Carbon						
Total Metals	Dissolved Organic Carbon (mg/L)					
	Aluminum (Al)-Total (mg/L)	0.489	<0.0030	0.0416	0.0443	
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Arsenic (As)-Total (mg/L)	0.00102	<0.00010	0.00066	0.00033	
	Barium (Ba)-Total (mg/L)	0.280	<0.00010	0.0483	0.0378	
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Total (mg/L)	0.016	<0.010	0.010	<0.010	
	Cadmium (Cd)-Total (mg/L)	0.0000152	<0.0000050	<0.0000050	0.0000062	
	Calcium (Ca)-Total (mg/L)	63.8	<0.050	32.1	26.7	
	Chromium (Cr)-Total (mg/L)	0.00052	<0.00010	<0.00010	0.00045	
	Cobalt (Co)-Total (mg/L)	0.00125	<0.00010	<0.00010	<0.00010	
	Copper (Cu)-Total (mg/L)	0.0464	<0.00050	0.0189	0.0209	
	Iron (Fe)-Total (mg/L)	9.73	<0.010	0.089	0.096	
	Lead (Pb)-Total (mg/L)	0.000113	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Total (mg/L)	0.0013	<0.0010	0.0021	<0.0010	
	Magnesium (Mg)-Total (mg/L)	14.8	<0.10	18.5	8.58	
	Manganese (Mn)-Total (mg/L)	0.661	<0.00010	0.0147	0.0106	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2166950-6 Water 17-SEP-18 16:00 W8A	L2166950-7 Water 17-SEP-18 16:50 W16			
Grouping	Analyte						
WATER							
Physical Tests	Conductivity (uS/cm)		1020	478			
	Hardness (as CaCO3) (mg/L)		499	226			
	pH (pH)		7.89	8.33			
	Total Suspended Solids (mg/L)		89.4	5.6			
	TDS (Calculated) (mg/L)		675	285			
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)		336	176			
	Alkalinity, Carbonate (as CaCO3) (mg/L)		<1.0	5.8			
	Alkalinity, Hydroxide (as CaCO3) (mg/L)		<1.0	<1.0			
	Alkalinity, Total (as CaCO3) (mg/L)		336	182			
	Ammonia, Total (as N) (mg/L)		0.106	0.0084			
	Chloride (Cl) (mg/L)		6.91	5.85			
	Nitrate and Nitrite (as N) (mg/L)		5.59	1.40			
	Nitrate (as N) (mg/L)		5.56	1.39			
	Nitrite (as N) (mg/L)		0.0282	0.0067			
	Sulfate (SO4) (mg/L)		223	69.6			
	Anion Sum (meq/L)		12.0	5.35			
	Cation Sum (meq/L)		11.8	5.14			
	Cation - Anion Balance (%)		-0.7	-2.1			
	Organic / Inorganic Carbon			15.2			
Total Metals	Aluminum (Al)-Total (mg/L)		0.204	0.0551			
	Antimony (Sb)-Total (mg/L)		0.00013	<0.00010			
	Arsenic (As)-Total (mg/L)		0.00074	0.00042			
	Barium (Ba)-Total (mg/L)		0.112	0.0747			
	Beryllium (Be)-Total (mg/L)		0.000032	<0.000020			
	Bismuth (Bi)-Total (mg/L)		<0.000050	<0.000050			
	Boron (B)-Total (mg/L)		0.023	0.013			
	Cadmium (Cd)-Total (mg/L)		0.000209	0.0000086			
	Calcium (Ca)-Total (mg/L)		127	59.7			
	Chromium (Cr)-Total (mg/L)		0.00068	0.00018			
	Cobalt (Co)-Total (mg/L)		0.00080	<0.00010			
	Copper (Cu)-Total (mg/L)		0.189	0.0316			
	Iron (Fe)-Total (mg/L)		1.62	0.102			
	Lead (Pb)-Total (mg/L)		0.000329	<0.000050			
	Lithium (Li)-Total (mg/L)		0.0038	0.0013			
	Magnesium (Mg)-Total (mg/L)		39.4	18.4			
	Manganese (Mn)-Total (mg/L)		1.49	0.0859			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2166950-1 Water 15-SEP-18 11:30 W10	L2166950-2 Water 15-SEP-18 11:30 F-BL	L2166950-3 Water 16-SEP-18 10:45 W30	L2166950-4 Water 16-SEP-18 11:00 W33S	L2166950-5 Water 16-SEP-18 17:00 W14
Grouping	Analyte						
WATER							
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Total (mg/L)	0.000854	<0.000050	0.00325	0.000805		
	Nickel (Ni)-Total (mg/L)	0.00060	<0.00050	<0.00050	0.00113		
	Phosphorus (P)-Total (mg/L)	0.114	<0.050	<0.050	<0.050		
	Potassium (K)-Total (mg/L)	2.12	<0.10	3.23	0.61		
	Selenium (Se)-Total (mg/L)	0.000238	<0.000050	0.000628	0.000181		
	Silicon (Si)-Total (mg/L)	4.76	<0.10	0.33	4.74		
	Silver (Ag)-Total (mg/L)	0.000020	<0.000010	<0.000010	<0.000010		
	Sodium (Na)-Total (mg/L)	9.33	<0.050	11.4	4.33		
	Strontium (Sr)-Total (mg/L)	0.462	<0.00020	0.514	0.214		
	Sulfur (S)-Total (mg/L)	3.10	<0.50	26.2	3.44		
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010		
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010		
	Titanium (Ti)-Total (mg/L)	0.0238	<0.00030	0.00162	0.00132		
	Uranium (U)-Total (mg/L)	0.000346	<0.000010	0.000515	0.000091		
	Vanadium (V)-Total (mg/L)	0.00442	<0.00050	<0.00050	<0.00050		
	Zinc (Zn)-Total (mg/L)	0.0144	<0.0030	<0.0030	<0.0030		
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	0.00033		
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0029	<0.0010	0.0135	0.0214	0.0399	
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	0.00057	
	Arsenic (As)-Dissolved (mg/L)	0.00010	<0.00010	0.00064	0.00033	0.00041	
	Barium (Ba)-Dissolved (mg/L)	0.206	<0.00010	0.0501	0.0376	0.170	
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000040 ^{DLA}	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.00010 ^{DLA}	
	Boron (B)-Dissolved (mg/L)	0.018	<0.010	0.012	<0.010	0.356	
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	0.0000076	0.000043	
	Calcium (Ca)-Dissolved (mg/L)	64.2	<0.050	34.7	28.8	549	
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00040	<0.00020 ^{DLA}	
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	0.00036	
	Copper (Cu)-Dissolved (mg/L)	0.00341	<0.00020	0.0138	0.0200	0.00990	
	Iron (Fe)-Dissolved (mg/L)	0.064	<0.010	0.037	0.056	0.033	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	0.00026	
	Lithium (Li)-Dissolved (mg/L)	0.0011	<0.0010	0.0021	<0.0010	0.0293	
	Magnesium (Mg)-Dissolved (mg/L)	14.5	<0.10	20.0	9.02	89.4	
	Manganese (Mn)-Dissolved (mg/L)	0.0321	<0.00010	0.00904	0.00896	0.612	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2166950-6 Water 17-SEP-18 16:00 W8A	L2166950-7 Water 17-SEP-18 16:50 W16			
Grouping	Analyte						
WATER							
Total Metals	Mercury (Hg)-Total (mg/L)	0.0000107	<0.0000050				
	Molybdenum (Mo)-Total (mg/L)	0.0111	0.00297				
	Nickel (Ni)-Total (mg/L)	0.00138	0.00081				
	Phosphorus (P)-Total (mg/L)	0.097	<0.050				
	Potassium (K)-Total (mg/L)	5.93	2.54				
	Selenium (Se)-Total (mg/L)	0.00476	0.000708				
	Silicon (Si)-Total (mg/L)	7.03	3.78				
	Silver (Ag)-Total (mg/L)	0.000036	<0.000010				
	Sodium (Na)-Total (mg/L)	35.9	11.3				
	Strontium (Sr)-Total (mg/L)	1.86	0.615				
	Sulfur (S)-Total (mg/L)	71.4	22.1				
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010				
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010				
	Titanium (Ti)-Total (mg/L)	0.00824	<0.0036 ^{DLM}				
	Uranium (U)-Total (mg/L)	0.00268	0.00137				
	Vanadium (V)-Total (mg/L)	0.00260	0.00062				
	Zinc (Zn)-Total (mg/L)	0.298	<0.0030				
	Zirconium (Zr)-Total (mg/L)	0.00039	<0.00030				
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD				
	Dissolved Metals Filtration Location	FIELD	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	0.0097	0.0024				
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010				
	Arsenic (As)-Dissolved (mg/L)	0.00063	0.00043				
	Barium (Ba)-Dissolved (mg/L)	0.108	0.0699				
	Beryllium (Be)-Dissolved (mg/L)	0.000021	<0.000020				
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050				
	Boron (B)-Dissolved (mg/L)	0.026	0.015				
	Cadmium (Cd)-Dissolved (mg/L)	0.000198	<0.0000050				
	Calcium (Ca)-Dissolved (mg/L)	135	60.3				
	Chromium (Cr)-Dissolved (mg/L)	0.00037	0.00011				
	Cobalt (Co)-Dissolved (mg/L)	0.00059	<0.00010				
	Copper (Cu)-Dissolved (mg/L)	0.0951	0.0262				
	Iron (Fe)-Dissolved (mg/L)	0.469	0.016				
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050				
	Lithium (Li)-Dissolved (mg/L)	0.0034	0.0012				
	Magnesium (Mg)-Dissolved (mg/L)	39.4	18.4				
	Manganese (Mn)-Dissolved (mg/L)	1.51	0.0176				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2166950-1 Water 15-SEP-18 11:30 W10	L2166950-2 Water 15-SEP-18 11:30 F-BL	L2166950-3 Water 16-SEP-18 10:45 W30	L2166950-4 Water 16-SEP-18 11:00 W33S	L2166950-5 Water 16-SEP-18 17:00 W14
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.00010 ^{DLM}
	Molybdenum (Mo)-Dissolved (mg/L)	0.000787	<0.000050	0.00348	0.000821	0.120
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	0.00116	0.0092
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.10 ^{DLA}
	Potassium (K)-Dissolved (mg/L)	1.77	<0.10	3.18	0.62	85.9
	Selenium (Se)-Dissolved (mg/L)	0.000141	<0.000050	0.000701	0.000213	0.00989
	Silicon (Si)-Dissolved (mg/L)	3.33	<0.050	0.253	5.10	2.35
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020 ^{DLA}
	Sodium (Na)-Dissolved (mg/L)	9.92	<0.050	12.3	4.88	178
	Strontium (Sr)-Dissolved (mg/L)	0.460	<0.00020	0.536	0.201	7.71
	Sulfur (S)-Dissolved (mg/L)	3.37	<0.50	29.3	3.78	770
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020 ^{DLA}
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020 ^{DLA}
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	0.00204	0.00065	0.00072
	Uranium (U)-Dissolved (mg/L)	0.000308	<0.000010	0.000512	0.000082	0.00624
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.0010 ^{DLA}
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	0.0043
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	0.00034	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2166950-6 Water 17-SEP-18 16:00 W8A	L2166950-7 Water 17-SEP-18 16:50 W16			
Grouping	Analyte						
WATER							
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	0.0000060	<0.0000050				
	Molybdenum (Mo)-Dissolved (mg/L)	0.0117	0.00293				
	Nickel (Ni)-Dissolved (mg/L)	0.00103	0.00074				
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050				
	Potassium (K)-Dissolved (mg/L)	5.83	2.47				
	Selenium (Se)-Dissolved (mg/L)	0.00524	0.000732				
	Silicon (Si)-Dissolved (mg/L)	6.84	3.67				
	Silver (Ag)-Dissolved (mg/L)	0.000014	<0.000010				
	Sodium (Na)-Dissolved (mg/L)	36.5	12.5				
	Strontium (Sr)-Dissolved (mg/L)	1.86	0.560				
	Sulfur (S)-Dissolved (mg/L)	77.4	23.2				
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010				
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010				
	Titanium (Ti)-Dissolved (mg/L)	<0.00060 ^{DLM}	<0.00030				
	Uranium (U)-Dissolved (mg/L)	0.00234	0.00132				
	Vanadium (V)-Dissolved (mg/L)	0.00120	<0.00050				
	Zinc (Zn)-Dissolved (mg/L)	0.170	<0.0010				
	Zirconium (Zr)-Dissolved (mg/L)	0.00035	<0.00030				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Dissolved Organic Carbon	MS-B	L2166950-7
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2166950-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2166950-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Copper (Cu)-Dissolved	MS-B	L2166950-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2166950-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2166950-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2166950-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2166950-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Calcium (Ca)-Total	MS-B	L2166950-1, -2, -3, -4, -6, -7
Matrix Spike	Cobalt (Co)-Total	MS-B	L2166950-1, -2, -3, -4, -6, -7
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2166950-1, -2, -3, -4, -6, -7
Matrix Spike	Manganese (Mn)-Total	MS-B	L2166950-1, -2, -3, -4, -6, -7
Matrix Spike	Nickel (Ni)-Total	MS-B	L2166950-1, -2, -3, -4, -6, -7
Matrix Spike	Sodium (Na)-Total	MS-B	L2166950-1, -2, -3, -4, -6, -7
Matrix Spike	Strontium (Sr)-Total	MS-B	L2166950-1, -2, -3, -4, -6, -7
Matrix Spike	Sulfur (S)-Total	MS-B	L2166950-1, -2, -3, -4, -6, -7
Matrix Spike	Nitrate (as N)	MS-B	L2166950-1, -2, -3, -4, -5, -6, -7

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-WR	Water	Nitrite & Nitrate Nitrogen	EPA 300.1
Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance.			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-WR	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)

Reference Information

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-WR Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
----------------------------	---------------------

WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
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VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
----	---

Chain of Custody Numbers:

Reference Information

2018-09-18 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2166950-COFC

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Report To		Report Format / Distribution		Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply	
Company:	Minto Explorations Ltd.	Select Report Format:	☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)	Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply	
Contact:	Minto Environment - Coordinator	Quality Control (QC) Report with Report	☒ YES ☐ NO	4 day [P4] ☐	
Phone:	1-604-759-4659	☒ Compare Results to Criteria on Report - provide details below if box checked		3 day [P3] ☐	1 Business day [E1] ☐
Company address below will appear on the final report		Select Distribution:	☒ EMAIL ☐ MAIL ☐ FAX	2 day [P2] ☐	Same Day, Weekend or Statutory holiday [E0] ☐
Street:	2100-510 West Georgia St.	Email 1 or Fax	mintoenvironment@mintomine.com	Date and Time Required for all E&P TATs:	
City/Province:	Vancouver, British Columbia	Email 2		For tests that can not be performed according to the service level selected, you will be contacted.	
Postal Code:	V6B 0M3	Email 3		Analysis Request	
Invoice To	Same as Report To ☐ YES ☒ NO	Invoice Distribution		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below	
	Copy of Invoice with Report ☐ YES ☒ NO	Select Invoice Distribution:	☒ EMAIL ☐ MAIL ☐ FAX		
Company:	Minto Explorations Ltd.	Email 1 or Fax	ap@mintomine.com		
Contact:	Ruth Cayetano	Email 2			
Project Information		Oil and Gas Required Fields (client use)			
ALS Account # / Quote #:		AFE/Cost Center:	PO#		
Job #:		Major/Minor Code:	Routing Code:		
PO / AFE:	229096 (WUL)	Requisitioner:			
LSD:		Location:			
ALS Lab Work Order # (lab use only)		ALS Contact:	Shane Stack	Sampler:	CH/SB
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	
W10		15-Sep-18	11:30	Water	
F-BL		15-Sep-18	11:30	Water	
W30		16-Sep-18	10:45	Water	
W33s		16-Sep-18	11:00	Water	
W14		16-Sep-18	17:00	Water	
W8A		17-Sep-18	16:00	Water	
W16		17-Sep-18	16:50	Water	
Drinking Water (DW) Samples ¹ (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)		SAMPLE CONDITION AS RECEIVED (lab use only)	
Are samples taken from a Regulated DW System? ☐ YES ☒ NO				Frozen ☐ SIF Observations Yes ☐ No ☐	
Are samples for human drinking water use? ☐ YES ☒ NO				Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐	
				Cooling Initiated ☒	
				INITIAL COOLER TEMPERATURES °C	
				FINAL COOLER TEMPERATURES °C	
				5°C	
				9	
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)		FINAL SHIPMENT RECEPTION (lab use only)	
Released by: Chris Harry	Date: 2018-09-18 10:30	Time:	Received by: [Signature]	Date: Sept 19/18	Time: 11:27
				Received by: HA	Date: 9/20
				Time: 12:50p	

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 19-SEP-18
Report Date: 01-OCT-18 14:14 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2167294
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-09-19 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

01-OCT-18 14:14 (MT)

Version: FINAL

Sample ID Description Sampled Date Sampled Time Client ID		L2167294-1 Water 18-SEP-18 09:30 W17	L2167294-2 Water 18-SEP-18 08:50 W3	L2167294-3 Water 18-SEP-18 14:15 MC1	L2167294-4 Water 18-SEP-18 14:45 W2	L2167294-5 Water 18-SEP-18 DUP
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	502	555	346	356	357
	Hardness (as CaCO3) (mg/L)	231	261	163	168	169
	pH (pH)	8.36	8.41	8.37	8.29	8.29
	Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0	<3.0	<3.0
	TDS (Calculated) (mg/L)	290	321	192	199	196
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	193	241	168	171	170
	Alkalinity, Carbonate (as CaCO3) (mg/L)	7.4	12.0	6.0	2.6	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	201	253	174	174	170
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Chloride (Cl) (mg/L)	5.85	4.48	1.47	1.91	1.91
	Nitrate and Nitrite (as N) (mg/L)	0.249	0.122	<0.0051	<0.0051	<0.0051
	Nitrate (as N) (mg/L)	0.249	0.122	<0.0050	<0.0050	<0.0050
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	65.5	57.7	19.8	23.4	23.4
	Anion Sum (meq/L)	5.55	6.39	3.94	4.01	3.93
	Cation Sum (meq/L)	5.29	6.07	3.71	3.82	3.83
	Cation - Anion Balance (%)	-2.4	-2.6	-3.0	-2.4	-1.3
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	9.77	6.60	10.7	10.0	9.98
Total Metals	Aluminum (Al)-Total (mg/L)	<0.0030	0.0052	0.0373	0.0137	0.0145
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00036	0.00025	0.00053	0.00040	0.00039
	Barium (Ba)-Total (mg/L)	0.0628	0.0622	0.0575	0.0616	0.0617
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.023	0.025	<0.010	<0.010	<0.010
	Cadmium (Cd)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	0.0000063
	Calcium (Ca)-Total (mg/L)	62.2	58.7	41.1	43.6	43.0
	Chromium (Cr)-Total (mg/L)	0.00012	0.00011	0.00030	0.00022	0.00025
	Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Total (mg/L)	0.00693	0.00289	0.00183	0.00204	0.00205
	Iron (Fe)-Total (mg/L)	<0.010	0.025	0.208	0.071	0.074
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	0.0014	0.0031	0.0014	0.0017	0.0017
	Magnesium (Mg)-Total (mg/L)	19.1	29.3	15.1	14.8	14.9
	Manganese (Mn)-Total (mg/L)	0.00514	0.0408	0.0256	0.0104	0.0103

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2167294-1 Water 18-SEP-18 09:30 W17	L2167294-2 Water 18-SEP-18 08:50 W3	L2167294-3 Water 18-SEP-18 14:15 MC1	L2167294-4 Water 18-SEP-18 14:45 W2	L2167294-5 Water 18-SEP-18 DUP
Grouping	Analyte						
WATER							
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.00639	0.00477	0.00153	0.00126	0.00126	0.00126
	Nickel (Ni)-Total (mg/L)	0.00071	0.00102	0.00118	0.00099	0.00099	0.00099
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	3.38	2.16	1.14	1.44	1.43	1.43
	Selenium (Se)-Total (mg/L)	0.000489	0.000261	0.000084	0.000161	0.000134	0.000134
	Silicon (Si)-Total (mg/L)	5.54	6.38	6.51	6.21	6.21	6.21
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	13.6	18.1	9.50	9.66	9.58	9.58
	Strontium (Sr)-Total (mg/L)	0.653	0.752	0.400	0.444	0.430	0.430
	Sulfur (S)-Total (mg/L)	22.2	19.8	6.93	8.50	8.27	8.27
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	<0.00030	<0.00030	0.00207	0.00059	0.00069	0.00069
	Uranium (U)-Total (mg/L)	0.00194	0.00265	0.00142	0.00170	0.00172	0.00172
	Vanadium (V)-Total (mg/L)	<0.00050	<0.00050	0.00084	0.00061	0.00064	0.00064
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0016	0.0041	0.0049	0.0072	0.0043	0.0043
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00036	0.00023	0.00055	0.00037	0.00039	0.00039
	Barium (Ba)-Dissolved (mg/L)	0.0635	0.0609	0.0561	0.0616	0.0630	0.0630
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.022	0.023	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	61.1	57.3	40.6	43.1	43.5	43.5
	Chromium (Cr)-Dissolved (mg/L)	0.00011	0.00011	0.00019	0.00021	0.00016	0.00016
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00684	0.00309	0.00173	0.00201	0.00189	0.00189
	Iron (Fe)-Dissolved (mg/L)	<0.010	0.020	0.121	0.054	0.050	0.050
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0015	0.0030	0.0013	0.0017	0.0017	0.0017
	Magnesium (Mg)-Dissolved (mg/L)	19.0	28.7	14.9	14.6	14.6	14.6
	Manganese (Mn)-Dissolved (mg/L)	0.00414	0.0398	0.0220	0.00951	0.00924	0.00924

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2167294-1 Water 18-SEP-18 09:30 W17	L2167294-2 Water 18-SEP-18 08:50 W3	L2167294-3 Water 18-SEP-18 14:15 MC1	L2167294-4 Water 18-SEP-18 14:45 W2	L2167294-5 Water 18-SEP-18 DUP
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00641	0.00474	0.00152	0.00123	0.00122
	Nickel (Ni)-Dissolved (mg/L)	0.00060	0.00095	0.00101	0.00096	0.00094
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	3.39	2.16	1.12	1.42	1.42
	Selenium (Se)-Dissolved (mg/L)	0.000506	0.000328	0.000138	0.000111	0.000148
	Silicon (Si)-Dissolved (mg/L)	5.23	6.15	6.24	6.06	5.98
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	13.6	18.3	9.58	9.81	9.70
	Strontium (Sr)-Dissolved (mg/L)	0.663	0.747	0.401	0.446	0.441
	Sulfur (S)-Dissolved (mg/L)	21.9	19.5	6.78	7.87	7.93
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	0.00037	0.00035	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00191	0.00260	0.00137	0.00167	0.00170
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	0.00065	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0015	0.0028	<0.0010	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2167294-1, -2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2167294-1, -2, -3, -4, -5
Matrix Spike	Copper (Cu)-Dissolved	MS-B	L2167294-1, -2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2167294-1, -2, -3, -4, -5
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2167294-1, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2167294-1, -2, -3, -4, -5
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2167294-1, -2, -3, -4, -5
Matrix Spike	Barium (Ba)-Total	MS-B	L2167294-1, -2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Total	MS-B	L2167294-1, -2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2167294-1, -2, -3, -4, -5
Matrix Spike	Sodium (Na)-Total	MS-B	L2167294-1, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Total	MS-B	L2167294-1, -2, -3, -4, -5

Qualifiers for Individual Parameters Listed:

Qualifier	Description
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-WR	Water	Nitrite & Nitrate Nitrogen	EPA 300.1
Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance.			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-WR	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions)			

Reference Information

should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-WR Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-09-19 A

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 26-SEP-18
Report Date: 12-OCT-18 20:25 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2171436
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-09-26 A
Legal Site Desc:

Shane Stack
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2171436-1 Water 24-SEP-18 09:50 W8A	L2171436-2 Water 24-SEP-18 10:40 W16	L2171436-3 Water 24-SEP-18 14:20 UG1	L2171436-4 Water 24-SEP-18 15:05 UG4	L2171436-5 Water 25-SEP-18 09:30 W3
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	1150	470	1980	2080	541
	Hardness (as CaCO3) (mg/L)	562	236	1030	1210	263
	pH (pH)	7.56	8.23	7.89	7.94	8.16
	Total Suspended Solids (mg/L)	26.1	5.3	182	438	7.6
	TDS (Calculated) (mg/L)	786	255	1670	1830	311
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	348	128	174	177	234
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	348	128	174	177	234
	Ammonia, Total (as N) (mg/L)	0.190	0.0162	3.49	2.78	0.0341
	Chloride (Cl) (mg/L)	8.9	5.88	17.9	23.0	4.44
	Nitrate and Nitrite (as N) (mg/L)	6.51	1.34	7.07	5.75	0.131
	Nitrate (as N) (mg/L)	6.41	1.33	6.44	5.23	0.131
	Nitrite (as N) (mg/L)	0.0975	0.0055	0.631	0.517	<0.0010
	Sulfate (SO4) (mg/L)	293	68.9	1040	1120	58.2
	Anion Sum (meq/L)	13.8	4.25	26.1	27.8	6.03
	Cation Sum (meq/L)	13.2	5.36	24.4	28.4	6.09
	Cation - Anion Balance (%)	-1.9	11.5	-3.3	1.1	0.5
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)		14.8			5.99
Total Metals	Aluminum (Al)-Total (mg/L)	0.431	0.0450	5.51	17.8	0.0049
	Antimony (Sb)-Total (mg/L)	0.00019	<0.00010	0.00027	0.00028	<0.00010
	Arsenic (As)-Total (mg/L)	0.00078	0.00043	0.00128	0.00224	0.00028
	Barium (Ba)-Total (mg/L)	0.135	0.0778	0.139	0.378	0.0720
	Beryllium (Be)-Total (mg/L)	0.000028	<0.000020	0.000118	0.000399	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.00010 ^{DLA}	0.00047	<0.000050
	Boron (B)-Total (mg/L)	0.030	0.016	0.327	0.282	0.025
	Cadmium (Cd)-Total (mg/L)	0.000292	0.0000095	0.000406	0.000895	<0.0000050
	Calcium (Ca)-Total (mg/L)	157	59.7	358	401	58.1
	Chromium (Cr)-Total (mg/L)	0.00093	0.00016	0.00200	0.00621	<0.00010
	Cobalt (Co)-Total (mg/L)	0.00091	<0.00010	0.00292	0.0102	<0.00010
	Copper (Cu)-Total (mg/L)	0.189	0.0338	0.555	5.63	0.00348
	Iron (Fe)-Total (mg/L)	1.52	0.094	7.42	31.3	0.024
	Lead (Pb)-Total (mg/L)	0.000415	<0.000050	0.00295	0.00892	<0.000050
	Lithium (Li)-Total (mg/L)	0.0040	0.0013	0.0123	0.0181	0.0032
	Magnesium (Mg)-Total (mg/L)	44.5	18.6	45.1	52.6	28.4
	Manganese (Mn)-Total (mg/L)	1.61	0.118	0.346	1.01	0.0441

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2171436-6 Water 25-SEP-18 10:20 W17	L2171436-7 Water 25-SEP-18 14:30 W2	L2171436-8 Water 25-SEP-18 15:20 MC1	L2171436-9 Water 25-SEP-18 16:10 MN	L2171436-10 Water 25-SEP-18 DUP
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	492	349	335	481	546
	Hardness (as CaCO3) (mg/L)	244	167	173	179	263
	pH (pH)	8.14	8.16	8.27	7.84	8.23
	Total Suspended Solids (mg/L)	<3.0	4.2	6.6	14.8	<3.0
	TDS (Calculated) (mg/L)	288	192	190	299	320
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	190	163	161	89.0	250
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	190	163	161	89.0	250
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	1.47	<0.0050
	Chloride (Cl) (mg/L)	5.93	1.88	1.51	1.66	4.45
	Nitrate and Nitrite (as N) (mg/L)	0.231	<0.0051	0.0663	15.2	0.127
	Nitrate (as N) (mg/L)	0.231	<0.0050	0.0663	14.9	0.127
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	0.303	<0.0010
	Sulfate (SO4) (mg/L)	65.5	23.9	21.7	85.3	58.2
	Anion Sum (meq/L)	5.34	3.81	3.72	4.69	6.34
	Cation Sum (meq/L)	5.56	3.79	3.92	4.65	6.10
	Cation - Anion Balance (%)	2.0	-0.3	2.5	-0.4	-2.0
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	9.69	8.11	8.54		5.87
Total Metals	Aluminum (Al)-Total (mg/L)	<0.0030	0.0146	0.0399	0.205	0.0056
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	0.00055	<0.00010
	Arsenic (As)-Total (mg/L)	0.00041	0.00037	0.00050	0.00053	0.00026
	Barium (Ba)-Total (mg/L)	0.0691	0.0669	0.0609	0.0331	0.0685
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.023	<0.010	<0.010	0.075	0.026
	Cadmium (Cd)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	0.0000744	<0.0000050
	Calcium (Ca)-Total (mg/L)	64.4	44.0	42.1	57.6	58.9
	Chromium (Cr)-Total (mg/L)	0.00011	0.00020	0.00029	0.00014	0.00011
	Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	<0.00010	0.00017	<0.00010
	Copper (Cu)-Total (mg/L)	0.00757	0.00187	0.00201	0.0475	0.00329
	Iron (Fe)-Total (mg/L)	<0.010	0.045	0.139	0.467	0.026
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	0.000180	<0.000050
	Lithium (Li)-Total (mg/L)	0.0015	0.0018	0.0015	0.0046	0.0033
	Magnesium (Mg)-Total (mg/L)	19.6	15.2	15.1	8.54	29.7
	Manganese (Mn)-Total (mg/L)	0.00589	0.00753	0.0168	0.0340	0.0437

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2171436-1 Water 24-SEP-18 09:50 W8A	L2171436-2 Water 24-SEP-18 10:40 W16	L2171436-3 Water 24-SEP-18 14:20 UG1	L2171436-4 Water 24-SEP-18 15:05 UG4	L2171436-5 Water 25-SEP-18 09:30 W3
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	0.0000093	<0.0000050	0.0000059	0.000054	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.0133	0.00296	0.0199	0.0236	0.00472
	Nickel (Ni)-Total (mg/L)	0.00174	0.00091	0.0027	0.0077	0.00099
	Phosphorus (P)-Total (mg/L)	0.065	<0.050	0.14	0.55	<0.050
	Potassium (K)-Total (mg/L)	7.17	2.78	11.4	16.1	2.40
	Selenium (Se)-Total (mg/L)	0.00611	0.000663	0.00162	0.00263	0.000313
	Silicon (Si)-Total (mg/L)	7.17	3.43	15.4	32.3	5.76
	Silver (Ag)-Total (mg/L)	0.000045	<0.000010	0.000247	0.00209	<0.000010
	Sodium (Na)-Total (mg/L)	41.6	12.8	81.5	89.6	18.4
	Strontium (Sr)-Total (mg/L)	2.24	0.594	7.09	6.54	0.760
	Sulfur (S)-Total (mg/L)	96.7	21.9	347	370	18.8
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	0.000066	0.000196	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	0.00023	0.00119	<0.00010
	Titanium (Ti)-Total (mg/L)	0.0216	<0.0030 ^{DLM}	0.370	1.17	<0.00030
	Uranium (U)-Total (mg/L)	0.00292	0.00134	0.00921	0.00795	0.00271
	Vanadium (V)-Total (mg/L)	0.00316	0.00054	0.0179	0.0592	<0.00050
	Zinc (Zn)-Total (mg/L)	0.451	<0.0030	0.0627	0.163	<0.0030
	Zirconium (Zr)-Total (mg/L)	0.00045	<0.00030	0.00037	0.00059	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0087	0.0029	0.0133	0.0154	0.0018
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	0.00024	0.00021	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00047	0.00041	0.00084	0.00101	0.00022
	Barium (Ba)-Dissolved (mg/L)	0.115	0.0743	0.0304	0.0383	0.0651
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000040 ^{DLA}	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.00010 ^{DLA}	<0.000050
	Boron (B)-Dissolved (mg/L)	0.031	0.016	0.326	0.275	0.026
	Cadmium (Cd)-Dissolved (mg/L)	0.000239	0.0000051	0.000121	0.000041	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	154	63.0	347	411	57.5
	Chromium (Cr)-Dissolved (mg/L)	0.00042	<0.00010	<0.00010	0.00023	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	0.00056	<0.00010	0.00051	0.00072	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.0805	0.0264	0.0165	0.00288	0.00274
	Iron (Fe)-Dissolved (mg/L)	0.410	0.014	<0.010	<0.020 ^{DLA}	0.020
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.00010 ^{DLA}	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0038	0.0013	0.0102	0.0113	0.0033
	Magnesium (Mg)-Dissolved (mg/L)	43.0	19.2	41.0	45.0	28.9
	Manganese (Mn)-Dissolved (mg/L)	1.51	0.00378	0.121	0.145	0.0413

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2171436-6 Water 25-SEP-18 10:20 W17	L2171436-7 Water 25-SEP-18 14:30 W2	L2171436-8 Water 25-SEP-18 15:20 MC1	L2171436-9 Water 25-SEP-18 16:10 MN	L2171436-10 Water 25-SEP-18 DUP
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	0.0000088	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.00611	0.00129	0.00147	0.0193	0.00474
	Nickel (Ni)-Total (mg/L)	0.00066	0.00093	0.00103	<0.00050	0.00100
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	0.192	<0.050
	Potassium (K)-Total (mg/L)	3.72	1.57	1.24	4.41	2.40
	Selenium (Se)-Total (mg/L)	0.000478	0.000137	0.000102	0.0140	0.000298
	Silicon (Si)-Total (mg/L)	4.99	5.57	5.72	2.74	6.19
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	14.0	10.2	9.87	20.8	19.1
	Strontium (Sr)-Total (mg/L)	0.666	0.442	0.410	1.46	0.746
	Sulfur (S)-Total (mg/L)	20.6	7.68	6.53	27.4	20.1
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	<0.00030	<0.0012 ^{DLM}	0.00201	0.0108	<0.00030
	Uranium (U)-Total (mg/L)	0.00199	0.00190	0.00150	0.000840	0.00282
	Vanadium (V)-Total (mg/L)	<0.00050	0.00057	0.00077	0.00128	<0.00050
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	0.0067	<0.0030
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0042	0.0038	0.0053	0.0039	0.0022
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00050	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00037	0.00034	0.00045	0.00047	0.00021
	Barium (Ba)-Dissolved (mg/L)	0.0679	0.0611	0.0568	0.0294	0.0647
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.023	<0.010	<0.010	0.075	0.025
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	0.0000713	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	65.3	42.5	43.2	57.5	57.7
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00718	0.00163	0.00167	0.0117	0.00271
	Iron (Fe)-Dissolved (mg/L)	<0.010	0.032	0.082	<0.010	0.019
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0015	0.0018	0.0015	0.0045	0.0032
	Magnesium (Mg)-Dissolved (mg/L)	19.8	14.7	15.8	8.54	29.0
	Manganese (Mn)-Dissolved (mg/L)	0.00306	0.00662	0.0120	0.0192	0.0404

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2171436-1 Water 24-SEP-18 09:50 W8A	L2171436-2 Water 24-SEP-18 10:40 W16	L2171436-3 Water 24-SEP-18 14:20 UG1	L2171436-4 Water 24-SEP-18 15:05 UG4	L2171436-5 Water 25-SEP-18 09:30 W3
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.0133	0.00304	0.0204	0.0241	0.00475
	Nickel (Ni)-Dissolved (mg/L)	0.00125	0.00089	0.00139	0.0032 ^{DLA}	0.00098
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.10 ^{DLA}	<0.050
	Potassium (K)-Dissolved (mg/L)	6.69	2.96	8.30	8.88	2.36
	Selenium (Se)-Dissolved (mg/L)	0.00592	0.000670	0.00138	0.00135	0.000283
	Silicon (Si)-Dissolved (mg/L)	6.76	3.67	6.90	6.72 ^{DLA}	6.05
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000020 ^{DLA}	<0.000010
	Sodium (Na)-Dissolved (mg/L)	40.0	12.8	75.5	87.8	17.9
	Strontium (Sr)-Dissolved (mg/L)	2.00	0.595	7.06	6.30	0.753
	Sulfur (S)-Dissolved (mg/L)	99.7	23.2	382	398	19.0
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	0.000015	<0.000020 ^{DLA}	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010 ^{DLM}	<0.00010	<0.00010	<0.00020 ^{DLA}	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00060 ^{DLM}	<0.00030	<0.00030	<0.00060 ^{DLA}	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00283	0.00135	0.00904	0.00716 ^{DLA}	0.00268
	Vanadium (V)-Dissolved (mg/L)	0.00113	<0.00050	0.00056	<0.0010 ^{DLA}	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.255	<0.0010	0.0096	0.0040	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	0.00033	<0.00030	<0.00030	<0.00030	<0.00030

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2171436-6 Water 25-SEP-18 10:20 W17	L2171436-7 Water 25-SEP-18 14:30 W2	L2171436-8 Water 25-SEP-18 15:20 MC1	L2171436-9 Water 25-SEP-18 16:10 MN	L2171436-10 Water 25-SEP-18 DUP
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00607	0.00133	0.00155	0.0193	0.00477
	Nickel (Ni)-Dissolved (mg/L)	0.00063	0.00083	0.00095	<0.00050	0.00101
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	0.159	<0.050
	Potassium (K)-Dissolved (mg/L)	3.70	1.57	1.28	4.30	2.27
	Selenium (Se)-Dissolved (mg/L)	0.000532	0.000115	0.000114	0.0129	0.000313
	Silicon (Si)-Dissolved (mg/L)	5.41	5.66	6.05	2.50	6.02
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	13.4	9.54	9.77	19.8	17.8
	Strontium (Sr)-Dissolved (mg/L)	0.658	0.426	0.424	1.38	0.746
	Sulfur (S)-Dissolved (mg/L)	22.0	7.67	6.91	27.8	18.7
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	0.00038	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00196	0.00180	0.00149	0.000816	0.00268
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	0.00061	<0.00050 ^{DTC}	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	0.0170	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Laboratory Control Sample	Sulfur (S)-Total	MES	L2171436-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Dissolved Organic Carbon	MS-B	L2171436-10, -2, -5, -6, -7, -8
Matrix Spike	Dissolved Organic Carbon	MS-B	L2171436-10, -2, -5, -6, -7, -8
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2171436-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2171436-9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2171436-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2171436-9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2171436-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2171436-9
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2171436-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2171436-9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2171436-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2171436-9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2171436-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2171436-9
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2171436-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2171436-9
Matrix Spike	Uranium (U)-Dissolved	MS-B	L2171436-1, -10, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DTC	Dissolved concentration exceeds total. Results were confirmed by re-analysis.
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-WR	Water	Nitrite & Nitrate Nitrogen	EPA 300.1
Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance.			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-WR	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			

Reference Information

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NO2-L-IC-N-WR	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-WR	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
SO4-IC-WR	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)
This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.			
TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA

Reference Information

VA

ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-09-26 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

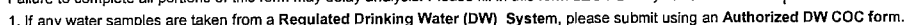
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.





Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 03-OCT-18
Report Date: 15-OCT-18 14:49 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2175170
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-10-03 A
Legal Site Desc:

Shane Stack
Account Manager

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ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2175170-1 Water 01-OCT-18 09:25 W16	L2175170-2 Water 01-OCT-18 10:05 W8A	L2175170-3 Water 02-OCT-18 08:35 W3	L2175170-4 Water 02-OCT-18 09:15 W17	L2175170-5 Water 02-OCT-18 09:45 MC1
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	488	1300	578	517	393
	Hardness (as CaCO3) (mg/L)	228	653	277	244	187
	pH (pH)	8.19	8.00	8.25	8.28	8.31
	Total Suspended Solids (mg/L)	3.3	36.7	4.7	<3.0	29.3
	TDS (Calculated) (mg/L)	285	874	331	297	214
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	183	398	258	198	181
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	6.4	5.8
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	183	398	258	204	187
	Ammonia, Total (as N) (mg/L)	0.0110	0.245	0.0063	<0.0050	0.0052
	Chloride (Cl) (mg/L)	6.00	10.0	4.50	5.98	1.72
	Nitrate and Nitrite (as N) (mg/L)	1.26	6.68	0.146	0.215	0.0793
	Nitrate (as N) (mg/L)	1.25	6.51	0.146	0.215	0.0782
	Nitrite (as N) (mg/L)	0.0056	0.177	<0.0010	<0.0010	0.0011
	Sulfate (SO4) (mg/L)	67.8	310	58.3	63.9	23.3
	Anion Sum (meq/L)	5.33	15.2	6.51	5.59	4.27
	Cation Sum (meq/L)	5.22	15.4	6.47	5.64	4.26
	Cation - Anion Balance (%)	-1.1	0.8	-0.4	0.4	-0.1
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	14.8		6.05	9.76	8.31
Total Metals	Aluminum (Al)-Total (mg/L)	0.0176	0.293	0.0147	0.0041	0.0114
	Antimony (Sb)-Total (mg/L)	<0.00010	0.00020	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00044	0.00075	0.00029	0.00041	0.00046
	Barium (Ba)-Total (mg/L)	0.0763	0.131	0.0662	0.0639	0.0646
	Beryllium (Be)-Total (mg/L)	<0.000020	0.000029	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.016	0.032	0.025	0.022	<0.010
	Cadmium (Cd)-Total (mg/L)	0.0000070	0.000295	0.0000078	<0.0000050	<0.0000050
	Calcium (Ca)-Total (mg/L)	58.3	173	57.1	61.4	43.8
	Chromium (Cr)-Total (mg/L)	0.00017	0.00078	0.00015	0.00013	0.00022
	Cobalt (Co)-Total (mg/L)	<0.00010	0.00082	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Total (mg/L)	0.0270	0.152	0.00424	0.00686	0.00155
	Iron (Fe)-Total (mg/L)	0.063	1.65	0.042	<0.010	0.079
	Lead (Pb)-Total (mg/L)	<0.000050	0.000449	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	0.0012	0.0041	0.0033	0.0015	0.0015
	Magnesium (Mg)-Total (mg/L)	18.0	46.7	28.3	18.4	15.9
	Manganese (Mn)-Total (mg/L)	0.148	1.68	0.0440	0.00965	0.0127

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2175170-6 Water 01-OCT-18 DUP				
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	493				
	Hardness (as CaCO3) (mg/L)	239				
	pH (pH)	8.26				
	Total Suspended Solids (mg/L)	3.3				
	TDS (Calculated) (mg/L)	289				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	184				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Total (as CaCO3) (mg/L)	184				
	Ammonia, Total (as N) (mg/L)	0.0116				
	Chloride (Cl) (mg/L)	5.96				
	Nitrate and Nitrite (as N) (mg/L)	1.25				
	Nitrate (as N) (mg/L)	1.25				
	Nitrite (as N) (mg/L)	0.0057				
	Sulfate (SO4) (mg/L)	67.4				
	Anion Sum (meq/L)	5.34				
	Cation Sum (meq/L)	5.44				
	Cation - Anion Balance (%)	1.0				
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	14.8				
Total Metals	Aluminum (Al)-Total (mg/L)	0.0160				
	Antimony (Sb)-Total (mg/L)	<0.00010				
	Arsenic (As)-Total (mg/L)	0.00044				
	Barium (Ba)-Total (mg/L)	0.0736				
	Beryllium (Be)-Total (mg/L)	<0.000020				
	Bismuth (Bi)-Total (mg/L)	<0.000050				
	Boron (B)-Total (mg/L)	0.016				
	Cadmium (Cd)-Total (mg/L)	0.0000075				
	Calcium (Ca)-Total (mg/L)	60.6				
	Chromium (Cr)-Total (mg/L)	0.00017				
	Cobalt (Co)-Total (mg/L)	<0.00010				
	Copper (Cu)-Total (mg/L)	0.0260				
	Iron (Fe)-Total (mg/L)	0.059				
	Lead (Pb)-Total (mg/L)	<0.000050				
	Lithium (Li)-Total (mg/L)	0.0013				
	Magnesium (Mg)-Total (mg/L)	17.8				
	Manganese (Mn)-Total (mg/L)	0.145				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2175170-1 Water 01-OCT-18 09:25 W16	L2175170-2 Water 01-OCT-18 10:05 W8A	L2175170-3 Water 02-OCT-18 08:35 W3	L2175170-4 Water 02-OCT-18 09:15 W17	L2175170-5 Water 02-OCT-18 09:45 MC1
Grouping	Analyte						
WATER							
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.00287	0.0142	0.00490	0.00607	0.00158	0.00158
	Nickel (Ni)-Total (mg/L)	0.00082	0.00154	0.00105	0.00069	0.00090	0.00090
	Phosphorus (P)-Total (mg/L)	<0.050	0.072	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	2.75	7.15	2.48	3.44	1.38	1.38
	Selenium (Se)-Total (mg/L)	0.000633	0.00679	0.000286	0.000430	0.000124	0.000124
	Silicon (Si)-Total (mg/L)	3.84	7.43	6.55	5.33	6.56	6.56
	Silver (Ag)-Total (mg/L)	<0.000010	0.000033	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	12.6	44.1	19.0	13.6	10.8	10.8
	Strontium (Sr)-Total (mg/L)	0.569	2.40	0.782	0.675	0.462	0.462
	Sulfur (S)-Total (mg/L)	23.8	117	21.0	21.8	8.28	8.28
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	<0.00087 ^{DLM}	0.0118	0.00123	<0.00030	0.00055	0.00055
	Uranium (U)-Total (mg/L)	0.00141	0.00325	0.00290	0.00219	0.00176	0.00176
	Vanadium (V)-Total (mg/L)	0.00062	0.00291	0.00058	0.00058	0.00074	0.00074
	Zinc (Zn)-Total (mg/L)	<0.0030	0.340	<0.0030	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	<0.00030	0.00045	<0.00030	<0.00030	<0.00030	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0031	0.0125	0.0015	0.0017	0.0051	0.0051
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00044	0.00054	0.00025	0.00038	0.00041	0.00041
	Barium (Ba)-Dissolved (mg/L)	0.0714	0.126	0.0664	0.0685	0.0664	0.0664
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	0.000021	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.015	0.031	0.023	0.020	<0.010	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	0.000251	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	59.8	178	59.3	63.3	45.8	45.8
	Chromium (Cr)-Dissolved (mg/L)	0.00012	0.00042	<0.00010	0.00012	0.00017	0.00017
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00065	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.0240	0.0748	0.00249	0.00733	0.00149	0.00149
	Iron (Fe)-Dissolved (mg/L)	0.015	0.734	0.019	<0.010	0.062	0.062
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0013	0.0041	0.0033	0.0015	0.0016	0.0016
	Magnesium (Mg)-Dissolved (mg/L)	19.2	50.4	31.3	20.8	17.6	17.6
	Manganese (Mn)-Dissolved (mg/L)	0.0144	1.73	0.0418	0.00424	0.0114	0.0114

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID				
		L2175170-6 Water 01-OCT-18 DUP				
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050				
	Molybdenum (Mo)-Total (mg/L)	0.00288				
	Nickel (Ni)-Total (mg/L)	0.00081				
	Phosphorus (P)-Total (mg/L)	<0.050				
	Potassium (K)-Total (mg/L)	2.77				
	Selenium (Se)-Total (mg/L)	0.000618				
	Silicon (Si)-Total (mg/L)	3.81				
	Silver (Ag)-Total (mg/L)	<0.000010				
	Sodium (Na)-Total (mg/L)	12.6				
	Strontium (Sr)-Total (mg/L)	0.596				
	Sulfur (S)-Total (mg/L)	23.5				
	Thallium (Tl)-Total (mg/L)	<0.000010				
	Tin (Sn)-Total (mg/L)	<0.00010				
	Titanium (Ti)-Total (mg/L)	0.00091				
	Uranium (U)-Total (mg/L)	0.00144				
	Vanadium (V)-Total (mg/L)	0.00060				
	Zinc (Zn)-Total (mg/L)	<0.0030				
	Zirconium (Zr)-Total (mg/L)	<0.00030				
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD				
	Dissolved Metals Filtration Location	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	0.0159				
	Antimony (Sb)-Dissolved (mg/L)	<0.00010				
	Arsenic (As)-Dissolved (mg/L)	0.00043				
	Barium (Ba)-Dissolved (mg/L)	0.0763				
	Beryllium (Be)-Dissolved (mg/L)	<0.000020				
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050				
	Boron (B)-Dissolved (mg/L)	0.014				
	Cadmium (Cd)-Dissolved (mg/L)	0.0000064				
	Calcium (Ca)-Dissolved (mg/L)	63.2				
	Chromium (Cr)-Dissolved (mg/L)	0.00014				
	Cobalt (Co)-Dissolved (mg/L)	<0.00010				
	Copper (Cu)-Dissolved (mg/L)	0.0265				
	Iron (Fe)-Dissolved (mg/L)	0.039				
	Lead (Pb)-Dissolved (mg/L)	<0.000050				
	Lithium (Li)-Dissolved (mg/L)	0.0013				
	Magnesium (Mg)-Dissolved (mg/L)	19.8				
	Manganese (Mn)-Dissolved (mg/L)	0.0154				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2175170-1 Water 01-OCT-18 09:25 W16	L2175170-2 Water 01-OCT-18 10:05 W8A	L2175170-3 Water 02-OCT-18 08:35 W3	L2175170-4 Water 02-OCT-18 09:15 W17	L2175170-5 Water 02-OCT-18 09:45 MC1
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00278	0.0141	0.00473	0.00573	0.00146
	Nickel (Ni)-Dissolved (mg/L)	0.00077	0.00123	0.00094	0.00072	0.00083
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	2.73	7.20	2.32	3.71	1.31
	Selenium (Se)-Dissolved (mg/L)	0.000710	0.00844	0.000315	0.000445	0.000160
	Silicon (Si)-Dissolved (mg/L)	3.91	7.13	6.87	5.36	6.56
	Silver (Ag)-Dissolved (mg/L)	<0.000010	0.000012	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	13.3	47.0	20.1	15.3	11.2
	Strontium (Sr)-Dissolved (mg/L)	0.558	2.36	0.755	0.654	0.433
	Sulfur (S)-Dissolved (mg/L)	24.1	116	21.9	21.9	7.99
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.0015 ^{DLM}	<0.00030	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00121	0.00306	0.00259	0.00183	0.00148
	Vanadium (V)-Dissolved (mg/L)	<0.00050	0.00128	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	0.230	0.0022	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	0.00044	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2175170-6 Water 01-OCT-18 DUP				
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050				
	Molybdenum (Mo)-Dissolved (mg/L)	0.00285				
	Nickel (Ni)-Dissolved (mg/L)	0.00084				
	Phosphorus (P)-Dissolved (mg/L)	<0.050				
	Potassium (K)-Dissolved (mg/L)	2.76				
	Selenium (Se)-Dissolved (mg/L)	0.000670				
	Silicon (Si)-Dissolved (mg/L)	3.81				
	Silver (Ag)-Dissolved (mg/L)	<0.000010				
	Sodium (Na)-Dissolved (mg/L)	13.4				
	Strontium (Sr)-Dissolved (mg/L)	0.569				
	Sulfur (S)-Dissolved (mg/L)	23.3				
	Thallium (Tl)-Dissolved (mg/L)	<0.000010				
	Tin (Sn)-Dissolved (mg/L)	<0.00010				
	Titanium (Ti)-Dissolved (mg/L)	0.00156 ^{DTMF}				
	Uranium (U)-Dissolved (mg/L)	0.00125				
	Vanadium (V)-Dissolved (mg/L)	<0.00050				
	Zinc (Zn)-Dissolved (mg/L)	0.0012				
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Dissolved Organic Carbon	MS-B	L2175170-1, -3, -4, -5, -6
Matrix Spike	Barium (Ba)-Total	MS-B	L2175170-1, -2, -3, -4, -5, -6
Matrix Spike	Calcium (Ca)-Total	MS-B	L2175170-1, -2, -3, -4, -5, -6
Matrix Spike	Copper (Cu)-Total	MS-B	L2175170-1, -2, -3, -4, -5, -6
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2175170-1, -2, -3, -4, -5, -6
Matrix Spike	Manganese (Mn)-Total	MS-B	L2175170-1, -2, -3, -4, -5, -6
Matrix Spike	Sodium (Na)-Total	MS-B	L2175170-1, -2, -3, -4, -5, -6
Matrix Spike	Strontium (Sr)-Total	MS-B	L2175170-1, -2, -3, -4, -5, -6
Matrix Spike	Sulfur (S)-Total	MS-B	L2175170-1, -2, -3, -4, -5, -6

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DTMF	Dissolved concentration exceeds total for field-filtered metals sample. Metallic contaminants may have been introduced to dissolved sample during field filtration.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions)			

Reference Information

should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-MAN-WR Water Total Suspended Solids by Gravimetric APHA 2540 D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids are determined by filtering a sample through a glass fibre filter and drying the filter at 104 degrees celsius.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-10-03 A

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lw - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2175170-COFC

COC Number: 2018-10-03 A

Page 1 of 1

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Report To			Contact and company name below will appear on the final report						
Company:			Minto Explorations Ltd.						
Contact:			Minto Environment - Coordinator						
Phone:			1-604-759-4659						
			Company address below will appear on the final report						
Street:			2100-510 West Georgia St.						
City/Province:			Vancouver, British Columbia						
Postal Code:			V6B 0M3						
Invoice To			Same as Report To ☐ YES ☒ NO						
			Copy of Invoice with Report ☐ YES ☒ NO						
Company:			Minto Explorations Ltd.						
Contact:			Ruth Cayetano						
Project Information			Oil and Gas Required Fields (client use)						
ALS Account # / Quote #:			AFE/Cost Center:			PO#			
Job #:			Major/Minor Code:			Routing Code:			
PO / AFE: 229096 (WUL)			Requisitioner:						
LSD:			Location:						
ALS Lab Work Order # (lab use only)			ALS Contact: Shane Stack		Sampler: CR/EB				
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)					Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	
	W16					1-Oct-18	9:25	Water	
	W8A					1-Oct-18	10:05	Water	
	W3					2-Oct-18	8:35	Water	
	W17					2-Oct-18	9:15	Water	
	MC1					2-Oct-18	9:45	Water	
	DUP					1-Oct-18			
Drinking Water (DW) Samples ¹ (client use)			Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)						
Are samples taken from a Regulated DW System? ☐ YES ☒ NO									
Are samples for human drinking water use? ☐ YES ☒ NO									
SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)						
Released by: Corey Roberts			Date: 2018-10-03			Time:			
			Received by: EHF			Date: 03 Oct 2018			
						Time: 11:20			
SAMPLE CONDITION AS RECEIVED (lab use only)			Frozen ☐ SIF Observations Yes ☐ No ☒						
			Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☒						
			Cooling Initiated ☐						
			INITIAL COOLER TEMPERATURES °C FINAL COOLER TEMPERATURES °C						
			0.0 8						
FINAL SHIPMENT RECEPTION (lab use only)			Received by: IJA						
			Date: 10/4						
			Time: 12 pm						

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

WHITE - LABORATORY COPY

YELLOW - CLIENT COPY

OCTOBER 2016 FRONT



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 03-OCT-18
Report Date: 15-OCT-18 14:51 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2175214
Project P.O. #: 229100
Job Reference:
C of C Numbers: 2018-10-03 B
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2175214-1 Water 28-SEP-18 08:25 LP2	L2175214-2 Water 28-SEP-18 08:30 LP1	L2175214-3 Water 28-SEP-18 DUP	L2175214-4 Water 28-SEP-18 16:50 SS102	
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	2010	1640	2060	1410	
	Hardness (as CaCO3) (mg/L)	1080	884	1080	601	
	pH (pH)	7.86	7.78	7.82	8.23	
	Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0	4.7	
	TDS (Calculated) (mg/L)	1630	1350	1630	984	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	71.9	57.5	71.7	117	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Total (as CaCO3) (mg/L)	71.9	57.5	71.7	117	
	Ammonia, Total (as N) (mg/L)	12.5	0.0119	10.8	0.102	
	Chloride (Cl) (mg/L)	<5.0 ^{DLDS}	5.6	<5.0 ^{DLDS}	6.9	
	Nitrate and Nitrite (as N) (mg/L)	81.3	52.2	81.9	96.0	
	Nitrate (as N) (mg/L)	81.2	52.2	81.8	96.0	
	Nitrite (as N) (mg/L)	0.114	<0.010 ^{DLDS}	0.112	0.0337	
	Sulfate (SO4) (mg/L)	815	725	816	239	
	Anion Sum (meq/L)	24.2	20.1	24.3	14.4	
	Cation Sum (meq/L)	24.7	19.2	24.5	14.2	
	Cation - Anion Balance (%)	1.1	-2.5	0.5	-0.7	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0021	<0.0010	0.0012	0.0017	
	Antimony (Sb)-Dissolved (mg/L)	0.00038	<0.00010	0.00038	0.00074	
	Arsenic (As)-Dissolved (mg/L)	0.00049	0.00028	0.00047	0.00035	
	Barium (Ba)-Dissolved (mg/L)	0.0338	0.0570	0.0348	0.0730	
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	0.601	0.068	0.602	0.214	
	Cadmium (Cd)-Dissolved (mg/L)	0.000226	0.000160	0.000256	<0.00010 ^{DLM}	
	Calcium (Ca)-Dissolved (mg/L)	201	266	196	109	
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	0.00012	<0.00010	
	Cobalt (Co)-Dissolved (mg/L)	0.00043	<0.00010	0.00042	0.00016	
	Copper (Cu)-Dissolved (mg/L)	0.0969	0.0454	0.0948	0.0563	
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	
	Lead (Pb)-Dissolved (mg/L)	0.000376	<0.000050	0.000350	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.0393	0.0051	0.0386	0.0136	
	Magnesium (Mg)-Dissolved (mg/L)	142	53.7	144	79.9	
	Manganese (Mn)-Dissolved (mg/L)	0.600	0.0384	0.587	0.0617	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2175214-1 Water 28-SEP-18 08:25 LP2	L2175214-2 Water 28-SEP-18 08:30 LP1	L2175214-3 Water 28-SEP-18 DUP	L2175214-4 Water 28-SEP-18 16:50 SS102	
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Dissolved (mg/L)	0.0376	0.0428	0.0381	0.0731	
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Potassium (K)-Dissolved (mg/L)	15.7	12.4	15.7	9.73	
	Selenium (Se)-Dissolved (mg/L)	0.153	0.167	0.154	0.0191	
	Silicon (Si)-Dissolved (mg/L)	3.47	5.43	3.46	3.80	
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Sodium (Na)-Dissolved (mg/L)	40.5	26.8	40.2	44.2	
	Strontium (Sr)-Dissolved (mg/L)	7.12	2.49	7.14	2.85	
	Sulfur (S)-Dissolved (mg/L)	291	247	293	82.7	
	Thallium (Tl)-Dissolved (mg/L)	0.000021	<0.000010	0.000021	<0.000010	
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	
	Uranium (U)-Dissolved (mg/L)	0.000519	0.000986	0.000536	0.00246	
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Zinc (Zn)-Dissolved (mg/L)	0.0408	0.0131	0.0437	0.0022	
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-MAN-VA	Water	Conductivity (Manual)	APHA 2510 Conductivity
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
$\text{Ion Balance (\%)} = \frac{[\text{Cation Sum} - \text{Anion Sum}]}{[\text{Cation Sum} + \text{Anion Sum}]}$			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
PH-MAN-VA	Water	pH by Manual Meter	APHA 4500-H pH Value

Reference Information

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode.

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-MAN-WR Water Total Suspended Solids by Gravimetric APHA 2540 D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids are determined by filtering a sample through a glass fibre filter and drying the filter at 104 degrees celsius.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-10-03 B

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

[illegible]

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2016 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 11-OCT-18
Report Date: 23-OCT-18 17:57 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2179645
Project P.O. #: 229096 (WUL)
Job Reference:
C of C Numbers: 2018-10-10 C
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2179645-1 Water 08-OCT-18 14:40 W46	L2179645-2 Water 08-OCT-18 15:15 W7	L2179645-3 Water 08-OCT-18 09:30 W8A	L2179645-4 Water 08-OCT-18 10:30 W16	L2179645-5 Water 09-OCT-18 09:20 W3
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	415	312	1310	484	564
	Hardness (as CaCO3) (mg/L)	206	155	662	242	274
	pH (pH)	8.15	8.10	7.94	8.30	8.23
	Total Suspended Solids (mg/L)	3.0	5.2	52.2	5.2	4.8
	TDS (Calculated) (mg/L)	216	175	855	295	328
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	157	163	404	185	253
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	2.4	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	157	163	404	187	253
	Ammonia, Total (as N) (mg/L)	0.0196	0.0271	0.209	0.0127	0.0160
	Chloride (Cl) (mg/L)	2.91	0.58	9.6	6.33	4.58
	Nitrate and Nitrite (as N) (mg/L)	0.158	0.172	5.90	1.25	0.153
	Nitrate (as N) (mg/L)	0.157	0.172	5.73	1.24	0.153
	Nitrite (as N) (mg/L)	0.0011	<0.0010	0.170	0.0059	<0.0010
	Sulfate (SO4) (mg/L)	34.3	13.3	289	70.7	59.5
	Anion Sum (meq/L)	3.95	3.57	14.8	5.48	6.43
	Cation Sum (meq/L)	4.75	3.53	15.6	5.51	6.42
	Cation - Anion Balance (%)	9.2	-0.5	2.7	0.3	0.0
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	6.42	7.25		15.3	5.61
Total Metals	Aluminum (Al)-Total (mg/L)	0.0471	0.103	0.228	0.0377	0.0816
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	0.00017	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00044	0.00058	0.00073	0.00046	0.00029
	Barium (Ba)-Total (mg/L)	0.0800	0.0813	0.131	0.0769	0.0692
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	0.000034	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.011	<0.010	0.032	0.017	0.026
	Cadmium (Cd)-Total (mg/L)	<0.0000050	0.0000074	0.000287	0.0000055	0.0000055
	Calcium (Ca)-Total (mg/L)	48.2	39.0	179	64.3	58.9
	Chromium (Cr)-Total (mg/L)	<0.00070 ^{DLB}	<0.00080 ^{DLB}	0.00101	<0.00060 ^{DLB}	<0.00070 ^{DLB}
	Cobalt (Co)-Total (mg/L)	0.00013	0.00019	0.00072	<0.00010	0.00012
	Copper (Cu)-Total (mg/L)	0.00252	0.00236	0.132	0.0284	0.00802
	Iron (Fe)-Total (mg/L)	0.256	0.326	1.15	0.070	0.152
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	0.000821	<0.000050	0.000090
	Lithium (Li)-Total (mg/L)	0.0017	0.0012	0.0039	0.0014	0.0033
	Magnesium (Mg)-Total (mg/L)	21.3	14.6	52.6	20.9	31.3
	Manganese (Mn)-Total (mg/L)	0.0832	0.0728	1.83	0.0914	0.0731

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2179645-6 Water 09-OCT-18 10:15 W17	L2179645-7 Water 09-OCT-18 13:20 W12	L2179645-8 Water 09-OCT-18 DUP	L2179645-9 Water 08-OCT-18 DUP1	
Grouping	Analyte						
WATER							
Physical Tests	Conductivity (uS/cm)	497	2280	558	421		
	Hardness (as CaCO3) (mg/L)	241	1110	276	207		
	pH (pH)	8.26	8.17	8.26	8.20		
	Total Suspended Solids (mg/L)	<3.0	13.0	3.8	8.6		
	TDS (Calculated) (mg/L)	290	1920	332	243		
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	197	215	257	201		
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0		
	Alkalinity, Total (as CaCO3) (mg/L)	197	215	257	201		
	Ammonia, Total (as N) (mg/L)	<0.0050	3.77	0.0061	0.0203		
	Chloride (Cl) (mg/L)	6.14	32	4.57	2.99		
	Nitrate and Nitrite (as N) (mg/L)	0.184	7.30	0.168	0.231		
	Nitrate (as N) (mg/L)	0.184	4.57	0.168	0.231		
	Nitrite (as N) (mg/L)	<0.0010	2.73	<0.0010	<0.0010		
	Sulfate (SO4) (mg/L)	63.8	1170	59.5	34.3		
	Anion Sum (meq/L)	5.45	30.0	6.52	4.83		
	Cation Sum (meq/L)	5.54	28.7	6.45	4.76		
	Cation - Anion Balance (%)	0.8	-2.2	-0.5	-0.7		
	Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	9.40		5.53	6.32	
Total Metals	Aluminum (Al)-Total (mg/L)	0.0036	0.125	0.0281	0.0056		
	Antimony (Sb)-Total (mg/L)	<0.00010	0.00031	<0.00010	<0.00010		
	Arsenic (As)-Total (mg/L)	0.00039	0.00051	0.00026	0.00046		
	Barium (Ba)-Total (mg/L)	0.0638	0.0697	0.0690	0.0792		
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000040 ^{DLA}	<0.000020	<0.000020		
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.00010 ^{DLA}	<0.000050	<0.000050		
	Boron (B)-Total (mg/L)	0.023	0.251	0.027	0.012		
	Cadmium (Cd)-Total (mg/L)	<0.0000050	<0.000090 ^{DLM}	0.0000059	<0.0000050		
	Calcium (Ca)-Total (mg/L)	63.7 ^{DLB}	338 ^{DLB}	58.9 ^{DLB}	48.8 ^{DLB}		
	Chromium (Cr)-Total (mg/L)	<0.00060	<0.00060	<0.00060	<0.00060		
	Cobalt (Co)-Total (mg/L)	<0.00010	0.00095	<0.00010	<0.00010		
	Copper (Cu)-Total (mg/L)	0.00724	0.0866	0.00386	0.00164		
	Iron (Fe)-Total (mg/L)	<0.010	0.306	0.065	0.170		
	Lead (Pb)-Total (mg/L)	<0.000050	0.00018	<0.000050	<0.000050		
	Lithium (Li)-Total (mg/L)	0.0014	0.0159	0.0033	0.0017		
	Magnesium (Mg)-Total (mg/L)	20.7	66.2	31.4	21.8		
	Manganese (Mn)-Total (mg/L)	0.0149	0.839	0.0604	0.0814		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2179645-1 Water 08-OCT-18 14:40 W46	L2179645-2 Water 08-OCT-18 15:15 W7	L2179645-3 Water 08-OCT-18 09:30 W8A	L2179645-4 Water 08-OCT-18 10:30 W16	L2179645-5 Water 09-OCT-18 09:20 W3
Grouping	Analyte						
WATER							
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	0.0000056	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Total (mg/L)	0.00202	0.00122	0.0142	0.00309	0.00484	
	Nickel (Ni)-Total (mg/L)	0.00115	0.00117	0.00168	0.00123	0.00133	
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	0.052	<0.050	<0.050	
	Potassium (K)-Total (mg/L)	1.55	1.20	7.20	2.75	2.25	
	Selenium (Se)-Total (mg/L)	0.000204	0.000207	0.00700	0.000707	0.000366	
	Silicon (Si)-Total (mg/L)	6.43	6.34	7.41	4.14	6.60	
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	0.000034	<0.000010	<0.000010	
	Sodium (Na)-Total (mg/L)	13.3	8.74	48.2	13.8	19.7	
	Strontium (Sr)-Total (mg/L)	0.560	0.410	2.48	0.607	0.793	
	Sulfur (S)-Total (mg/L)	11.6	4.82	117	25.8	20.4	
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Total (mg/L)	0.00214	0.00435	0.0114	0.00155	0.00396	
	Uranium (U)-Total (mg/L)	0.00192	0.00150	0.00359	0.00149	0.00289	
	Vanadium (V)-Total (mg/L)	0.00072	0.00082	0.00252	<0.00050	0.00061	
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	0.607	<0.0030	<0.0030	
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	0.00038	<0.00030	<0.00030	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0032	0.0037	0.0066	0.0021	0.0024	
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
	Arsenic (As)-Dissolved (mg/L)	0.00043	0.00053	0.00051	0.00042	0.00022	
	Barium (Ba)-Dissolved (mg/L)	0.0798	0.0831	0.137	0.0802	0.0734	
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	0.011	<0.010	0.029	0.015	0.023	
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	0.0000057	0.000225	0.0000060	0.0000050	
	Calcium (Ca)-Dissolved (mg/L)	47.1	36.7	177	62.5	56.0	
	Chromium (Cr)-Dissolved (mg/L)	0.00013	0.00017	0.00042	0.00012	0.00010	
	Cobalt (Co)-Dissolved (mg/L)	0.00011	0.00014	0.00058	<0.00010	<0.00010	
	Copper (Cu)-Dissolved (mg/L)	0.00167	0.00098	0.0689	0.0248	0.00290	
	Iron (Fe)-Dissolved (mg/L)	0.169	0.191	0.318	0.018	0.025	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.0016	0.0012	0.0038	0.0013	0.0031	
	Magnesium (Mg)-Dissolved (mg/L)	21.5	15.4	53.1	20.8	32.5	
Manganese (Mn)-Dissolved (mg/L)	0.0796	0.0677	1.75	0.00255	0.0528		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2179645-6 Water 09-OCT-18 10:15 W17	L2179645-7 Water 09-OCT-18 13:20 W12	L2179645-8 Water 09-OCT-18 DUP	L2179645-9 Water 08-OCT-18 DUP1	
Grouping	Analyte						
WATER							
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Total (mg/L)	0.00597	0.0605	0.00475	0.00210		
	Nickel (Ni)-Total (mg/L)	0.00097	0.0046	0.00122	0.00104		
	Phosphorus (P)-Total (mg/L)	<0.050	<0.10 ^{DLA}	<0.050	<0.050		
	Potassium (K)-Total (mg/L)	3.34	38.8	2.23	1.54		
	Selenium (Se)-Total (mg/L)	0.000412	0.00680	0.000297	0.000208		
	Silicon (Si)-Total (mg/L)	5.41	4.62	6.48	6.35		
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000020 ^{DLA}	<0.000010	<0.000010		
	Sodium (Na)-Total (mg/L)	14.5	116	19.5	13.2		
	Strontium (Sr)-Total (mg/L)	0.676	5.84	0.794	0.575		
	Sulfur (S)-Total (mg/L)	22.6	409	20.4	11.8		
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000020 ^{DLA}	<0.000010	<0.000010		
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00020 ^{DLA}	<0.00010	<0.00010		
	Titanium (Ti)-Total (mg/L)	<0.00030	<0.0060 ^{DLM}	0.00191	<0.00030		
	Uranium (U)-Total (mg/L)	0.00214	0.00672	0.00293	0.00206		
	Vanadium (V)-Total (mg/L)	<0.00050	<0.0010 ^{DLA}	<0.00050	0.00062		
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0060 ^{DLA}	<0.0030	<0.0030		
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030		
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD		
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD		
	Aluminum (Al)-Dissolved (mg/L)	0.0014	0.0054	0.0026	0.0253 ^{DTC}		
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	0.00030	<0.00010	<0.00010		
	Arsenic (As)-Dissolved (mg/L)	0.00037	0.00042	0.00023	0.00043		
	Barium (Ba)-Dissolved (mg/L)	0.0681	0.0720	0.0708	0.0829		
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000040 ^{DLA}	<0.000020	<0.000020		
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.00010 ^{DLA}	<0.000050	<0.000050		
	Boron (B)-Dissolved (mg/L)	0.021	0.237 ^{DLM}	0.024	0.011		
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.000090	0.0000055	<0.0000050		
	Calcium (Ca)-Dissolved (mg/L)	61.9 ^{DLB}	337 ^{DLB}	58.3	47.6		
	Chromium (Cr)-Dissolved (mg/L)	<0.0010	<0.00060	0.00013	0.00017		
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00089	<0.00010	0.00012		
	Copper (Cu)-Dissolved (mg/L)	0.00694	0.0533	0.00292	0.00198		
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.020 ^{DLA}	0.027	0.245 ^{DTC}		
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.00010 ^{DLA}	<0.000050	<0.000050		
	Lithium (Li)-Dissolved (mg/L)	0.0014	0.0155	0.0031	0.0016		
	Magnesium (Mg)-Dissolved (mg/L)	21.0	66.0	31.6	21.3		
	Manganese (Mn)-Dissolved (mg/L)	0.00333	0.823	0.0519	0.0794		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2179645-1 Water 08-OCT-18 14:40 W46	L2179645-2 Water 08-OCT-18 15:15 W7	L2179645-3 Water 08-OCT-18 09:30 W8A	L2179645-4 Water 08-OCT-18 10:30 W16	L2179645-5 Water 09-OCT-18 09:20 W3
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00215	0.00133	0.0154	0.00314	0.00502
	Nickel (Ni)-Dissolved (mg/L)	0.00080	0.00079	0.00115	0.00081	0.00097
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	1.58	1.23	7.23	2.89	2.52
	Selenium (Se)-Dissolved (mg/L)	0.000233	0.000212	0.00743	0.000710	0.000293
	Silicon (Si)-Dissolved (mg/L)	6.40	6.46	7.26	4.07	6.58
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	0.000012	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	13.2	9.02	47.7	13.8	20.3
	Strontium (Sr)-Dissolved (mg/L)	0.584	0.430	2.59	0.635	0.838
	Sulfur (S)-Dissolved (mg/L)	11.4	4.31	115	24.3	20.3
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00060 ^{DLM}	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00179	0.00134	0.00330	0.00131	0.00269
	Vanadium (V)-Dissolved (mg/L)	0.00052	0.00058	0.00115	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	0.555	0.0021	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	0.00040	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2179645-6 Water 09-OCT-18 10:15 W17	L2179645-7 Water 09-OCT-18 13:20 W12	L2179645-8 Water 09-OCT-18 DUP	L2179645-9 Water 08-OCT-18 DUP1	
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Dissolved (mg/L)	0.00619	0.0635	0.00515	0.00216	
	Nickel (Ni)-Dissolved (mg/L)	<0.0015 ^{DLB}	<0.0050 ^{DLB}	0.00099	0.00086	
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.10 ^{DLA}	<0.050	<0.050	
	Potassium (K)-Dissolved (mg/L)	3.53	39.8	2.44	1.54	
	Selenium (Se)-Dissolved (mg/L)	0.000459	0.00634	0.000333	0.000197	
	Silicon (Si)-Dissolved (mg/L)	5.47	4.35	6.32	6.34	
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000020 ^{DLA}	<0.000010	<0.000010	
	Sodium (Na)-Dissolved (mg/L)	14.6	118	20.1	13.2	
	Strontium (Sr)-Dissolved (mg/L)	0.719	6.03	0.850	0.595	
	Sulfur (S)-Dissolved (mg/L)	21.7	395	19.8	11.0	
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000020 ^{DLA}	<0.000010	<0.000010	
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00020 ^{DLA}	<0.00010	<0.00010	
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00060 ^{DLA}	<0.00030	0.00088	
	Uranium (U)-Dissolved (mg/L)	0.00192	0.00644	0.00264	0.00179	
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.0010 ^{DLA}	<0.00050	0.00059	
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	0.0030	<0.0010	0.0015	
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Chromium (Cr)-Dissolved	MB-LOR	L2179645-6, -7
Method Blank	Nickel (Ni)-Dissolved	MB-LOR	L2179645-6, -7
Method Blank	Chromium (Cr)-Total	MB-LOR	L2179645-1, -2, -3, -4, -5, -6, -7, -8, -9
Method Blank	Magnesium (Mg)-Total	MB-LOR	L2179645-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Dissolved Organic Carbon	MS-B	L2179645-1, -2, -4, -5, -6, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2179645-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2179645-1, -2, -3, -4, -5, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2179645-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2179645-1, -2, -3, -4, -5, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2179645-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2179645-1, -2, -3, -4, -5, -8, -9
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2179645-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2179645-1, -2, -3, -4, -5, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2179645-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2179645-1, -2, -3, -4, -5, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2179645-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2179645-1, -2, -3, -4, -5, -8, -9
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2179645-1, -2, -3, -4, -5, -8, -9
Matrix Spike	Barium (Ba)-Total	MS-B	L2179645-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L2179645-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2179645-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Total	MS-B	L2179645-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Total	MS-B	L2179645-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L2179645-1, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLB	Detection Limit Raised. Analyte detected at comparable level in Method Blank.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DTC	Dissolved concentration exceeds total. Results were confirmed by re-analysis.
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)

Reference Information

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

EC-PCT-VA Water Conductivity (Automated) APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-SCREEN-VA Water Conductivity Screen (Internal Use Only) APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 µm), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = \frac{[\text{Cation Sum} - \text{Anion Sum}]}{[\text{Cation Sum} + \text{Anion Sum}]}$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Reference Information

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-10-10 C

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2179645-COFC

COC Number: 2018-10-10 C

Page 1 of 1

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Report To			Contact and company name below will appear on the final report			Report Format / Distribution						Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply																			
Company:			Minto Explorations Ltd.			Select Report Format: ☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)						Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply																			
Contact:			Minto Environment - Coordinator			Quality Control (QC) Report with Report ☒ YES ☐ NO						Priority (Business Day) 4 day [P4] ☐ 3 day [P3] ☐ 2 day [P2] ☐																			
Phone:			1-604-759-4659			☒ Compare Results to Criteria on Report - provide details below if box checked						EMERGENCY 1 Business day [E1] ☐ Same Day, Weekend or Statutory holiday [EO] ☐																			
			Company address below will appear on the final report			Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX						Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm																			
Street:			2100-510 West Georgia St.			Email 1 or Fax mintoenvironment@mintomine.com						For tests that can not be performed according to the service level selected, you will be contacted.																			
City/Province:			Vancouver, British Columbia			Email 2						Analysis Request																			
Postal Code:			V6B 0M3			Email 3						Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below																			
Invoice To			Same as Report To ☐ YES ☒ NO			Invoice Distribution																									
			Copy of Invoice with Report ☐ YES ☒ NO			Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX																									
Company:			Minto Explorations Ltd.			Email 1 or Fax ap@mintomine.com																									
Contact:			Ruth Cayetano			Email 2																									
Project Information						Oil and Gas Required Fields (client use)																									
ALS Account # / Quote #:						AFE/Cost Center:						PO#																			
Job #:						Major/Minor Code:						Routing Code:																			
PO / AFE: 229096 (WUL)						Requisitioner:																									
LSD:						Location:																									
ALS Lab Work Order # (lab use only)						ALS Contact: Shane Stack						Sampler:																			
ALS Sample # (lab use only)		Sample Identification and/or Coordinates (This description will appear on the report)				Date (dd-mmm-yy)		Time (hh:mm)		Sample Type		pH / Conductivity / Alkalinity / Anions		Total Suspended Solids (TSS)		Total Dissolved Solids (TDS)		Total Metals (TM), Hardness		Dissolved Metals (DM) (filtered and preserved)		Total Mercury, Hardness		Dissolved Mercury [I] (Filtered + preserved)		Total Nutrients (Ammonia)		Dissolved Organic Carbon (DOC)		Number of Containers	
		W46				8-Oct-18		14:40		Water		R R		R R		R R		R R		R R		R R		R R		R R		R R		7	
		W7				8-Oct-18		15:15		Water		R R		R R		R R		R R		R R		R R		R R		R R		R R		7	
		W8A				8-Oct-18		9:30		Water		R R		R R		R R		R R		R R		R R		R R		R R		R R		6	
		W16				8-Oct-18		10:30		Water		R R		R R		R R		R R		R R		R R		R R		R R		R R		7	
		W3				9-Oct-18		9:20		Water		R R		R R		R R		R R		R R		R R		R R		R R		R R		7	
		W17				9-Oct-18		10:15		Water		R R		R R		R R		R R		R R		R R		R R		R R		R R		7	
		W12				9-Oct-18		13:20		Water		R R		R R		R R		R R		R R		R R		R R		R R		R R		6	
		DUP				9-Oct-18				Water		R R		R R		R R		R R		R R		R R		R R		R R		R R		7	
		DUP 1				8-Oct-18				Water		R R		R R		R R		R R		R R		R R		R R		R R		R R		7	
Drinking Water (DW) Samples ¹ (client use)						Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)																									
Are samples taken from a Regulated DW System? ☐ YES ☒ NO																															
Are samples for human drinking water use? ☐ YES ☒ NO																															
SHIPMENT RELEASE (client use)						INITIAL SHIPMENT RECEPTION (lab use only)																									
Released by: Shaheen Baker						Received by: EHF						Date: 11 Oct 2018						Time: 11:40													
Date: Oct 10, 2018						Time:						Received by: H.A						Date: 10/12													
Time:						Time:						Time:						Time: 12:05													

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FROM



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 17-OCT-18
Report Date: 26-OCT-18 13:16 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2182778
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-10-17 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

26-OCT-18 13:16 (MT)

Version: FINAL

Sample ID Description Sampled Date Sampled Time Client ID		L2182778-1 Water 13-OCT-18 11:10 MN-4.5	L2182778-2 Water 13-OCT-18 12:05 MN-0.5	L2182778-3 Water 13-OCT-18 12:40 MN-2.5	L2182778-4 Water 13-OCT-18 14:40 MN-1.5	L2182778-6 Water 13-OCT-18 DUP
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	216	252	197	136	198
	Hardness (as CaCO3) (mg/L)	113	129	102	69.9	106
	pH (pH)	7.78	7.87	7.81	7.68	7.91
	Total Suspended Solids (mg/L)	30.7	4.0	40.7	6.7	80.0
	TDS (Calculated) (mg/L)	124	139	105	72.0	103
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	108	114	97.3	59.1	90.7
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	108	114	97.3	59.1	90.7
	Ammonia, Total (as N) (mg/L)	0.0067	<0.0050	0.0080	0.0105	0.0093
	Chloride (Cl) (mg/L)	0.71	0.50	0.54	0.82	0.58
	Nitrate and Nitrite (as N) (mg/L)	0.123	0.116	0.0430	<0.0051	0.0599
	Nitrate (as N) (mg/L)	0.123	0.116	0.0430	<0.0050	0.0599
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	10.9	15.6	4.77	3.69	4.76
	Anion Sum (meq/L)	2.41	2.63	2.06	1.28	1.93
	Cation Sum (meq/L)	2.53	2.95	2.26	1.71	2.34
	Cation - Anion Balance (%)	2.4	5.8	4.5	14.4	9.6
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	9.36	7.70	7.85	25.7	7.73
Total Metals	Aluminum (Al)-Total (mg/L)	0.325	0.0402	0.421	0.0740	0.542
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	0.00012	0.00010	0.00011
	Arsenic (As)-Total (mg/L)	0.00048	0.00035	0.00049	0.00040	0.00055
	Barium (Ba)-Total (mg/L)	0.0575	0.0634	0.0582	0.0365	0.0586
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	0.000025
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)-Total (mg/L)	<0.0000050	<0.0000050	0.0000103	0.0000211	0.0000148
	Calcium (Ca)-Total (mg/L)	33.2	36.2	28.7	16.8	28.2
	Chromium (Cr)-Total (mg/L)	0.00077	0.00022	0.00113	0.00101	0.00130
	Cobalt (Co)-Total (mg/L)	0.00025	<0.00010	0.00036	0.00019	0.00043
	Copper (Cu)-Total (mg/L)	0.00274	0.00875	0.00565	0.00777	0.00567
	Iron (Fe)-Total (mg/L)	0.477	0.068	0.750	0.174	0.920
	Lead (Pb)-Total (mg/L)	0.000158	<0.000050	0.000229	<0.000050	0.000263
	Lithium (Li)-Total (mg/L)	0.0014	0.0014	0.0014	<0.0010	0.0014
	Magnesium (Mg)-Total (mg/L)	8.52	9.94	8.50	6.43	8.30
	Manganese (Mn)-Total (mg/L)	0.0264	0.00269	0.0838	0.0559	0.0873

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2182778-7 Water 15-OCT-18 15:00 W16	L2182778-8 Water 15-OCT-18 15:45 W8A	L2182778-9 Water 16-OCT-18 09:35 W3	L2182778-10 Water 16-OCT-18 10:00 W17	L2182778-11 Water 16-OCT-18 DUP
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	446	1330	529	477	528
	Hardness (as CaCO3) (mg/L)	164	707	276	245	274
	pH (pH)	8.24	7.68	8.14	8.24	8.24
	Total Suspended Solids (mg/L)	13.3	9.3	<3.0	<3.0	<3.0
	TDS (Calculated) (mg/L)	238	925	317	289	313
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	157	430	236	195	231
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	157	430	236	195	231
	Ammonia, Total (as N) (mg/L)	0.0080	0.222	0.0052	<0.0050	0.0055
	Chloride (Cl) (mg/L)	5.74	10.7	4.37	6.08	4.37
	Nitrate and Nitrite (as N) (mg/L)	1.09	6.27	0.142	0.160	0.140
	Nitrate (as N) (mg/L)	1.09	6.05	0.142	0.160	0.140
	Nitrite (as N) (mg/L)	0.0048	0.224	<0.0010	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	65.1	320	57.4	62.3	57.5
	Anion Sum (meq/L)	4.74	16.0	6.04	5.37	5.95
	Cation Sum (meq/L)	3.74	16.6	6.44	5.62	6.37
	Cation - Anion Balance (%)	-11.8	1.9	3.2	2.3	3.4
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	12.7		5.91	9.93	5.97
Total Metals	Aluminum (Al)-Total (mg/L)	0.514	0.221	0.0470	0.0032	0.0108
	Antimony (Sb)-Total (mg/L)	<0.00010	0.00016	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00048	0.00089	0.00030	0.00040	0.00030
	Barium (Ba)-Total (mg/L)	0.0776	0.150	0.0695	0.0720	0.0680
	Beryllium (Be)-Total (mg/L)	0.000020	0.000025	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.014	0.035	0.026	0.023	0.026
	Cadmium (Cd)-Total (mg/L)	0.0000111	0.000286	0.0000085	<0.0000050	<0.0000050
	Calcium (Ca)-Total (mg/L)	54.3	192	57.8	62.9	58.4
	Chromium (Cr)-Total (mg/L)	0.00043	0.00081	0.00016	0.00011	0.00013
	Cobalt (Co)-Total (mg/L)	0.00038	0.00081	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Total (mg/L)	0.0614	0.156	0.00745	0.00729	0.00395
	Iron (Fe)-Total (mg/L)	0.892	2.32	0.084	<0.010	0.028
	Lead (Pb)-Total (mg/L)	0.000163	0.000356	0.000069	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	0.0014	0.0042	0.0033	0.0015	0.0032
	Magnesium (Mg)-Total (mg/L)	17.2	57.2	30.6	21.0	30.7
	Manganese (Mn)-Total (mg/L)	0.0949	2.15	0.0455	0.00852	0.0398

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2182778-1 Water 13-OCT-18 11:10 MN-4.5	L2182778-2 Water 13-OCT-18 12:05 MN-0.5	L2182778-3 Water 13-OCT-18 12:40 MN-2.5	L2182778-4 Water 13-OCT-18 14:40 MN-1.5	L2182778-6 Water 13-OCT-18 DUP
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.000918	0.00113	0.000753	0.000324	0.000797
	Nickel (Ni)-Total (mg/L)	0.00131	0.00072	0.00148	0.00118	0.00163
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	0.147	<0.050
	Potassium (K)-Total (mg/L)	0.91	0.97	1.06	2.33	1.07
	Selenium (Se)-Total (mg/L)	0.000278	0.000197	0.000059	0.000082	0.000082
	Silicon (Si)-Total (mg/L)	6.21	6.43	7.36	9.03	7.49
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	5.51	7.11	4.26	4.86	4.25
	Strontium (Sr)-Total (mg/L)	0.211	0.272	0.146	0.0852	0.148
	Sulfur (S)-Total (mg/L)	4.30	5.93	1.92	1.54	1.84
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	0.0137	0.00192	0.0191	0.00327	0.0241
	Uranium (U)-Total (mg/L)	0.00125	0.000617	0.000231	0.000017	0.000235
	Vanadium (V)-Total (mg/L)	0.00148	0.00074	0.00174	0.00068	0.00211
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	0.0083	0.0056	0.0062
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	0.00052	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0241	0.0108	0.0068	0.0350	0.0075
	Antimony (Sb)-Dissolved (mg/L)	0.00016	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00027	0.00031	0.00024	0.00036	0.00023
	Barium (Ba)-Dissolved (mg/L)	0.0505	0.0604	0.0448	0.0355	0.0462
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	0.0000089	<0.0000050	<0.0000050	0.0000249	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	31.7	35.9	27.7	17.1	29.0
	Chromium (Cr)-Dissolved (mg/L)	0.00014	0.00013	0.00015	0.00071	0.00014
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00019	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00511 ^{DTC}	0.00221	0.00139	0.00510	0.00181
	Iron (Fe)-Dissolved (mg/L)	0.052	0.025	0.043	0.074	0.045
	Lead (Pb)-Dissolved (mg/L)	0.000146	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0010	0.0012	0.0010	<0.0010	0.0010
	Magnesium (Mg)-Dissolved (mg/L)	8.19	9.67	7.99	6.64	8.12
	Manganese (Mn)-Dissolved (mg/L)	0.00228	0.00144	0.0452	0.0655	0.0455

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ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2182778-7 Water 15-OCT-18 15:00 W16	L2182778-8 Water 15-OCT-18 15:45 W8A	L2182778-9 Water 16-OCT-18 09:35 W3	L2182778-10 Water 16-OCT-18 10:00 W17	L2182778-11 Water 16-OCT-18 DUP
Grouping	Analyte						
WATER							
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.00263	0.0151	0.00525	0.00627	0.00520	
	Nickel (Ni)-Total (mg/L)	0.00093	0.00151	0.00103	0.00070	0.00105	
	Phosphorus (P)-Total (mg/L)	0.062	0.077	<0.050	<0.050	<0.050	
	Potassium (K)-Total (mg/L)	2.59	7.69	2.37	3.61	2.41	
	Selenium (Se)-Total (mg/L)	0.000551	0.00763	0.000249	0.000449	0.000272	
	Silicon (Si)-Total (mg/L)	4.30	7.97	6.55	5.54	6.49	
	Silver (Ag)-Total (mg/L)	0.000013	0.000044	<0.000010	<0.000010	<0.000010	
	Sodium (Na)-Total (mg/L)	11.0	50.0	18.4	13.8	18.6	
	Strontium (Sr)-Total (mg/L)	0.525	2.66	0.798	0.700	0.810	
	Sulfur (S)-Total (mg/L)	22.1	131	21.2	22.8	21.5	
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Total (mg/L)	0.0325	0.0128	0.00273	<0.00030	0.00060	
	Uranium (U)-Total (mg/L)	0.00117	0.00355	0.00273	0.00203	0.00271	
	Vanadium (V)-Total (mg/L)	0.00228	0.00336	0.00064	0.00056	0.00056	
	Zinc (Zn)-Total (mg/L)	0.0047	0.304	0.0037	<0.0030	<0.0030	
	Zirconium (Zr)-Total (mg/L)	<0.00030	0.00042	<0.00030	<0.00030	<0.00030	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0141	0.0237	0.0186	0.0042	0.0065	
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
	Arsenic (As)-Dissolved (mg/L)	0.00028	0.00048	0.00025	0.00037	0.00022	
	Barium (Ba)-Dissolved (mg/L)	0.0515	0.145	0.0679	0.0654	0.0654	
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	0.010	0.031	0.024	0.021	0.024	
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	0.000275	0.0000055	<0.0000050	0.0000057	
	Calcium (Ca)-Dissolved (mg/L)	42.5	195	59.9	64.7	60.2	
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00042	0.00013	<0.00010	<0.00010	
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00064	<0.00010	<0.00010	<0.00010	
	Copper (Cu)-Dissolved (mg/L)	0.0201	0.0720	0.00562	0.00716	0.00320	
	Iron (Fe)-Dissolved (mg/L)	0.026	0.355	0.047	<0.010	0.022	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	<0.0010	0.0037	0.0031	0.0014	0.0031	
	Magnesium (Mg)-Dissolved (mg/L)	14.0	53.7	30.7	20.2	30.1	
	Manganese (Mn)-Dissolved (mg/L)	0.00257	1.97	0.0378	0.00488	0.0359	

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2182778-1 Water 13-OCT-18 11:10 MN-4.5	L2182778-2 Water 13-OCT-18 12:05 MN-0.5	L2182778-3 Water 13-OCT-18 12:40 MN-2.5	L2182778-4 Water 13-OCT-18 14:40 MN-1.5	L2182778-6 Water 13-OCT-18 DUP
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.000903	0.00113	0.000774	0.000295	0.000766
	Nickel (Ni)-Dissolved (mg/L)	0.00068	0.00063	0.00070	0.00113	0.00077
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	0.171	<0.050
	Potassium (K)-Dissolved (mg/L)	0.84	0.93	0.94	2.69	0.96
	Selenium (Se)-Dissolved (mg/L)	0.000213	0.000186	0.000067	0.000069	0.000076
	Silicon (Si)-Dissolved (mg/L)	5.38	6.02	6.48	8.40	6.32
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	5.83	7.72	4.33	5.39	4.49
	Strontium (Sr)-Dissolved (mg/L)	0.215	0.277	0.145	0.0880	0.148
	Sulfur (S)-Dissolved (mg/L)	3.36	5.24	1.41	1.07	1.29
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00246	0.00066	<0.00030	0.00127	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00116	0.000594	0.000205	0.000016	0.000209
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0017	0.0011	0.0026	0.0040	0.0026
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	0.00051	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2182778-7 Water 15-OCT-18 15:00 W16	L2182778-8 Water 15-OCT-18 15:45 W8A	L2182778-9 Water 16-OCT-18 09:35 W3	L2182778-10 Water 16-OCT-18 10:00 W17	L2182778-11 Water 16-OCT-18 DUP
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00207	0.0145	0.00519	0.00599	0.00520
	Nickel (Ni)-Dissolved (mg/L)	0.00053	0.00113	0.00091	0.00060	0.00086
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	1.91	7.45	2.29	3.44	2.26
	Selenium (Se)-Dissolved (mg/L)	0.000401	0.00727	0.000333	0.000407	0.000317
	Silicon (Si)-Dissolved (mg/L)	2.52	7.11	6.15	5.34	6.09
	Silver (Ag)-Dissolved (mg/L)	<0.000010	0.000014	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	9.54	50.1	19.6	14.7	19.1
	Strontium (Sr)-Dissolved (mg/L)	0.422	2.66	0.799	0.701	0.811
	Sulfur (S)-Dissolved (mg/L)	16.1	120	19.4	21.4	19.3
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00117	<0.0036 ^{DLM}	0.00238	<0.00030	0.00046
	Uranium (U)-Dissolved (mg/L)	0.000939	0.00355	0.00268	0.00198	0.00270
	Vanadium (V)-Dissolved (mg/L)	<0.00050	0.00134	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	0.238	0.0019	<0.0010	0.0024
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	0.00040	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Dissolved Organic Carbon	MS-B	L2182778-1, -10, -11, -2, -3, -4, -6, -7, -9
Matrix Spike	Dissolved Organic Carbon	MS-B	L2182778-1, -10, -11, -2, -3, -4, -6, -7, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2182778-1, -10, -11, -2, -3, -4, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2182778-1
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2182778-1, -10, -11, -2, -3, -4, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2182778-1
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2182778-1, -10, -11, -2, -3, -4, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2182778-1
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2182778-1, -10, -11, -2, -3, -4, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2182778-1, -10, -11, -2, -3, -4, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2182778-1
Matrix Spike	Barium (Ba)-Total	MS-B	L2182778-1, -10, -11, -2, -3, -4, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L2182778-1, -10, -11, -2, -3, -4, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2182778-1, -10, -11, -2, -3, -4, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Total	MS-B	L2182778-1, -10, -11, -2, -3, -4, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L2182778-1, -10, -11, -2, -3, -4, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DTC	Dissolved concentration exceeds total. Results were confirmed by re-analysis.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)

Reference Information

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-MAN-WR Water Total Suspended Solids by Gravimetric APHA 2540 D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids are determined by filtering a sample through a glass fibre filter and drying the filter at 104 degrees celsius.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-10-17 A

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lw - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form



DOC Number: 2018-10-17 A

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2182778-COFC

Page 1 of 1

Report To Contact and company name below will appear on the final report		Report Format / Distribution		Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply													
Company:	Minto Explorations Ltd.	Select Report Format: ☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)		Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply													
Contact:	Minto Environment - Coordinator	Quality Control (QC) Report with Report ☒ YES ☐ NO		PRIORITY (Business Days)				EMERGENCY									
Phone:	1-604-759-4659	☒ Compare Results to Criteria on Report - provide details below if box checked		4 day [P4] ☐				1 Business day [E1] ☐									
Company address below will appear on the final report		Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX		3 day [P3] ☐				Same Day, Weekend or Statutory holiday [E0] ☐									
Street:		Email 1 or Fax mintoenvironment@mintomine.com		Date and Time Required for all E&P TATs:													
City/Province:		Email 2		For tests that can not be performed according to the service level selected, you will be contacted.													
Postal Code:		Email 3		Analysis Request													
Invoice To		Invoice Distribution		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below													
Same as Report To ☐ YES ☒ NO		Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX															
Copy of Invoice with Report ☐ YES ☒ NO		Email 1 or Fax ap@mintomine.com															
Company:		Email 2															
Contact:																	
Project Information		Oil and Gas Required Fields (client use)															
ALS Account # / Quote #:		AFE/Cost Center:		PO#													
Job #:		Major/Minor Code:		Routing Code:													
PO / AFE: 229096 (WUL)		Requisitioner:															
LSD:		Location:															
ALS Lab Work Order # (lab use only)		ALS Contact: Shane Stack		Sampler: CH/TS													
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	pH / Conductivity / Alkalinity / Anions	Total Suspended Solids (TSS)	Total Dissolved Solids (TDS)	Total Metals (TM), Hardness	Dissolved Metals (DM) (filtered and preserved)	Total Mercury, Hardness	Dissolved Mercury [1] (Filtered + preserved)	Total Nutrients (Ammonia)	Dissolved Organic Carbon (DOC)	Number of Containers			
	MN-4.5	13-Oct-18	11:10	Water	R	R	R	R	R	R	R	R	R		7		
	MN-0.5	13-Oct-18	12:05	Water	R	R	R	R	R	R	R	R	R		7		
	MN-2.5	13-Oct-18	12:40	Water	R	R	R	R	R	R	R	R	R		7		
	MN-1.5	13-Oct-18	14:40	Water	R	R	R	R	R	R	R	R	R		7		
	MN-0.2	13-Oct-18	15:45	Water	R	R	R	R	R	R	R	R	R		7		
	DUP	13-Oct-18		Water	R	R	R	R	R	R	R	R	R		7		
	W16	15-Oct-18	15:00	Water	R	R	R	R	R	R	R	R	R		7		
	W8A	15-Oct-18	15:45	Water	R	R	R	R	R	R	R	R	R		7		
	W3	16-Oct-18	9:35	Water	R	R	R	R	R	R	R	R	R		6		
	W17	16-Oct-18	10:00	Water	R	R	R	R	R	R	R	R	R		7		
	DUP	16-Oct-18		Water	R	R	R	R	R	R	R	R	R		7		
Drinking Water (DW) Samples¹ (client use)		SAMPLE CONDITION AS RECEIVED (lab use only)															
Are samples taken from a Regulated DW System? ☐ YES ☒ NO		Frozen ☐ SIF Observations Yes ☐ No ☐															
Are samples for human drinking water use? ☐ YES ☒ NO		Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐															
		Cooling Initiated ☐															
		INITIAL COOLER TEMPERATURES °C: 4.0 FINAL COOLER TEMPERATURES °C: 6															
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)															
Released by: Chris Harry		Date: 2018-10-17 9:00		Time:		Received by: EHF		Date: 17 Oct 2018		Time: 14:30		Received by: HA		Date: 10/18		Time: 11:40	

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 29-OCT-18
Report Date: 07-NOV-18 17:16 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2188467
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-10-27 B
Legal Site Desc:

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2188467-1 Water 23-OCT-18 09:15 W3	L2188467-2 Water 23-OCT-18 09:30 W17	L2188467-3 Water 23-OCT-18 09:50 W8A	L2188467-4 Water 24-OCT-18 15:00 W30	L2188467-5 Water 24-OCT-18 15:20 W15
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	550	498	1420	490	1010
	Hardness (as CaCO3) (mg/L)	259	239	701	225	514
	pH (pH)	8.07	8.07	7.95	8.07	8.00
	Total Suspended Solids (mg/L)	<3.0	<3.0	32.4	26.6	<3.0
	TDS (Calculated) (mg/L)	305	286	952	289	675
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	229	196	466	156	278
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	229	196	466	156	278
	Ammonia, Total (as N) (mg/L)	0.0095	<0.0050	0.380	0.0101	0.0694
	Chloride (Cl) (mg/L)	4.39	6.17	11.6	1.96	4.4
	Nitrate and Nitrite (as N) (mg/L)	0.143	0.133	6.18	0.142	12.7
	Nitrate (as N) (mg/L)	0.143	0.133	5.92	0.141	12.6
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	0.258	0.0011	0.0470
	Sulfate (SO4) (mg/L)	57.4	61.2	328	99.9	246
	Anion Sum (meq/L)	5.90	5.38	16.9	5.25	11.7
	Cation Sum (meq/L)	6.03	5.47	16.5	5.27	11.2
	Cation - Anion Balance (%)	1.1	0.8	-1.3	0.1	-2.3
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	5.63	9.26			14.7
Total Metals	Aluminum (Al)-Total (mg/L)	0.0074	0.0071	0.184	0.417	0.0534
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	0.00023	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00032	0.00046	0.00076	0.00092	0.00055
	Barium (Ba)-Total (mg/L)	0.0673	0.0689	0.144	0.0891	0.118
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	0.000033	0.000021	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.026	0.023	0.036	0.013	<0.010
	Cadmium (Cd)-Total (mg/L)	0.0000181	0.0000183	0.000400	0.0000226	0.0000116
	Calcium (Ca)-Total (mg/L)	58.3	63.0	203	51.4	145
	Chromium (Cr)-Total (mg/L)	0.00011	0.00012	0.00097	0.00031	0.00019
	Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	0.00093	0.00027	0.00028
	Copper (Cu)-Total (mg/L)	0.00479	0.00887	0.156	0.0446	0.0239
	Iron (Fe)-Total (mg/L)	0.024	<0.010	1.78	0.717	0.341
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	0.000286	0.000174	<0.000050
	Lithium (Li)-Total (mg/L)	0.0034	0.0016	0.0044	0.0026	<0.0010
	Magnesium (Mg)-Total (mg/L)	31.0	20.8	59.1	25.2	44.9
	Manganese (Mn)-Total (mg/L)	0.0393	0.0118	2.28	0.161	0.158

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2188467-6 Water 24-OCT-18 15:55 W62	L2188467-7 Water 25-OCT-18 09:45 UG4	L2188467-8 Water 25-OCT-18 14:00 UG1	L2188467-9 Water 23-OCT-18 DUP1	
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	1200	1730	1870	501	
	Hardness (as CaCO3) (mg/L)	649	925	937	250	
	pH (pH)	8.31	8.06	7.88	8.07	
	Total Suspended Solids (mg/L)	3.0	46.2	151	<3.0	
	TDS (Calculated) (mg/L)	827	1370	1560	280	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	383	172	185	179	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	4.4	<1.0	<1.0	<1.0	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Total (as CaCO3) (mg/L)	388	172	185	179	
	Ammonia, Total (as N) (mg/L)	0.0144	0.175	1.72	<0.0050	
	Chloride (Cl) (mg/L)	28.0	24.8	19.1	6.20	
	Nitrate and Nitrite (as N) (mg/L)	11.3	0.850	3.76	0.132	
	Nitrate (as N) (mg/L)	11.2	0.735	3.37	0.132	
	Nitrite (as N) (mg/L)	0.0645	0.115	0.389	<0.0010	
	Sulfate (SO4) (mg/L)	251	829	987	61.2	
	Anion Sum (meq/L)	14.6	21.5	25.1	5.03	
	Cation Sum (meq/L)	14.6	21.4	22.2	5.73	
	Cation - Anion Balance (%)	0.1	-0.1	-6.1	6.5	
					9.27	
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)					
Total Metals	Aluminum (Al)-Total (mg/L)	0.0300	0.0335	2.13	0.0070	
	Antimony (Sb)-Total (mg/L)	0.00011	<0.00010	0.00022	<0.00010	
	Arsenic (As)-Total (mg/L)	0.00061	0.00121	0.00124	0.00044	
	Barium (Ba)-Total (mg/L)	0.112	0.0202	0.0636	0.0672	
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	0.000056 ^{DLA}	<0.000020	
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.00010	<0.000050	
	Boron (B)-Total (mg/L)	0.028	0.139	0.274	0.024	
	Cadmium (Cd)-Total (mg/L)	0.0000497	0.000223	0.000170	0.0000093	
	Calcium (Ca)-Total (mg/L)	172	297	324	65.1	
	Chromium (Cr)-Total (mg/L)	0.00034	0.00012	0.00108	0.00014	
	Cobalt (Co)-Total (mg/L)	0.00017	0.00028	0.00139	<0.00010	
	Copper (Cu)-Total (mg/L)	0.0701	0.0703	0.362	0.00995	
	Iron (Fe)-Total (mg/L)	0.121	0.071	3.46	0.011	
	Lead (Pb)-Total (mg/L)	<0.000050	0.000066	0.00115	<0.000050	
	Lithium (Li)-Total (mg/L)	0.0036	0.0086	0.0109	0.0016	
	Magnesium (Mg)-Total (mg/L)	48.4	44.2	44.0	20.3	
	Manganese (Mn)-Total (mg/L)	0.0431	0.0885	0.176	0.00784	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2188467-1 Water 23-OCT-18 09:15 W3	L2188467-2 Water 23-OCT-18 09:30 W17	L2188467-3 Water 23-OCT-18 09:50 W8A	L2188467-4 Water 24-OCT-18 15:00 W30	L2188467-5 Water 24-OCT-18 15:20 W15
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.00514	0.00612	0.0149	0.00303	0.00226
	Nickel (Ni)-Total (mg/L)	0.00093	0.00070	0.00196	0.00068	0.00083
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	2.40	3.57	8.13	4.12	4.87
	Selenium (Se)-Total (mg/L)	0.000299	0.000449	0.00771	0.000727	0.00475
	Silicon (Si)-Total (mg/L)	6.80	5.78	8.24	2.42	6.11
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	0.000036	0.000012	<0.000010
	Sodium (Na)-Total (mg/L)	19.6	14.5	52.3	15.1	19.5
	Strontium (Sr)-Total (mg/L)	0.800	0.711	2.81	0.706	1.26
	Sulfur (S)-Total (mg/L)	21.8	23.2	140	38.5	93.9
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	0.00021	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	0.00037	0.00032	0.0100	0.0156	0.00349
	Uranium (U)-Total (mg/L)	0.00307	0.00222	0.00430	0.000710	0.00378
	Vanadium (V)-Total (mg/L)	<0.00050	<0.00050	0.00271	0.00162	0.00065
	Zinc (Zn)-Total (mg/L)	0.0060	0.0045	0.418	0.0062	0.0035
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	0.00046	<0.00030	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0067	0.0053	0.0228	0.0029	0.0046
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	0.00012	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00024	0.00038	0.00044	0.00070	0.00040
	Barium (Ba)-Dissolved (mg/L)	0.0643	0.0696	0.139	0.0781	0.114
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.023	0.021	0.032	0.012	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	0.0000161	0.0000128	0.000319	0.0000130	0.0000101
	Calcium (Ca)-Dissolved (mg/L)	55.9	63.1	192	48.7	138
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	0.00041	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	0.00079	<0.00010	0.00023
	Copper (Cu)-Dissolved (mg/L)	0.00338	0.00767	0.0779	0.0158	0.0149
	Iron (Fe)-Dissolved (mg/L)	0.026	<0.010	0.345	0.017	0.053
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0033	0.0015	0.0042	0.0024	<0.0010
	Magnesium (Mg)-Dissolved (mg/L)	29.1	19.8	53.8	25.2	41.3
	Manganese (Mn)-Dissolved (mg/L)	0.0380	0.00650	2.24	0.0976	0.152

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2188467-6 Water 24-OCT-18 15:55 W62	L2188467-7 Water 25-OCT-18 09:45 UG4	L2188467-8 Water 25-OCT-18 14:00 UG1	L2188467-9 Water 23-OCT-18 DUP1	
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Total (mg/L)	0.00935	0.0192	0.0192	0.00619	
	Nickel (Ni)-Total (mg/L)	0.00122	<0.00050	0.0013 ^{DLA}	0.00067	
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.10 ^{DLA}	<0.050	
	Potassium (K)-Total (mg/L)	6.53	4.81	7.60	3.65	
	Selenium (Se)-Total (mg/L)	0.00356	0.00241	0.00162	0.000409	
	Silicon (Si)-Total (mg/L)	7.75	7.30	11.0	5.58	
	Silver (Ag)-Total (mg/L)	0.000014	<0.000010	0.000186	<0.000010	
	Sodium (Na)-Total (mg/L)	31.8	66.3	75.5	14.7	
	Strontium (Sr)-Total (mg/L)	1.92	6.30	7.43	0.699	
	Sulfur (S)-Total (mg/L)	89.7	321	358	21.7	
	Thallium (Tl)-Total (mg/L)	<0.000010	0.000012	0.000035 ^{DLA}	<0.000010	
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010 ^{DLM}	<0.00020 ^{DLA}	<0.00010	
	Titanium (Ti)-Total (mg/L)	0.00198	<0.0021 ^{DLM}	0.127	0.00032	
	Uranium (U)-Total (mg/L)	0.00540	0.00796	0.00936	0.00221	
	Vanadium (V)-Total (mg/L)	0.00086	0.00066	0.0077	0.00051	
	Zinc (Zn)-Total (mg/L)	0.0264	0.0051	0.0264	0.0031	
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0032	0.0027	0.0089	0.0029	
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00020 ^{DLA}	<0.00010	
	Arsenic (As)-Dissolved (mg/L)	0.00050	0.00094	0.00089	0.00035	
	Barium (Ba)-Dissolved (mg/L)	0.109	0.0177	0.0274 ^{DLA}	0.0637	
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000040 ^{DLA}	<0.000020	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.00010 ^{DLA}	<0.000050	
	Boron (B)-Dissolved (mg/L)	0.027	0.131	0.252	0.023	
	Cadmium (Cd)-Dissolved (mg/L)	0.0000452	0.000175	0.000020	0.0000051	
	Calcium (Ca)-Dissolved (mg/L)	173	298	307 ^{DLA}	64.9	
	Chromium (Cr)-Dissolved (mg/L)	0.00020	<0.00010	<0.00020 ^{DLA}	<0.00010	
	Cobalt (Co)-Dissolved (mg/L)	0.00014	0.00024	0.00037	<0.00010	
	Copper (Cu)-Dissolved (mg/L)	0.0631	0.0597	0.0132 ^{DLA}	0.00790	
	Iron (Fe)-Dissolved (mg/L)	0.039	<0.010	<0.020 ^{DLA}	<0.010	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.00010 ^{DLA}	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.0036	0.0086	0.0095	0.0015	
	Magnesium (Mg)-Dissolved (mg/L)	52.8	44.0	41.4	21.4	
	Manganese (Mn)-Dissolved (mg/L)	0.0432	0.0821	0.0879	0.00603	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2188467-1 Water 23-OCT-18 09:15 W3	L2188467-2 Water 23-OCT-18 09:30 W17	L2188467-3 Water 23-OCT-18 09:50 W8A	L2188467-4 Water 24-OCT-18 15:00 W30	L2188467-5 Water 24-OCT-18 15:20 W15
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00513	0.00610	0.0145	0.00286	0.00217
	Nickel (Ni)-Dissolved (mg/L)	0.00089	0.00066	0.00156	<0.00050	0.00076
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	2.39	3.67	7.89	4.35	4.71
	Selenium (Se)-Dissolved (mg/L)	0.000222	0.000428	0.00789	0.000720	0.00492
	Silicon (Si)-Dissolved (mg/L)	6.03	5.28	7.23	1.44	5.41
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	18.0	13.8	48.8	14.9	17.7
	Strontium (Sr)-Dissolved (mg/L)	0.775	0.677	2.65	0.655	1.20
	Sulfur (S)-Dissolved (mg/L)	20.2	22.3	138	37.1	92.7
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00090 ^{DLM}	0.00048	0.00284	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00275	0.00206	0.00394	0.000626	0.00339
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	0.00131	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0041	0.0025	0.342	0.0031	0.0025
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	0.00046	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2188467-6 Water 24-OCT-18 15:55 W62	L2188467-7 Water 25-OCT-18 09:45 UG4	L2188467-8 Water 25-OCT-18 14:00 UG1	L2188467-9 Water 23-OCT-18 DUP1	
Grouping	Analyte						
WATER							
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Dissolved (mg/L)	0.00945	0.0191	0.0191	0.00608	0.00608	
	Nickel (Ni)-Dissolved (mg/L)	0.00115	<0.00050	0.0010	0.00067	0.00067	
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.10 ^{DLA}	<0.050	<0.050	
	Potassium (K)-Dissolved (mg/L)	6.57	4.57	7.36	3.54	3.54	
	Selenium (Se)-Dissolved (mg/L)	0.00387	0.00235	0.00144	0.000317	0.000317	
	Silicon (Si)-Dissolved (mg/L)	7.30	6.46	6.71	5.29	5.29	
	Silver (Ag)-Dissolved (mg/L)	0.000017	0.000018	<0.000020 ^{DLA}	<0.000010	<0.000010	
	Sodium (Na)-Dissolved (mg/L)	33.3	64.5	72.3	14.8	14.8	
	Strontium (Sr)-Dissolved (mg/L)	2.01	6.34	6.92	0.733	0.733	
	Sulfur (S)-Dissolved (mg/L)	85.1	281	366	20.6	20.6	
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	0.000010	<0.000020 ^{DLA}	<0.000010	<0.000010	
	Tin (Sn)-Dissolved (mg/L)	<0.00010 ^{DLM}	<0.00010	<0.00020 ^{DLA}	<0.00010	<0.00010	
	Titanium (Ti)-Dissolved (mg/L)	<0.00060	<0.00030	<0.00060 ^{DLA}	<0.00030	<0.00030	
	Uranium (U)-Dissolved (mg/L)	0.00478	0.00715	0.00893	0.00198	0.00198	
	Vanadium (V)-Dissolved (mg/L)	0.00061	<0.00050	<0.0010 ^{DLA}	<0.00050	<0.00050	
	Zinc (Zn)-Dissolved (mg/L)	0.0274	0.0023	0.0031	<0.0010	<0.0010	
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2188467-6, -7, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2188467-6, -7, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2188467-6, -7, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2188467-6, -7, -9
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2188467-6, -7, -9
Matrix Spike	Barium (Ba)-Total	MS-B	L2188467-1, -2, -3, -4, -5, -8
Matrix Spike	Calcium (Ca)-Total	MS-B	L2188467-1, -2, -3, -4, -5, -8
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2188467-1, -2, -3, -4, -5, -8
Matrix Spike	Manganese (Mn)-Total	MS-B	L2188467-1, -2, -3, -4, -5, -8
Matrix Spike	Sodium (Na)-Total	MS-B	L2188467-1, -2, -3, -4, -5, -8
Matrix Spike	Strontium (Sr)-Total	MS-B	L2188467-1, -2, -3, -4, -5, -8
Matrix Spike	Sulfur (S)-Total	MS-B	L2188467-1, -2, -3, -4, -5, -8

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			

Reference Information

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
----------------------------	---------------------

VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
----	---

Chain of Custody Numbers:

2018-10-27 B

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form



L2188467-COFC

COC Number: 2018-10-27 B

Page 1 of 1

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

Report To				Report Format / Distribution				Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply															
Contact and company name below will appear on the final report				Select Report Format: ☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)				Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply															
Company: Minto Explorations Ltd.				Quality Control (QC) Report with Report ☒ YES ☐ NO				PRIORITY (Business Days)				EMERGENCY											
Contact: Minto Environment - Coordinator				☒ Compare Results to Criteria on Report - provide details below if box checked				4 day [P4] ☐				1 Business day [E1] ☐											
Phone: 1-604-759-4659				Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX				3 day [P3] ☐				Same Day, Weekend or Statutory holiday [E0] ☐											
Company address below will appear on the final report				Email 1 or Fax: mintoenvironment@mintomine.com				Date and Time Required for all E&P TATs:															
Street: 2100-510 West Georgia St.				Email 2				For tests that can not be performed according to the service level selected, you will be contacted.															
City/Province: Vancouver, British Columbia				Email 3				Analysis Request															
Postal Code: V6B 0M3				Invoice Distribution				Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below															
Invoice To: Same as Report To ☐ YES ☒ NO				Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX																			
Copy of Invoice with Report ☐ YES ☒ NO				Email 1 or Fax: ap@mintomine.com																			
Company: Minto Explorations Ltd.				Email 2																			
Contact: Ruth Cayetano																							
Project Information				Oil and Gas Required Fields (client use)																			
ALS Account # / Quote #:				AFE/Cost Center:																			
Job #:				Major/Minor Code:																			
PO / AFE: 229096 (WUL)				Requisitioner:																			
LSD:				Location:																			
ALS Lab Work Order # (lab use only)				ALS Contact: Shane Stack				Sampler: CR/EB															
Number of Containers																							
ALS Sample # (lab use only)		Sample Identification and/or Coordinates (This description will appear on the report)			Date (dd-mmm-yy)		Time (hh:mm)		Sample Type														
W3					23-Oct-18		9:15		Water														
W17					23-Oct-18		9:30		Water														
W8A					23-Oct-18		9:50		Water														
W30					24-Oct-18		15:00		Water														
W15					24-Oct-18		15:20		Water														
W62					24-Oct-18		15:55		Water														
UG4					25-Oct-18		9:45		Water														
UG1					25-Oct-18		14:00		Water														
DUP 1					23-Oct-18				Water														
Drinking Water (DW) Samples ¹ (client use)																							
Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)																							
Are samples taken from a Regulated DW System? ☐ YES ☒ NO																							
Are samples for human drinking water use? ☐ YES ☒ NO																							
SHIPMENT RELEASE (client use)																							
Released by: Corey Roberts Date: 2018-10-27 Time: Received by: LHF Date: 29 Oct 2018 Time: 09:40																							
INITIAL SHIPMENT RECEPTION (lab use only)																							
FINAL SHIPMENT RECEPTION (lab use only)																							
Received by: UA Date: 10/30/18 Time: 2 p.m.																							

SAMPLE CONDITION AS RECEIVED (lab use only)											
Frozen ☐ SIF Observations Yes ☐ No ☐											
Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐											
Cooling Initiated ☐											
INITIAL COOLER TEMPERATURES °C						FINAL COOLER TEMPERATURES °C					
3.0						9					

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY

YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 01-NOV-18
Report Date: 13-NOV-18 18:25 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2190604
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-10-31 A
Legal Site Desc:

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2190604-1 Water 30-OCT-18 08:10 W8A	L2190604-2 Water 30-OCT-18 08:40 W3	L2190604-3 Water 30-OCT-18 08:45 W17	L2190604-4 Water 30-OCT-18 DUP	
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	1390	550	509	552	
	Hardness (as CaCO3) (mg/L)	741	264	236	262	
	pH (pH)	7.99	8.24	8.27	8.24	
	Total Suspended Solids (mg/L)	36.7	<3.0	<3.0	3.3	
	TDS (Calculated) (mg/L)	965	313	289	314	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	460	239	208	243	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Total (as CaCO3) (mg/L)	460	239	208	243	
	Ammonia, Total (as N) (mg/L)	0.223	0.0123	<0.0050	0.0085	
	Chloride (Cl) (mg/L)	12.2	4.28	6.07	4.28	
	Nitrate and Nitrite (as N) (mg/L)	5.82	0.158	0.129	0.158	
	Nitrate (as N) (mg/L)	5.55	0.158	0.129	0.158	
	Nitrite (as N) (mg/L)	0.265	<0.0010	<0.0010	<0.0010	
	Sulfate (SO4) (mg/L)	331	56.6	58.0	56.8	
	Anion Sum (meq/L)	16.8	6.09	5.54	6.18	
	Cation Sum (meq/L)	17.3	6.15	5.42	6.09	
	Cation - Anion Balance (%)	1.4	0.5	-1.1	-0.7	
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)		5.78	9.59	5.39	
Total Metals	Aluminum (Al)-Total (mg/L)	0.113	0.0076	0.0048	0.0302	
	Antimony (Sb)-Total (mg/L)	0.00016	<0.00010	<0.00010	<0.00010	
	Arsenic (As)-Total (mg/L)	0.00063	0.00025	0.00038	0.00026	
	Barium (Ba)-Total (mg/L)	0.145	0.0643	0.0645	0.0640	
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Total (mg/L)	0.034	0.025	0.023	0.026	
	Cadmium (Cd)-Total (mg/L)	0.000290	0.0000236	0.0000068	0.0000157	
	Calcium (Ca)-Total (mg/L)	200	57.3	63.4	60.2	
	Chromium (Cr)-Total (mg/L)	0.00077	<0.00010	0.00010	0.00020	
	Cobalt (Co)-Total (mg/L)	0.00072	<0.00010	<0.00010	<0.00010	
	Copper (Cu)-Total (mg/L)	0.118	0.00401	0.00737	0.00774	
	Iron (Fe)-Total (mg/L)	1.03	0.025	<0.010	0.065	
	Lead (Pb)-Total (mg/L)	0.000189	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Total (mg/L)	0.0042	0.0033	0.0015	0.0034	
	Magnesium (Mg)-Total (mg/L)	54.9	28.9	20.0	29.5	
	Manganese (Mn)-Total (mg/L)	2.28	0.0351	0.00820	0.0417	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2190604-1 Water 30-OCT-18 08:10 W8A	L2190604-2 Water 30-OCT-18 08:40 W3	L2190604-3 Water 30-OCT-18 08:45 W17	L2190604-4 Water 30-OCT-18 DUP	
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	0.0000060	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Total (mg/L)	0.0144	0.00523	0.00619	0.00532	
	Nickel (Ni)-Total (mg/L)	0.00146	0.00092	0.00071	0.00096	
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Potassium (K)-Total (mg/L)	7.79	2.38	3.57	2.41	
	Selenium (Se)-Total (mg/L)	0.00628	0.000285	0.000383	0.000293	
	Silicon (Si)-Total (mg/L)	8.16	6.56	5.73	6.56	
	Silver (Ag)-Total (mg/L)	0.000028	<0.000010	<0.000010	<0.000010	
	Sodium (Na)-Total (mg/L)	51.8	19.2	14.7	18.9	
	Strontium (Sr)-Total (mg/L)	2.80	0.792	0.720	0.812	
	Sulfur (S)-Total (mg/L)	128	20.9	21.9	20.7	
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Tin (Sn)-Total (mg/L)	0.00011	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Total (mg/L)	<0.0063 ^{DLM}	0.00041	<0.00030	0.00167	
	Uranium (U)-Total (mg/L)	0.00429	0.00304	0.00227	0.00298	
	Vanadium (V)-Total (mg/L)	0.00251	<0.00050	<0.00050	0.00054	
	Zinc (Zn)-Total (mg/L)	0.550	0.0052	<0.0030	0.0077	
	Zirconium (Zr)-Total (mg/L)	0.00064	<0.00030	<0.00030	<0.00030	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0098	0.0030	0.0015	0.0051	
	Antimony (Sb)-Dissolved (mg/L)	0.00010	<0.00010	<0.00010	<0.00010	
	Arsenic (As)-Dissolved (mg/L)	0.00050	0.00023	0.00038	0.00025	
	Barium (Ba)-Dissolved (mg/L)	0.142	0.0646	0.0669	0.0651	
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	0.035	0.025	0.022	0.025	
	Cadmium (Cd)-Dissolved (mg/L)	0.000255	0.0000169	<0.0000050	0.0000066	
	Calcium (Ca)-Dissolved (mg/L)	204	57.7	62.1	56.8	
	Chromium (Cr)-Dissolved (mg/L)	0.00048	<0.00010	<0.00010	<0.00010	
	Cobalt (Co)-Dissolved (mg/L)	0.00066	<0.00010	<0.00010	<0.00010	
	Copper (Cu)-Dissolved (mg/L)	0.0722	0.00351	0.00692	0.00326	
	Iron (Fe)-Dissolved (mg/L)	0.392	0.023	<0.010	0.030	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.0041	0.0033	0.0015	0.0033	
	Magnesium (Mg)-Dissolved (mg/L)	56.3	29.2	19.7	29.1	
	Manganese (Mn)-Dissolved (mg/L)	2.22	0.0329	0.00567	0.0336	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2190604-1 Water 30-OCT-18 08:10 W8A	L2190604-2 Water 30-OCT-18 08:40 W3	L2190604-3 Water 30-OCT-18 08:45 W17	L2190604-4 Water 30-OCT-18 DUP	
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Dissolved (mg/L)	0.0141	0.00511	0.00603	0.00509	
	Nickel (Ni)-Dissolved (mg/L)	0.00132	0.00091	0.00064	0.00085	
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Potassium (K)-Dissolved (mg/L)	7.78	2.30	3.47	2.31	
	Selenium (Se)-Dissolved (mg/L)	0.00737	0.000363	0.000410	0.000355	
	Silicon (Si)-Dissolved (mg/L)	7.89	6.39	5.49	6.49	
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Sodium (Na)-Dissolved (mg/L)	49.8	18.6	14.1	18.3	
	Strontium (Sr)-Dissolved (mg/L)	2.73	0.788	0.696	0.774	
	Sulfur (S)-Dissolved (mg/L)	129	20.6	21.1	20.7	
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Dissolved (mg/L)	0.00057	<0.00030	<0.00030	0.00056	
	Uranium (U)-Dissolved (mg/L)	0.00426	0.00295	0.00218	0.00295	
	Vanadium (V)-Dissolved (mg/L)	0.00145	<0.00050	<0.00050	<0.00050	
	Zinc (Zn)-Dissolved (mg/L)	0.563	0.0045	<0.0010	<0.0010	
	Zirconium (Zr)-Dissolved (mg/L)	0.00053	<0.00030	<0.00030	<0.00030	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Dissolved Organic Carbon	MS-B	L2190604-2, -3, -4
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2190604-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2190604-1, -2, -3, -4
Matrix Spike	Copper (Cu)-Dissolved	MS-B	L2190604-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2190604-1, -2, -3, -4
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2190604-1, -2, -3, -4
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2190604-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2190604-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2190604-1, -2, -3, -4
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2190604-1, -2, -3, -4
Matrix Spike	Uranium (U)-Dissolved	MS-B	L2190604-1, -2, -3, -4
Matrix Spike	Zinc (Zn)-Dissolved	MS-B	L2190604-1, -2, -3, -4
Matrix Spike	Aluminum (Al)-Total	MS-B	L2190604-1, -2, -3, -4
Matrix Spike	Barium (Ba)-Total	MS-B	L2190604-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Total	MS-B	L2190604-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2190604-1, -2, -3, -4
Matrix Spike	Manganese (Mn)-Total	MS-B	L2190604-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Total	MS-B	L2190604-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Total	MS-B	L2190604-1, -2, -3, -4
Matrix Spike	Ammonia, Total (as N)	MS-B	L2190604-1, -2, -3, -4
Matrix Spike	Nitrate (as N)	MS-B	L2190604-1, -2, -3, -4
Matrix Spike	Sulfate (SO4)	MS-B	L2190604-1, -2, -3, -4

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			

Reference Information

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
SO4-IC-N-VA	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)
This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.			
TSS-MAN-WR	Water	Total Suspended Solids by Gravimetric	APHA 2540 D
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids are determined by filtering a sample through a glass fibre filter and drying the filter at 104 degrees celsius.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Reference Information

Chain of Custody Numbers:

2018-10-31 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

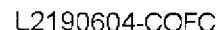
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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Page 1 of 1

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2016 FRONT



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 09-NOV-18
Report Date: 20-NOV-18 16:00 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2194872
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-11-07 A
Legal Site Desc:

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2194872-1 Water 04-NOV-18 13:40 W46	L2194872-2 Water 06-NOV-18 09:30 W8A	L2194872-3 Water 06-NOV-18 09:55 W3	L2194872-4 Water 06-NOV-18 10:10 W17	L2194872-5 Water 04-NOV-18 DUP
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	428	1480	573	510	429
	Hardness (as CaCO3) (mg/L)	216	775	280	257	210
	pH (pH)	8.14	8.02	8.25	8.34	8.15
	Total Suspended Solids (mg/L)	3.8	34.0	7.0	15.0	5.4
	TDS (Calculated) (mg/L)	249	1060	342	310	248
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	207	525	265	211	209
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	5.6	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	207	525	265	216	209
	Ammonia, Total (as N) (mg/L)	0.0319	0.287	0.0061	0.0057	0.0333
	Chloride (Cl) (mg/L)	2.89	13.4	4.41	6.64	2.91
	Nitrate and Nitrite (as N) (mg/L)	0.147	5.94	0.176	0.117	0.145
	Nitrate (as N) (mg/L)	0.146	5.66	0.176	0.117	0.144
	Nitrite (as N) (mg/L)	0.0010	0.285	<0.0010	<0.0010	0.0010
	Sulfate (SO4) (mg/L)	33.0	367	63.6	64.3	33.3
	Anion Sum (meq/L)	4.92	18.9	6.76	5.85	4.96
	Cation Sum (meq/L)	4.96	18.4	6.56	5.91	4.84
	Cation - Anion Balance (%)	0.4	-1.4	-1.5	0.5	-1.3
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	6.93		5.58	10.3	7.30
Total Metals	Aluminum (Al)-Total (mg/L)	0.141	0.191	0.0076	0.0541	0.132
	Antimony (Sb)-Total (mg/L)	<0.00010	0.00034	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00055	0.00071	0.00023	0.00047	0.00060
	Barium (Ba)-Total (mg/L)	0.0977	0.164	0.0699	0.0771	0.0967
	Beryllium (Be)-Total (mg/L)	<0.000020	0.000030	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.012	0.035	0.027	0.023	0.012
	Cadmium (Cd)-Total (mg/L)	0.0000253	0.000328	0.0000085	0.0000123	0.0000114
	Calcium (Ca)-Total (mg/L)	50.9	222	60.6	69.3	53.1
	Chromium (Cr)-Total (mg/L)	0.00043	0.00317	0.00012	0.00020	0.00040
	Cobalt (Co)-Total (mg/L)	0.00024	0.00097	<0.00010	0.00017	0.00023
	Copper (Cu)-Total (mg/L)	0.00289	0.151	0.00247	0.0155	0.00237
	Iron (Fe)-Total (mg/L)	0.549	1.38	0.025	0.939	0.534
	Lead (Pb)-Total (mg/L)	0.000079	0.000630	<0.000050	0.000213	0.000057
	Lithium (Li)-Total (mg/L)	0.0019	0.0047	0.0039	0.0017	0.0020
	Magnesium (Mg)-Total (mg/L)	20.5	62.8	31.6	21.0	21.2
	Manganese (Mn)-Total (mg/L)	0.152	2.80	0.0268	0.272	0.152

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2194872-6 Water 06-NOV-18 DUP	L2194872-7 Water 07-NOV-18 T-BL			
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	511	<2.0			
	Hardness (as CaCO3) (mg/L)	257	<0.50 ^{HTC}			
	pH (pH)	8.33	5.46			
	Total Suspended Solids (mg/L)	4.0	<3.0			
	TDS (Calculated) (mg/L)	310	<1.0			
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	212	<1.0			
	Alkalinity, Carbonate (as CaCO3) (mg/L)	5.4	<1.0			
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0			
	Alkalinity, Total (as CaCO3) (mg/L)	217	<1.0			
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050			
	Chloride (Cl) (mg/L)	6.64	<0.50			
	Nitrate and Nitrite (as N) (mg/L)	0.116	<0.0051			
	Nitrate (as N) (mg/L)	0.116	<0.0050			
	Nitrite (as N) (mg/L)	<0.0010	<0.0010			
	Sulfate (SO4) (mg/L)	64.1	<0.30			
	Anion Sum (meq/L)	5.87	<0.10			
	Cation Sum (meq/L)	5.90	<0.10			
	Cation - Anion Balance (%)	0.2	0.0			
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	10.4				
Total Metals	Aluminum (Al)-Total (mg/L)	0.0400	<0.0030			
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010			
	Arsenic (As)-Total (mg/L)	0.00047	<0.00010			
	Barium (Ba)-Total (mg/L)	0.0759	<0.00010			
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020			
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050			
	Boron (B)-Total (mg/L)	0.023	<0.010			
	Cadmium (Cd)-Total (mg/L)	0.0000097	<0.0000050			
	Calcium (Ca)-Total (mg/L)	68.5	<0.050			
	Chromium (Cr)-Total (mg/L)	0.00018	<0.00010			
	Cobalt (Co)-Total (mg/L)	0.00016	<0.00010			
	Copper (Cu)-Total (mg/L)	0.0136	<0.00050			
	Iron (Fe)-Total (mg/L)	0.797	<0.010			
	Lead (Pb)-Total (mg/L)	0.000215	<0.000050			
	Lithium (Li)-Total (mg/L)	0.0016	<0.0010			
	Magnesium (Mg)-Total (mg/L)	20.5	<0.10			
	Manganese (Mn)-Total (mg/L)	0.273	<0.00010			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2194872-1 Water 04-NOV-18 13:40 W46	L2194872-2 Water 06-NOV-18 09:30 W8A	L2194872-3 Water 06-NOV-18 09:55 W3	L2194872-4 Water 06-NOV-18 10:10 W17	L2194872-5 Water 04-NOV-18 DUP
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	0.0000077	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.00176	0.0141	0.00494	0.00654	0.00185
	Nickel (Ni)-Total (mg/L)	0.00118	0.00194	0.00095	0.00107	0.00121
	Phosphorus (P)-Total (mg/L)	<0.050	0.076	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	1.65	8.46	2.44	3.73	1.68
	Selenium (Se)-Total (mg/L)	0.000204	0.00684	0.000356	0.000387	0.000192
	Silicon (Si)-Total (mg/L)	7.29	8.88	6.94	6.06	7.36
	Silver (Ag)-Total (mg/L)	<0.000010	0.000046	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	13.3	56.7	20.2	15.1	13.2
	Strontium (Sr)-Total (mg/L)	0.593	3.10	0.885	0.778	0.625
	Sulfur (S)-Total (mg/L)	11.7	141	22.5	23.1	11.9
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	0.000011	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	0.00012	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	0.00657	0.0107	0.00035	0.00321	0.00625
	Uranium (U)-Total (mg/L)	0.00177	0.00459	0.00303	0.00231	0.00178
	Vanadium (V)-Total (mg/L)	0.00109	0.00307	<0.00050	0.00080	0.00111
	Zinc (Zn)-Total (mg/L)	<0.0030	0.502	<0.0030	0.0197	<0.0030
	Zirconium (Zr)-Total (mg/L)	<0.00030	0.00058	<0.00030	<0.00030	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0042	0.0098	0.0032	0.0018	0.0053
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00044	0.00049	0.00021	0.00034	0.00046
	Barium (Ba)-Dissolved (mg/L)	0.0856	0.153	0.0679	0.0681	0.0883
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.011	0.034	0.026	0.022	0.011
	Cadmium (Cd)-Dissolved (mg/L)	0.0000191	0.000286	0.0000139	<0.0000050	0.0000097
	Calcium (Ca)-Dissolved (mg/L)	51.8	208	59.5	67.8	49.8
	Chromium (Cr)-Dissolved (mg/L)	0.00015	0.00078	<0.00010	0.00010	0.00012
	Cobalt (Co)-Dissolved (mg/L)	0.00013	0.00087	<0.00010	<0.00010	0.00013
	Copper (Cu)-Dissolved (mg/L)	0.00155	0.0814	0.00245	0.00743	0.00158
	Iron (Fe)-Dissolved (mg/L)	0.296	0.415	0.015	0.015	0.302
	Lead (Pb)-Dissolved (mg/L)	<0.000050	0.000055	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0018	0.0045	0.0038	0.0016	0.0018
	Magnesium (Mg)-Dissolved (mg/L)	21.0	62.0	31.9	21.4	20.8
	Manganese (Mn)-Dissolved (mg/L)	0.137	2.71	0.0241	0.0190	0.135

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2194872-6 Water 06-NOV-18 DUP	L2194872-7 Water 07-NOV-18 T-BL		
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050			
	Molybdenum (Mo)-Total (mg/L)	0.00636	<0.000050			
	Nickel (Ni)-Total (mg/L)	0.00104	<0.00050			
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050			
	Potassium (K)-Total (mg/L)	3.68	<0.10			
	Selenium (Se)-Total (mg/L)	0.000381	<0.000050			
	Silicon (Si)-Total (mg/L)	6.00	<0.10			
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010			
	Sodium (Na)-Total (mg/L)	14.6	<0.050			
	Strontium (Sr)-Total (mg/L)	0.768	<0.00020			
	Sulfur (S)-Total (mg/L)	22.6	<0.50			
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010			
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010			
	Titanium (Ti)-Total (mg/L)	0.00198	<0.00030			
	Uranium (U)-Total (mg/L)	0.00232	<0.000010			
	Vanadium (V)-Total (mg/L)	0.00075	<0.00050			
	Zinc (Zn)-Total (mg/L)	0.0192	<0.0030			
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030			
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD				
	Dissolved Metals Filtration Location	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	0.0020				
	Antimony (Sb)-Dissolved (mg/L)	<0.00010				
	Arsenic (As)-Dissolved (mg/L)	0.00037				
	Barium (Ba)-Dissolved (mg/L)	0.0698				
	Beryllium (Be)-Dissolved (mg/L)	<0.000020				
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050				
	Boron (B)-Dissolved (mg/L)	0.022				
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050				
	Calcium (Ca)-Dissolved (mg/L)	67.4				
	Chromium (Cr)-Dissolved (mg/L)	0.00028				
	Cobalt (Co)-Dissolved (mg/L)	<0.00010				
	Copper (Cu)-Dissolved (mg/L)	0.00730				
	Iron (Fe)-Dissolved (mg/L)	0.016				
	Lead (Pb)-Dissolved (mg/L)	<0.000050				
	Lithium (Li)-Dissolved (mg/L)	0.0015				
	Magnesium (Mg)-Dissolved (mg/L)	21.6				
	Manganese (Mn)-Dissolved (mg/L)	0.0187				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2194872-1 Water 04-NOV-18 13:40 W46	L2194872-2 Water 06-NOV-18 09:30 W8A	L2194872-3 Water 06-NOV-18 09:55 W3	L2194872-4 Water 06-NOV-18 10:10 W17	L2194872-5 Water 04-NOV-18 DUP
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00171	0.0134	0.00453	0.00589	0.00167
	Nickel (Ni)-Dissolved (mg/L)	0.00089	0.00150	0.00078	0.00075	0.00082
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	1.66	8.54	2.45	3.65	1.64
	Selenium (Se)-Dissolved (mg/L)	0.000166	0.00675	0.000316	0.000332	0.000164
	Silicon (Si)-Dissolved (mg/L)	6.74	8.02	6.23	5.59	6.77
	Silver (Ag)-Dissolved (mg/L)	<0.000010	0.000014	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	13.4	57.9	20.6	15.5	13.2
	Strontium (Sr)-Dissolved (mg/L)	0.584	2.92	0.801	0.721	0.556
	Sulfur (S)-Dissolved (mg/L)	11.3	133	20.5	21.8	11.5
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00038	<0.0012 ^{DLM}	<0.00030	<0.00030	0.00036
	Uranium (U)-Dissolved (mg/L)	0.00172	0.00446	0.00287	0.00221	0.00171
	Vanadium (V)-Dissolved (mg/L)	0.00051	0.00153 ^{DTC}	<0.00050	<0.00050	0.00054
	Zinc (Zn)-Dissolved (mg/L)	0.0013	0.881	0.0026	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	0.00054	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2194872-6 Water 06-NOV-18 DUP	L2194872-7 Water 07-NOV-18 T-BL			
Grouping	Analyte						
WATER							
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050					
	Molybdenum (Mo)-Dissolved (mg/L)	0.00614					
	Nickel (Ni)-Dissolved (mg/L)	0.00074					
	Phosphorus (P)-Dissolved (mg/L)	<0.050					
	Potassium (K)-Dissolved (mg/L)	3.62					
	Selenium (Se)-Dissolved (mg/L)	0.000397					
	Silicon (Si)-Dissolved (mg/L)	5.60					
	Silver (Ag)-Dissolved (mg/L)	<0.000020 ^{DLM}					
	Sodium (Na)-Dissolved (mg/L)	15.2					
	Strontium (Sr)-Dissolved (mg/L)	0.748					
	Sulfur (S)-Dissolved (mg/L)	21.7					
	Thallium (Tl)-Dissolved (mg/L)	<0.000010					
	Tin (Sn)-Dissolved (mg/L)	<0.00010					
	Titanium (Ti)-Dissolved (mg/L)	<0.00030					
	Uranium (U)-Dissolved (mg/L)	0.00217					
	Vanadium (V)-Dissolved (mg/L)	<0.00050					
	Zinc (Zn)-Dissolved (mg/L)	<0.0010					
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Manganese (Mn)-Dissolved	B	L2194872-2
Matrix Spike	Dissolved Organic Carbon	MS-B	L2194872-1, -3, -4, -5, -6
Matrix Spike	Dissolved Organic Carbon	MS-B	L2194872-1, -3, -4, -5, -6
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2194872-1, -2, -3, -4, -5, -6
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2194872-2
Matrix Spike	Boron (B)-Dissolved	MS-B	L2194872-2
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2194872-1, -2, -3, -4, -5, -6
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2194872-2
Matrix Spike	Chromium (Cr)-Dissolved	MS-B	L2194872-2
Matrix Spike	Iron (Fe)-Dissolved	MS-B	L2194872-2
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2194872-1, -2, -3, -4, -5, -6
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2194872-2
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2194872-2
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2194872-2
Matrix Spike	Silicon (Si)-Dissolved	MS-B	L2194872-2
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2194872-1, -2, -3, -4, -5, -6
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2194872-2
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2194872-1, -2, -3, -4, -5, -6
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2194872-2
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2194872-1, -2, -3, -4, -5, -6
Matrix Spike	Barium (Ba)-Total	MS-B	L2194872-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Calcium (Ca)-Total	MS-B	L2194872-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Copper (Cu)-Total	MS-B	L2194872-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2194872-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Manganese (Mn)-Total	MS-B	L2194872-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Potassium (K)-Total	MS-B	L2194872-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Sodium (Na)-Total	MS-B	L2194872-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Strontium (Sr)-Total	MS-B	L2194872-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Sulfur (S)-Total	MS-B	L2194872-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Uranium (U)-Total	MS-B	L2194872-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Zinc (Zn)-Total	MS-B	L2194872-1, -2, -3, -4, -5, -6, -7

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DTC	Dissolved concentration exceeds total. Results were confirmed by re-analysis.
HTC	Hardness was calculated from Total Ca and/or Mg concentrations and may be biased high (dissolved Ca/Mg results unavailable).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-WR	Water	Nitrite & Nitrate Nitrogen	EPA 300.1
Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance.			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Reference Information

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

CARBONS-DOC-VA Water Dissolved organic carbon by combustion APHA 5310B

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.

CL-IC-N-WR Water Chloride in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

EC-PCT-VA Water Conductivity (Automated) APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-SCREEN-VA Water Conductivity Screen (Internal Use Only) APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = \frac{[\text{Cation Sum} - \text{Anion Sum}]}{[\text{Cation Sum} + \text{Anion Sum}]}$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-WR Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Reference Information

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
----------------------------	---------------------

WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
----	---

VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
----	---

Chain of Custody Numbers:

2018-11-07 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2194872-COFC

COC Number: 2018-11-07 A

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REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

OCTOBER 2015 FRONT



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 16-NOV-18
Report Date: 27-NOV-18 14:39 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2197846
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-11-14 A
Legal Site Desc:

Shane Stack
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2197846-1 Water 10-NOV-18 10:30 UG1	L2197846-2 Water 10-NOV-18 15:15 UG4	L2197846-3 Water 13-NOV-18 10:10 W3	L2197846-4 Water 13-NOV-18 10:15 W17	L2197846-5 Water 13-NOV-18 10:45 W8A
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	1840	1730	551	501	1480
	Hardness (as CaCO3) (mg/L)	1020	937	283	251	786
	pH (pH)	7.90	8.10	8.05	8.24	7.72
	Total Suspended Solids (mg/L)	67.2	10.4	<3.0	<3.0	18.0
	TDS (Calculated) (mg/L)	1540	1380	330	298	1050
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	182	185	250	209	537
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	182	185	250	209	537
	Ammonia, Total (as N) (mg/L)	2.20	0.115	0.0128	0.0077	0.298
	Chloride (Cl) (mg/L)	13.1	24.5	4.50	6.40	13.2
	Nitrate and Nitrite (as N) (mg/L)	3.52	0.661	0.163	0.105	5.69
	Nitrate (as N) (mg/L)	3.13	0.563	0.163	0.105	5.33
	Nitrite (as N) (mg/L)	0.387	0.0980	<0.0010	<0.0010	0.369
	Sulfate (SO4) (mg/L)	939	830	60.4	61.3	348
	Anion Sum (meq/L)	23.8	21.7	6.39	5.65	18.7
	Cation Sum (meq/L)	23.7	21.7	6.57	5.70	18.3
	Cation - Anion Balance (%)	-0.2	0.0	1.4	0.5	-1.2
	Organic / Inorganic Carbon			5.74	10.2	
Total Metals	Aluminum (Al)-Total (mg/L)	2.48	0.0448	0.0639	0.0107	0.0773
	Antimony (Sb)-Total (mg/L)	0.00019	<0.00010	<0.00010	0.00011	0.00011
	Arsenic (As)-Total (mg/L)	0.00110	0.00112	0.00026	0.00038	0.00059
	Barium (Ba)-Total (mg/L)	0.0682	0.0190	0.0697	0.0666	0.173
	Beryllium (Be)-Total (mg/L)	0.000069	0.000021	<0.000020	<0.000020	0.000023
	Bismuth (Bi)-Total (mg/L)	0.000063	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.303	0.141	0.028	0.024	0.038
	Cadmium (Cd)-Total (mg/L)	0.000527	0.000209	0.0000278	0.0000075	0.000313
	Calcium (Ca)-Total (mg/L)	369	320	64.5	71.7	231
	Chromium (Cr)-Total (mg/L)	0.00127	0.00012	0.00017	0.00014	0.00083
	Cobalt (Co)-Total (mg/L)	0.00175	0.00029	<0.00010	<0.00010	0.00089
	Copper (Cu)-Total (mg/L)	0.630	0.0883	0.0121	0.0118	0.127
	Iron (Fe)-Total (mg/L)	4.26	0.093	0.128	0.040	1.69
	Lead (Pb)-Total (mg/L)	0.00183	0.000059	0.000056	0.000064	0.000081
	Lithium (Li)-Total (mg/L)	0.0098	0.0079	0.0033	0.0015	0.0043
	Magnesium (Mg)-Total (mg/L)	45.6	46.9	31.3	20.7	63.8
	Manganese (Mn)-Total (mg/L)	0.226	0.0940	0.0654	0.0255	3.12

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2197846-6 Water 13-NOV-18 DUP	L2197846-7 Water 14-NOV-18 07:40 T-BL			
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	554	<2.0			
	Hardness (as CaCO3) (mg/L)	280	<0.50 ^{HTC}			
	pH (pH)	8.07	5.56			
	Total Suspended Solids (mg/L)	<3.0	<3.0			
	TDS (Calculated) (mg/L)	326	<1.0			
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	246	<1.0			
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0			
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0			
	Alkalinity, Total (as CaCO3) (mg/L)	246	<1.0			
	Ammonia, Total (as N) (mg/L)	0.0111	<0.0050			
	Chloride (Cl) (mg/L)	4.49	<0.50			
	Nitrate and Nitrite (as N) (mg/L)	0.161	<0.0051			
	Nitrate (as N) (mg/L)	0.161	<0.0050			
	Nitrite (as N) (mg/L)	<0.0010	<0.0010			
	Sulfate (SO4) (mg/L)	60.4	<0.30			
	Anion Sum (meq/L)	6.31	<0.10			
	Cation Sum (meq/L)	6.47	<0.10			
	Cation - Anion Balance (%)	1.2	0.0			
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	5.91				
Total Metals	Aluminum (Al)-Total (mg/L)	0.0578	<0.0030			
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010			
	Arsenic (As)-Total (mg/L)	0.00025	<0.00010			
	Barium (Ba)-Total (mg/L)	0.0730	<0.00010			
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020			
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050			
	Boron (B)-Total (mg/L)	0.028	<0.010			
	Cadmium (Cd)-Total (mg/L)	0.0000291	<0.0000050			
	Calcium (Ca)-Total (mg/L)	64.9	<0.050			
	Chromium (Cr)-Total (mg/L)	0.00021	<0.00010			
	Cobalt (Co)-Total (mg/L)	0.00010	<0.00010			
	Copper (Cu)-Total (mg/L)	0.0130	<0.00050			
	Iron (Fe)-Total (mg/L)	0.126	<0.010			
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050			
	Lithium (Li)-Total (mg/L)	0.0033	<0.0010			
	Magnesium (Mg)-Total (mg/L)	31.4	<0.10			
	Manganese (Mn)-Total (mg/L)	0.0653	<0.00010			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2197846-1 Water 10-NOV-18 10:30 UG1	L2197846-2 Water 10-NOV-18 15:15 UG4	L2197846-3 Water 13-NOV-18 10:10 W3	L2197846-4 Water 13-NOV-18 10:15 W17	L2197846-5 Water 13-NOV-18 10:45 W8A
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.0176	0.0192	0.00506	0.00636	0.0140
	Nickel (Ni)-Total (mg/L)	0.00125	<0.00050	0.00101	0.00070	0.00143
	Phosphorus (P)-Total (mg/L)	0.097	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	8.17	4.27	2.27	3.36	8.17
	Selenium (Se)-Total (mg/L)	0.00153	0.00227	0.000319	0.000343	0.00635
	Silicon (Si)-Total (mg/L)	12.2	7.41	6.75	5.84	8.69
	Silver (Ag)-Total (mg/L)	0.000217	0.000010	<0.000010	<0.000010	0.000027
	Sodium (Na)-Total (mg/L)	68.8	66.1	18.1	14.1	53.0
	Strontium (Sr)-Total (mg/L)	8.23	6.69	0.871	0.780	3.20
	Sulfur (S)-Total (mg/L)	362	320	21.8	22.2	136
	Thallium (Tl)-Total (mg/L)	0.000035	0.000011	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	0.00013	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	0.184	<0.0027 ^{DLM}	0.00397	<0.00060 ^{DLM}	<0.0051 ^{DLM}
	Uranium (U)-Total (mg/L)	0.00994	0.00752	0.00287	0.00215	0.00471
	Vanadium (V)-Total (mg/L)	0.00921	0.00065	0.00064	<0.00050	0.00261
	Zinc (Zn)-Total (mg/L)	0.0333	0.0035	0.0073	0.0057	0.191
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	0.00063
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0492	0.0022	0.0029	0.0017	0.0081
	Antimony (Sb)-Dissolved (mg/L)	0.00015	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00078	0.00097	0.00022	0.00034	0.00048
	Barium (Ba)-Dissolved (mg/L)	0.0166	0.0156	0.0633	0.0599	0.138
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.265	0.120	0.027	0.023	0.032
	Cadmium (Cd)-Dissolved (mg/L)	0.000277	0.000234	0.0000125	<0.0000050	0.000290
	Calcium (Ca)-Dissolved (mg/L)	337	299	59.2	66.3	213
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00011	0.00056
	Cobalt (Co)-Dissolved (mg/L)	0.00046	0.00029	<0.00010	<0.00010	0.00075
	Copper (Cu)-Dissolved (mg/L)	0.0717	0.0753	0.00263	0.00729	0.0720
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	0.027	<0.010	0.392
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0085	0.0076	0.0031	0.0014	0.0041
	Magnesium (Mg)-Dissolved (mg/L)	43.1	46.1	32.8	20.7	61.7
	Manganese (Mn)-Dissolved (mg/L)	0.106	0.0910	0.0519	0.0185	2.78

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ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2197846-6 Water 13-NOV-18 DUP	L2197846-7 Water 14-NOV-18 07:40 T-BL		
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050			
	Molybdenum (Mo)-Total (mg/L)	0.00512	<0.000050			
	Nickel (Ni)-Total (mg/L)	0.00101	<0.00050			
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050			
	Potassium (K)-Total (mg/L)	2.29	<0.10			
	Selenium (Se)-Total (mg/L)	0.000370	<0.000050			
	Silicon (Si)-Total (mg/L)	6.97	<0.10			
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010			
	Sodium (Na)-Total (mg/L)	18.4	<0.050			
	Strontium (Sr)-Total (mg/L)	0.857	<0.00020			
	Sulfur (S)-Total (mg/L)	22.6	<0.50			
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010			
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010			
	Titanium (Ti)-Total (mg/L)	0.00369	<0.00030			
	Uranium (U)-Total (mg/L)	0.00293	<0.000010			
	Vanadium (V)-Total (mg/L)	0.00058	<0.00050			
	Zinc (Zn)-Total (mg/L)	0.0067	<0.0030			
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030			
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD				
	Dissolved Metals Filtration Location	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	0.0023				
	Antimony (Sb)-Dissolved (mg/L)	<0.00010				
	Arsenic (As)-Dissolved (mg/L)	0.00024				
	Barium (Ba)-Dissolved (mg/L)	0.0615				
	Beryllium (Be)-Dissolved (mg/L)	<0.000020				
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050				
	Boron (B)-Dissolved (mg/L)	0.024				
	Cadmium (Cd)-Dissolved (mg/L)	0.0000128				
	Calcium (Ca)-Dissolved (mg/L)	59.9				
	Chromium (Cr)-Dissolved (mg/L)	0.00014				
	Cobalt (Co)-Dissolved (mg/L)	<0.00010				
	Copper (Cu)-Dissolved (mg/L)	0.00260				
	Iron (Fe)-Dissolved (mg/L)	0.027				
	Lead (Pb)-Dissolved (mg/L)	<0.000050				
	Lithium (Li)-Dissolved (mg/L)	0.0032				
	Magnesium (Mg)-Dissolved (mg/L)	31.6				
	Manganese (Mn)-Dissolved (mg/L)	0.0504				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2197846-1 Water 10-NOV-18 10:30 UG1	L2197846-2 Water 10-NOV-18 15:15 UG4	L2197846-3 Water 13-NOV-18 10:10 W3	L2197846-4 Water 13-NOV-18 10:15 W17	L2197846-5 Water 13-NOV-18 10:45 W8A
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.0162	0.0182	0.00469	0.00566	0.0129
	Nickel (Ni)-Dissolved (mg/L)	0.00066	<0.00050	0.00092	0.00068	0.0012
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	7.36	4.41	2.34	3.41	7.95
	Selenium (Se)-Dissolved (mg/L)	0.00142	0.00232	0.000348	0.000362	0.00661
	Silicon (Si)-Dissolved (mg/L)	6.75	6.68	6.26	5.36	7.75
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	0.000012
	Sodium (Na)-Dissolved (mg/L)	68.3	65.5	19.6	13.9	51.8
	Strontium (Sr)-Dissolved (mg/L)	7.60	6.34	0.818	0.702	2.95
	Sulfur (S)-Dissolved (mg/L)	309	282	20.2	19.9	117
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00090 ^{DLM}
	Uranium (U)-Dissolved (mg/L)	0.00910	0.00710	0.00264	0.00206	0.00414
	Vanadium (V)-Dissolved (mg/L)	0.00059	<0.00050	<0.00050	<0.00050	0.00153
	Zinc (Zn)-Dissolved (mg/L)	0.0093	0.0031	0.0035	0.0015	0.144
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	0.00060

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2197846-6 Water 13-NOV-18 DUP	L2197846-7 Water 14-NOV-18 07:40 T-BL			
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050				
	Molybdenum (Mo)-Dissolved (mg/L)	0.00462				
	Nickel (Ni)-Dissolved (mg/L)	0.00088				
	Phosphorus (P)-Dissolved (mg/L)	<0.050				
	Potassium (K)-Dissolved (mg/L)	2.30				
	Selenium (Se)-Dissolved (mg/L)	0.000308				
	Silicon (Si)-Dissolved (mg/L)	6.23				
	Silver (Ag)-Dissolved (mg/L)	<0.000010				
	Sodium (Na)-Dissolved (mg/L)	18.8				
	Strontium (Sr)-Dissolved (mg/L)	0.813				
	Sulfur (S)-Dissolved (mg/L)	20.1				
	Thallium (Tl)-Dissolved (mg/L)	<0.000010				
	Tin (Sn)-Dissolved (mg/L)	<0.00010				
	Titanium (Ti)-Dissolved (mg/L)	<0.00030				
	Uranium (U)-Dissolved (mg/L)	0.00270				
	Vanadium (V)-Dissolved (mg/L)	<0.00050				
	Zinc (Zn)-Dissolved (mg/L)	0.0031				
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030				

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Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Dissolved Organic Carbon	MS-B	L2197846-3, -4, -6
Matrix Spike	Dissolved Organic Carbon	MS-B	L2197846-3, -4, -6
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2197846-1, -2, -3, -4, -5, -6
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2197846-1, -2, -3, -4, -5, -6
Matrix Spike	Copper (Cu)-Dissolved	MS-B	L2197846-1, -2, -3, -4, -5, -6
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2197846-1, -2, -3, -4, -5, -6
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2197846-1, -2, -3, -4, -5, -6
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2197846-1, -2, -3, -4, -5, -6
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2197846-1, -2, -3, -4, -5, -6
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2197846-1, -2, -3, -4, -5, -6
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2197846-1, -2, -3, -4, -5, -6
Matrix Spike	Uranium (U)-Dissolved	MS-B	L2197846-1, -2, -3, -4, -5, -6
Matrix Spike	Boron (B)-Total	MS-B	L2197846-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Calcium (Ca)-Total	MS-B	L2197846-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Copper (Cu)-Total	MS-B	L2197846-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2197846-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Manganese (Mn)-Total	MS-B	L2197846-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Potassium (K)-Total	MS-B	L2197846-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Sodium (Na)-Total	MS-B	L2197846-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Sodium (Na)-Total	MS-B	L2197846-7
Matrix Spike	Strontium (Sr)-Total	MS-B	L2197846-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Sulfur (S)-Total	MS-B	L2197846-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Uranium (U)-Total	MS-B	L2197846-1, -2, -3, -4, -5, -6, -7

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
HTC	Hardness was calculated from Total Ca and/or Mg concentrations and may be biased high (dissolved Ca/Mg results unavailable).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-WR	Water	Nitrite & Nitrate Nitrogen	EPA 300.1
Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance.			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-WR	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			

Reference Information

EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 µm), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Weston et al.			
NO2-L-IC-N-WR	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-WR	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
SO4-IC-WR	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)
This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".			
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.			
TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Reference Information

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-11-14 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lw - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

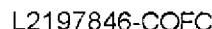
Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white-report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FROM

Read



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 22-NOV-18
Report Date: 10-DEC-18 18:49 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2200308
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-11-21 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2200308-1 Water 18-NOV-18 12:00 W15	L2200308-2 Water 18-NOV-18 15:50 W12	L2200308-3 Water 18-NOV-18 16:40 W62	L2200308-4 Water 19-NOV-18 08:45 W8A	L2200308-5 Water 19-NOV-18 09:30 W10
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	1300	2150	1190	1470	450
	Hardness (as CaCO3) (mg/L)	753	1060	668	824	246
	pH (pH)	8.34	8.21	8.19	8.24	8.12
	Total Suspended Solids (mg/L)	4.8	10.6	4.8	30.8	63.4
	TDS (Calculated) (mg/L)	974	1820	854	1100	296
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	396	226	380	566	180
	Alkalinity, Carbonate (as CaCO3) (mg/L)	10.4	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	406	226	380	566	180
	Ammonia, Total (as N) (mg/L)	0.125	3.17	0.0128	0.373	0.0729
	Chloride (Cl) (mg/L)	5.9	30.7	31.2	14.2	0.87
	Nitrate and Nitrite (as N) (mg/L)	18.2	7.40	9.89	5.56	16.2
	Nitrate (as N) (mg/L)	18.1	5.26	9.84	5.11	16.2
	Nitrite (as N) (mg/L)	0.0561	2.15	0.0462	0.452	0.0083
	Sulfate (SO4) (mg/L)	348	1090	278	362	12.5
	Anion Sum (meq/L)	16.8	28.6	15.0	19.7	5.03
	Cation Sum (meq/L)	16.5	27.1	15.0	19.5	5.54
	Cation - Anion Balance (%)	-1.0	-2.7	0.1	-0.5	4.7
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)		12.1			3.03
Total Metals	Aluminum (Al)-Total (mg/L)	0.0392	0.0793	0.0195	0.0798	0.110
	Antimony (Sb)-Total (mg/L)	0.00017	0.00030	0.00019	0.00025	0.00012
	Arsenic (As)-Total (mg/L)	0.00055	0.00049	0.00051	0.00060	0.00034
	Barium (Ba)-Total (mg/L)	0.172	0.0676	0.115	0.165	0.309
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000040 ^{DLA}	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.00010 ^{DLA}	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	<0.010	0.233 ^{DLM}	0.027	0.036	0.013
	Cadmium (Cd)-Total (mg/L)	0.0000718	<0.00012	0.0000390	0.000339	0.0000459
	Calcium (Ca)-Total (mg/L)	193	320	184	215	67.9
	Chromium (Cr)-Total (mg/L)	0.00047	0.00032	0.00045	0.00234	0.00028
	Cobalt (Co)-Total (mg/L)	0.00033	0.00085	0.00017	0.00088	0.00060
	Copper (Cu)-Total (mg/L)	0.0398	0.0856	0.0726	0.123	0.00446
	Iron (Fe)-Total (mg/L)	0.340	0.186	0.123	1.20	2.56
	Lead (Pb)-Total (mg/L)	<0.000050	0.00010	<0.000050	0.000325	0.000081
	Lithium (Li)-Total (mg/L)	0.0015	0.0145	0.0034	0.0044	0.0012
	Magnesium (Mg)-Total (mg/L)	60.8	60.5	50.5	61.9	16.6
	Manganese (Mn)-Total (mg/L)	0.223	0.682	0.0410	3.05	0.483

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2200308-6 Water 19-NOV-18 10:05 W30	L2200308-7 Water 19-NOV-18 14:30 W16	L2200308-8 Water 20-NOV-18 08:05 W3	L2200308-9 Water 20-NOV-18 08:25 W17	L2200308-10 Water 18-NOV-18 DUP
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	653	489	538	496	1200
	Hardness (as CaCO3) (mg/L)	327	246	272	248	707
	pH (pH)	8.37	8.39	8.40	8.42	8.16
	Total Suspended Solids (mg/L)	<3.0	<3.0	3.0	<3.0	<3.0
	TDS (Calculated) (mg/L)	421	303	325	303	867
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	232	190	240	209	382
	Alkalinity, Carbonate (as CaCO3) (mg/L)	7.8	7.0	10.2	9.8	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	240	197	250	219	382
	Ammonia, Total (as N) (mg/L)	0.0242	0.0251	0.0085	<0.0050	0.0114
	Chloride (Cl) (mg/L)	3.02	6.49	4.38	6.49	30.8
	Nitrate and Nitrite (as N) (mg/L)	0.159	1.15	0.161	0.0929	9.75
	Nitrate (as N) (mg/L)	0.156	1.15	0.161	0.0929	9.70
	Nitrite (as N) (mg/L)	0.0031	0.0030	<0.0010	<0.0010	0.0473
	Sulfate (SO4) (mg/L)	138	71.7	59.9	61.1	273
	Anion Sum (meq/L)	7.77	5.68	6.38	5.83	14.9
	Cation Sum (meq/L)	7.59	5.59	6.32	5.69	15.8
	Cation - Anion Balance (%)	-1.2	-0.8	-0.5	-1.2	3.0
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)		15.9	6.23	10.1	
Total Metals	Aluminum (Al)-Total (mg/L)	0.0105	0.0158	0.0838	0.0033	0.0683
	Antimony (Sb)-Total (mg/L)	<0.00010	0.00010	<0.00010	<0.00010	0.00019
	Arsenic (As)-Total (mg/L)	0.00089	0.00040	0.00025	0.00041	0.00054
	Barium (Ba)-Total (mg/L)	0.131	0.0771	0.0732	0.0697	0.116
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.017	0.017	0.025	0.023	0.027
	Cadmium (Cd)-Total (mg/L)	0.0000086	0.0000149	0.0000061	<0.0000050	0.0000352
	Calcium (Ca)-Total (mg/L)	72.9	64.4	58.6	65.9	184
	Chromium (Cr)-Total (mg/L)	0.00026	0.00024	0.00018	0.00017	0.00041
	Cobalt (Co)-Total (mg/L)	0.00013	<0.00010	0.00011	<0.00010	0.00019
	Copper (Cu)-Total (mg/L)	0.0205	0.0260	0.00377	0.00728	0.0925
	Iron (Fe)-Total (mg/L)	0.115	0.041	0.147	<0.010	0.255
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	0.000116
	Lithium (Li)-Total (mg/L)	0.0032	0.0014	0.0035	0.0016	0.0034
	Magnesium (Mg)-Total (mg/L)	33.7	19.8	29.8	21.2	50.8
	Manganese (Mn)-Total (mg/L)	0.496	0.0128	0.0854	0.0153	0.0436

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2200308-1 Water 18-NOV-18 12:00 W15	L2200308-2 Water 18-NOV-18 15:50 W12	L2200308-3 Water 18-NOV-18 16:40 W62	L2200308-4 Water 19-NOV-18 08:45 W8A	L2200308-5 Water 19-NOV-18 09:30 W10
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.00323	0.0538	0.00971	0.0128	0.000738
	Nickel (Ni)-Total (mg/L)	0.00099	0.0039	0.00114	0.00148	<0.00050
	Phosphorus (P)-Total (mg/L)	<0.050	<0.10 ^{DLA}	<0.050	0.067	<0.050
	Potassium (K)-Total (mg/L)	6.85	35.6	6.19	7.65	1.79
	Selenium (Se)-Total (mg/L)	0.00654	0.00586	0.00333	0.00577	0.000180
	Silicon (Si)-Total (mg/L)	8.11	4.86	7.71	8.28	3.56
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000020 ^{DLA}	0.000017	0.000034	<0.000010
	Sodium (Na)-Total (mg/L)	27.9	105	32.2	53.4	11.8
	Strontium (Sr)-Total (mg/L)	1.71	5.55	1.99	2.87	0.406
	Sulfur (S)-Total (mg/L)	127	380	99.2	128	5.09
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000020 ^{DLA}	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010 ^{DLM}	<0.00020 ^{DLA}	<0.00010 ^{DLM}	<0.00010 ^{DLM}	<0.00010
	Titanium (Ti)-Total (mg/L)	<0.0030	<0.0033 ^{DLM}	<0.0012 ^{DLM}	<0.0048 ^{DLM}	0.00412
	Uranium (U)-Total (mg/L)	0.00501	0.00678	0.00610	0.00477	0.000125
	Vanadium (V)-Total (mg/L)	0.00061	<0.0010 ^{DLA}	0.00075	0.00232	<0.00050
	Zinc (Zn)-Total (mg/L)	0.0107	<0.0060 ^{DLA}	0.0625	0.328	0.0110
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	0.00059	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0050	0.0047	0.0041	0.0102	0.0092
	Antimony (Sb)-Dissolved (mg/L)	0.00014	0.00026	0.00011	0.00011	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00057	0.00047	0.00052	0.00052	0.00018
	Barium (Ba)-Dissolved (mg/L)	0.165	0.0640	0.112	0.153	0.259
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000040 ^{DLA}	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.00010 ^{DLA}	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	<0.010	0.222 ^{DLM}	0.027	0.036	0.013
	Cadmium (Cd)-Dissolved (mg/L)	0.0000626	<0.00011 ^{DLM}	0.0000328	0.000378	0.0000411
	Calcium (Ca)-Dissolved (mg/L)	196	321 ^{DLA}	179	222	71.8
	Chromium (Cr)-Dissolved (mg/L)	0.00025	<0.00020	0.00034	0.00101	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	0.00030	0.00078	0.00016	0.00087	0.00054
	Copper (Cu)-Dissolved (mg/L)	0.0329	0.0641 ^{DLA}	0.0651	0.0765	0.00175
	Iron (Fe)-Dissolved (mg/L)	0.057	<0.020 ^{DLA}	0.039	0.405	0.544
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.00010 ^{DLA}	<0.000050	0.000089	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0015	0.0138	0.0034	0.0047	0.0011
	Magnesium (Mg)-Dissolved (mg/L)	64.1	62.4	53.7	65.5	16.2
	Manganese (Mn)-Dissolved (mg/L)	0.224	0.707	0.0411	3.35	0.482

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2200308-6 Water 19-NOV-18 10:05 W30	L2200308-7 Water 19-NOV-18 14:30 W16	L2200308-8 Water 20-NOV-18 08:05 W3	L2200308-9 Water 20-NOV-18 08:25 W17	L2200308-10 Water 18-NOV-18 DUP
Grouping	Analyte						
WATER							
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.00336	0.00313	0.00501	0.00596	0.00941	0.00941
	Nickel (Ni)-Total (mg/L)	0.00076	0.00068	0.00083	0.00056	0.00131	0.00131
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	5.73	2.88	2.32	3.82	6.47	6.47
	Selenium (Se)-Total (mg/L)	0.000799	0.000674	0.000311	0.000360	0.00342	0.00342
	Silicon (Si)-Total (mg/L)	3.07	3.92	6.43	5.53	7.73	7.73
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	0.000017	0.000017
	Sodium (Na)-Total (mg/L)	20.7	13.8	19.1	14.8	32.5	32.5
	Strontium (Sr)-Total (mg/L)	0.981	0.603	0.806	0.702	1.89	1.89
	Sulfur (S)-Total (mg/L)	47.2	24.7	20.6	20.9	97.0	97.0
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	<0.00060 ^{DLM}	0.00096	0.00394	<0.00030	0.00459	0.00459
	Uranium (U)-Total (mg/L)	0.000926	0.00152	0.00301	0.00232	0.00610	0.00610
	Vanadium (V)-Total (mg/L)	<0.00050	<0.00050	0.00061	<0.00050	0.00094	0.00094
	Zinc (Zn)-Total (mg/L)	0.0048	0.0091	<0.0030	<0.0030	0.0967	0.0967
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0024	0.0021	0.0020	0.0012	0.0035	0.0035
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	0.00013	0.00013
	Arsenic (As)-Dissolved (mg/L)	0.00094	0.00039	0.00022	0.00039	0.00050	0.00050
	Barium (Ba)-Dissolved (mg/L)	0.127	0.0737	0.0673	0.0647	0.113	0.113
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.016	0.017	0.024	0.021	0.029	0.029
	Cadmium (Cd)-Dissolved (mg/L)	0.0000085	0.0000057	<0.0000050	<0.0000050	0.0000409	0.0000409
	Calcium (Ca)-Dissolved (mg/L)	72.6	63.9	58.5	64.0	195	195
	Chromium (Cr)-Dissolved (mg/L)	0.00015	0.00013	<0.00010	<0.00010	0.00037	0.00037
	Cobalt (Co)-Dissolved (mg/L)	0.00011	<0.00010	<0.00010	<0.00010	0.00015	0.00015
	Copper (Cu)-Dissolved (mg/L)	0.0185	0.0231	0.00236	0.00720	0.0681	0.0681
	Iron (Fe)-Dissolved (mg/L)	0.022	0.015	0.018	<0.010	0.057	0.057
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0032	0.0014	0.0034	0.0016	0.0035	0.0035
	Magnesium (Mg)-Dissolved (mg/L)	35.3	21.1	30.7	21.5	53.5	53.5
	Manganese (Mn)-Dissolved (mg/L)	0.449	0.00256	0.0561	0.0103	0.0449	0.0449

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2200308-1 Water 18-NOV-18 12:00 W15	L2200308-2 Water 18-NOV-18 15:50 W12	L2200308-3 Water 18-NOV-18 16:40 W62	L2200308-4 Water 19-NOV-18 08:45 W8A	L2200308-5 Water 19-NOV-18 09:30 W10
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00320	0.0560	0.00941	0.0127	0.000712
	Nickel (Ni)-Dissolved (mg/L)	0.00142	0.0041 ^{DLA}	0.00159	0.00143	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.10 ^{DLA}	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	6.99	33.7	6.42	9.07	1.90
	Selenium (Se)-Dissolved (mg/L)	0.00738	0.00588	0.00407	0.00714	0.000140
	Silicon (Si)-Dissolved (mg/L)	7.83	4.70 ^{DLA}	7.67	8.13	3.39
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000020 ^{DLA}	<0.000010	0.000018	<0.000010
	Sodium (Na)-Dissolved (mg/L)	28.4	111	33.6	59.1	11.9
	Strontium (Sr)-Dissolved (mg/L)	1.76	5.84	1.95	3.12	0.426
	Sulfur (S)-Dissolved (mg/L)	120	398	94.7	124	4.86
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000020 ^{DLA}	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010 ^{DLM}	<0.00020 ^{DLA}	<0.00010 ^{DLM}	<0.00010 ^{DLM}	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00060 ^{DLM}	<0.00060 ^{DLA}	<0.00060 ^{DLM}	<0.00090 ^{DLM}	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00467	0.00671 ^{DLA}	0.00559	0.00497	0.000123
	Vanadium (V)-Dissolved (mg/L)	<0.00050 ^{DLB}	<0.0010 ^{DLA}	0.00062	0.00162	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.010 ^{DLB}	0.0036	0.0562	0.300	0.0078
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	0.00063	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2200308-6 Water 19-NOV-18 10:05 W30	L2200308-7 Water 19-NOV-18 14:30 W16	L2200308-8 Water 20-NOV-18 08:05 W3	L2200308-9 Water 20-NOV-18 08:25 W17	L2200308-10 Water 18-NOV-18 DUP
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00334	0.00303	0.00477	0.00584	0.00968
	Nickel (Ni)-Dissolved (mg/L)	0.00091	0.00110	0.00109	0.00096	0.00133
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	5.58	2.77	2.19	3.49	7.08
	Selenium (Se)-Dissolved (mg/L)	0.00129 ^{DTMF}	0.000737	0.000323	0.000430	0.00416
	Silicon (Si)-Dissolved (mg/L)	3.15	4.06	6.24	5.55	7.69
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	20.6	13.8	18.8	14.8	34.6
	Strontium (Sr)-Dissolved (mg/L)	0.989	0.603	0.786	0.700	2.11
	Sulfur (S)-Dissolved (mg/L)	47.7	24.3	20.4	20.3	92.6
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00060 ^{DLM}
	Uranium (U)-Dissolved (mg/L)	0.000849	0.00145	0.00277	0.00218	0.00645
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	0.00067
	Zinc (Zn)-Dissolved (mg/L)	<0.0060 ^{DLB}	<0.0090 ^{DLB}	<0.0020 ^{DLB}	<0.0010	0.0563
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Zinc (Zn)-Dissolved	MB-LOR	L2200308-1, -2, -3, -6, -7, -8, -9
Matrix Spike	Dissolved Organic Carbon	MS-B	L2200308-7, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2200308-10, -4, -5
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2200308-10, -4, -5
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2200308-10, -4, -5
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2200308-10, -4, -5
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2200308-10, -4, -5
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2200308-10, -4, -5

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLB	Detection Limit Raised. Analyte detected at comparable level in Method Blank.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DTMF	Dissolved concentration exceeds total for field-filtered metals sample. Metallic contaminants may have been introduced to dissolved sample during field filtration.
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-WR	Water	Nitrite & Nitrate Nitrogen	EPA 300.1
Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance.			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-WR	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
		Ion Balance Calculation	APHA 1030E

Reference Information

IONBALANCE-VA Water

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-WR Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-11-21 A

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.





Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 30-NOV-18
Report Date: 11-DEC-18 17:41 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2204218
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-11-28 A
Legal Site Desc:

Shane Stack
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2204218-1 Water 27-NOV-18 07:30 W3	L2204218-2 Water 27-NOV-18 07:45 W17	L2204218-3 Water 27-NOV-18 08:00 W8A	L2204218-4 Water 27-NOV-18 DUP	L2204218-5 Water 29-NOV-18 08:15 W15
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	539	499	1500	543	1540
	Hardness (as CaCO3) (mg/L)	291	265	866	279	930
	pH (pH)	8.29	8.27	8.06	8.23	8.19
	Total Suspended Solids (mg/L)	<3.0	<3.0	13.1	<3.0	<3.0
	TDS (Calculated) (mg/L)	331	301	1120	318	1140
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	248	206	567	237	434
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	248	206	567	237	434
	Ammonia, Total (as N) (mg/L)	0.0145	0.0065	0.386	0.0089	0.117
	Chloride (Cl) (mg/L)	4.56	6.75	15.2	4.55	6.8
	Nitrate and Nitrite (as N) (mg/L)	0.174	0.0888	5.67	0.175	25.3
	Nitrate (as N) (mg/L)	0.174	0.0888	5.10	0.175	25.2
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	0.565	<0.0010	0.0557
	Sulfate (SO4) (mg/L)	61.2	62.1	370	61.2	399
	Anion Sum (meq/L)	6.36	5.60	19.9	6.14	19.0
	Cation Sum (meq/L)	6.65	5.96	19.9	6.32	20.1
	Cation - Anion Balance (%)	2.2	3.1	0.1	1.4	2.8
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	5.65	9.78		5.19	21.9
Total Metals	Aluminum (Al)-Total (mg/L)	0.0098	0.0035	0.171	0.0068	0.0292
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	0.00042	<0.00010	0.00017
	Arsenic (As)-Total (mg/L)	0.00026	0.00041	0.00073	0.00025	0.00058
	Barium (Ba)-Total (mg/L)	0.0696	0.0696	0.193	0.0714	0.213
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	0.000023	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.027	0.023	0.036	0.026	<0.010
	Cadmium (Cd)-Total (mg/L)	0.0000058	<0.0000050	0.000316	0.0000075	0.0000434
	Calcium (Ca)-Total (mg/L)	63.2	71.0	237	61.9	250
	Chromium (Cr)-Total (mg/L)	<0.00010	<0.00010	0.00224	<0.00010	0.00020
	Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	0.00100	<0.00010	0.00030
	Copper (Cu)-Total (mg/L)	0.00300	0.00756	0.147	0.00243	0.0416
	Iron (Fe)-Total (mg/L)	0.025	<0.010	1.53	0.022	0.229
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	0.000377	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	0.0035	0.0016	0.0046	0.0034	0.0019
	Magnesium (Mg)-Total (mg/L)	33.2	22.5	69.9	32.2	71.0
	Manganese (Mn)-Total (mg/L)	0.0453	0.0149	3.50	0.0453	0.216

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2204218-1 Water 27-NOV-18 07:30 W3	L2204218-2 Water 27-NOV-18 07:45 W17	L2204218-3 Water 27-NOV-18 08:00 W8A	L2204218-4 Water 27-NOV-18 DUP	L2204218-5 Water 29-NOV-18 08:15 W15
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	0.0000083	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.00495	0.00628	0.0125	0.00475	0.00407
	Nickel (Ni)-Total (mg/L)	0.00084	0.00069	0.00220	0.00078	0.00115
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	0.080	<0.050	<0.050
	Potassium (K)-Total (mg/L)	2.20	3.45	8.65	2.16	7.71
	Selenium (Se)-Total (mg/L)	0.000346	0.000324	0.00499	0.000290	0.00805
	Silicon (Si)-Total (mg/L)	6.27	5.57	8.25	6.28	8.65
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	0.000047	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	17.2	13.6	51.4	16.7	28.6
	Strontium (Sr)-Total (mg/L)	0.859	0.782	3.29	0.873	2.45
	Sulfur (S)-Total (mg/L)	21.1	21.3	131	21.5	138
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	0.00021	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	<0.00060 ^{DLM}	<0.00030	0.0101	0.00038	<0.0018 ^{DLM}
	Uranium (U)-Total (mg/L)	0.00267	0.00205	0.00436	0.00263	0.00485
	Vanadium (V)-Total (mg/L)	0.00062	0.00054	0.00267	0.00052	0.00071
	Zinc (Zn)-Total (mg/L)	0.0034	0.0032	0.506	<0.0030	0.0211
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	0.00066	<0.00030	0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	<0.0020 ^{DLB}	<0.0020 ^{DLB}	0.0101	<0.0020 ^{DLB}	<0.0050 ^{DLB}
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	0.00021	<0.00010	0.00013
	Arsenic (As)-Dissolved (mg/L)	0.00022	0.00039	0.00054	0.00022	0.00055
	Barium (Ba)-Dissolved (mg/L)	0.0748	0.0734	0.190	0.0678	0.212
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.026	0.022	0.036	0.025	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	0.0000056	<0.0000050	0.000257	<0.0000050	0.0000417
	Calcium (Ca)-Dissolved (mg/L)	62.9	68.7	238	60.8	256
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	0.00060	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	0.00086	<0.00010	0.00026
	Copper (Cu)-Dissolved (mg/L)	0.00232	0.00733	0.0782	0.00226	0.0374
	Iron (Fe)-Dissolved (mg/L)	0.014	<0.010	0.314	0.014	0.049
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0034	0.0016	0.0045	0.0033	0.0019
	Magnesium (Mg)-Dissolved (mg/L)	32.6	22.6	66.2	30.8	70.8
	Manganese (Mn)-Dissolved (mg/L)	0.0458	0.0120	3.42	0.0432	0.218

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2204218-1 Water 27-NOV-18 07:30 W3	L2204218-2 Water 27-NOV-18 07:45 W17	L2204218-3 Water 27-NOV-18 08:00 W8A	L2204218-4 Water 27-NOV-18 DUP	L2204218-5 Water 29-NOV-18 08:15 W15
Grouping	Analyte						
WATER							
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00487	0.00595	0.0127	0.00487	0.00399	0.00399
	Nickel (Ni)-Dissolved (mg/L)	0.00082	0.00067	0.00186	0.00077	0.00124	0.00124
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	2.27	3.73	8.64	2.14	8.31	8.31
	Selenium (Se)-Dissolved (mg/L)	0.000312	0.000314	0.00640	0.000334	0.00941	0.00941
	Silicon (Si)-Dissolved (mg/L)	6.36	5.54	8.17	6.31	8.90	8.90
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	0.000013	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	17.7	13.3	50.0	16.1	28.5	28.5
	Strontium (Sr)-Dissolved (mg/L)	0.867	0.774	3.31	0.873	2.40	2.40
	Sulfur (S)-Dissolved (mg/L)	20.2	20.1	126	19.8	131	131
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00090 ^{DLM}	<0.00030	<0.00060 ^{DLM}	<0.00060 ^{DLM}
	Uranium (U)-Dissolved (mg/L)	0.00263	0.00201	0.00434	0.00258	0.00485	0.00485
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	0.00134	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	0.456	0.0022	0.0206	0.0206
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	0.00060	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Aluminum (Al)-Dissolved	MB-LOR	L2204218-1, -2, -3, -4, -5
Matrix Spike	Dissolved Organic Carbon	MS-B	L2204218-1, -2, -4, -5
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2204218-1, -2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2204218-1, -2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2204218-1, -2, -3, -4, -5
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2204218-1, -2, -3, -4, -5
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2204218-1, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2204218-1, -2, -3, -4, -5
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2204218-1, -2, -3, -4, -5
Matrix Spike	Barium (Ba)-Total	MS-B	L2204218-1, -2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Total	MS-B	L2204218-1, -2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2204218-1, -2, -3, -4, -5
Matrix Spike	Sodium (Na)-Total	MS-B	L2204218-1, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Total	MS-B	L2204218-1, -2, -3, -4, -5
Matrix Spike	Sulfur (S)-Total	MS-B	L2204218-1, -2, -3, -4, -5

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLB	Detection Limit Raised. Analyte detected at comparable level in Method Blank.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)

Reference Information

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
----------------------------	---------------------

VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
----	---

Chain of Custody Numbers:

2018-11-28 A

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lw - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

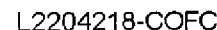
Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Canada Toll Free: 1 800 668 9878



COC Number: 2018-11-28 A

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REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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OCTOBER 2015 FROM

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 06-DEC-18
Report Date: 17-DEC-18 17:54 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2207177
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-12-05 A
Legal Site Desc:

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2207177-1 Water 01-DEC-18 10:45 W62	L2207177-2 Water 01-DEC-18 11:00 W16	L2207177-3 Water 01-DEC-18 09:45 W10	L2207177-4 Water 01-DEC-18 10:25 W12	L2207177-5 Water 01-DEC-18 09:50 F-BL
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	1270	509	573	2150	<2.0
	Hardness (as CaCO3) (mg/L)	746	269	285	1160	<0.50
	pH (pH)	8.19	8.28	7.92	8.20	5.43
	Total Suspended Solids (mg/L)	6.0	<3.0	3.2	8.2	<3.0
	TDS (Calculated) (mg/L)	909	312	351	1820	<1.0
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	395	196	232	229	<1.0
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	395	196	232	229	<1.0
	Ammonia, Total (as N) (mg/L)	0.0115	0.0276	0.179	2.98	<0.0050
	Bromide (Br) (mg/L)	<0.25 ^{DLDS}	<0.050	<0.050	<0.50 ^{DLDS}	<0.050
	Chloride (Cl) (mg/L)	31.1	6.51	0.98	29.8	<0.50
	Fluoride (F) (mg/L)	0.41	0.262	0.128	1.12	<0.020
	Nitrate and Nitrite (as N) (mg/L)	9.90	1.14	17.7	7.57	<0.0051
	Nitrate (as N) (mg/L)	9.86	1.13	17.6	5.71	<0.0050
	Nitrite (as N) (mg/L)	0.0319	0.0025	0.0268	1.86	<0.0010
	Sulfate (SO4) (mg/L)	292	70.8	14.1	1050	<0.30
	Anion Sum (meq/L)	15.6	5.66	6.22	27.9	<0.10
	Cation Sum (meq/L)	16.6	6.12	6.37	29.1	<0.10
	Cation - Anion Balance (%)	3.3	3.9	1.2	2.2	0.0
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)		15.8			1.07
Total Metals	Aluminum (Al)-Total (mg/L)	0.0228	0.0103	0.0699	0.0863	<0.0030
	Antimony (Sb)-Total (mg/L)	0.00012	<0.00010	<0.00010	0.00028	<0.00010
	Arsenic (As)-Total (mg/L)	0.00056	0.00046	0.00030	0.00052	<0.00010
	Barium (Ba)-Total (mg/L)	0.115	0.0781	0.316	0.0673	0.00019 ^{RRV}
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000040 ^{DLA}	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.00010 ^{DLA}	<0.000050
	Boron (B)-Total (mg/L)	0.029	0.018	0.015	0.225	<0.010
	Cadmium (Cd)-Total (mg/L)	0.0000200	0.0000107	0.0000188	0.000135	<0.0000050
	Calcium (Ca)-Total (mg/L)	184	64.9	75.1	312	<0.050
	Chromium (Cr)-Total (mg/L)	0.00034	0.00030	0.00027	<0.00020 ^{DLA}	0.00015 ^{RRV}
	Cobalt (Co)-Total (mg/L)	0.00016	<0.00010	0.00059	0.00087	<0.00010
	Copper (Cu)-Total (mg/L)	0.0735	0.0268	0.00423	0.0950	0.00140 ^{RRV}
	Iron (Fe)-Total (mg/L)	0.123	0.037	1.32	0.189	<0.010
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	0.000054	0.00010	<0.000050
	Lithium (Li)-Total (mg/L)	0.0035	0.0014	0.0011	0.0145	<0.0010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2207177-6 Water 03-DEC-18 14:00 W8A	L2207177-7 Water 04-DEC-18 08:50 W3	L2207177-8 Water 04-DEC-18 09:25 W17	L2207177-9 Water 01-DEC-18 DUP	L2207177-10 Water 04-DEC-18 DUP
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	1550	553	511	2170	551
	Hardness (as CaCO3) (mg/L)	890	297	258	1160	293
	pH (pH)	7.99	8.32	8.35	8.23	8.28
	Total Suspended Solids (mg/L)	14.2	<3.0	<3.0	7.8	3.6
	TDS (Calculated) (mg/L)	1130	337	309	1830	337
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	581	246	216	227	253
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	5.6	6.6	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	581	252	223	227	253
	Ammonia, Total (as N) (mg/L)	0.399	0.0097	<0.0050	3.08	0.0078
	Bromide (Br) (mg/L)	<0.25 ^{DLDS}	<0.050	<0.050	<0.50 ^{DLDS}	<0.050
	Chloride (Cl) (mg/L)	15.3	4.37	6.61	30.0	4.37
	Fluoride (F) (mg/L)	0.65	0.554	0.351	1.14	0.549
	Nitrate and Nitrite (as N) (mg/L)	5.19	0.175	0.0813	7.62	0.180
	Nitrate (as N) (mg/L)	4.57	0.175	0.0813	5.72	0.180
	Nitrite (as N) (mg/L)	0.618	<0.0010	<0.0010	1.90	<0.0010
	Sulfate (SO4) (mg/L)	359	58.3	59.5	1060	58.3
	Anion Sum (meq/L)	19.9	6.41	5.90	28.0	6.43
	Cation Sum (meq/L)	20.9	6.95	5.91	29.3	6.88
	Cation - Anion Balance (%)	2.4	4.0	0.1	2.2	3.4
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)		5.58	10.4		5.47
Total Metals	Aluminum (Al)-Total (mg/L)	0.150	0.0193	0.0032	0.0765	0.0081
	Antimony (Sb)-Total (mg/L)	0.00020	<0.00010	<0.00010	0.00027	<0.00010
	Arsenic (As)-Total (mg/L)	0.00077	0.00026	0.00038	0.00058	0.00024
	Barium (Ba)-Total (mg/L)	0.182	0.0698	0.0683	0.0666	0.0676
	Beryllium (Be)-Total (mg/L)	0.000022	<0.000020	<0.000020	<0.000040 ^{DLA}	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.00010 ^{DLA}	<0.000050
	Boron (B)-Total (mg/L)	0.037	0.025	0.022	0.221	0.025
	Cadmium (Cd)-Total (mg/L)	0.000655	0.0000070	<0.0000050	0.000113	<0.0000050
	Calcium (Ca)-Total (mg/L)	212	57.7	63.4	310	57.5
	Chromium (Cr)-Total (mg/L)	0.00121	0.00013	0.00015	0.00023	0.00012
	Cobalt (Co)-Total (mg/L)	0.00103	<0.00010	<0.00010	0.00087	<0.00010
	Copper (Cu)-Total (mg/L)	0.172	0.00270	0.00787	0.0914	0.00230
	Iron (Fe)-Total (mg/L)	2.97	0.050	<0.010	0.181	0.028
	Lead (Pb)-Total (mg/L)	0.000238	<0.000050	<0.000050	0.00010	<0.000050
	Lithium (Li)-Total (mg/L)	0.0048	0.0035	0.0016	0.0142	0.0034

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2207177-1 Water 01-DEC-18 10:45 W62	L2207177-2 Water 01-DEC-18 11:00 W16	L2207177-3 Water 01-DEC-18 09:45 W10	L2207177-4 Water 01-DEC-18 10:25 W12	L2207177-5 Water 01-DEC-18 09:50 F-BL
Grouping	Analyte					
WATER						
Total Metals	Magnesium (Mg)-Total (mg/L)	51.3	20.5	17.3	61.1	<0.10 ^{RRV}
	Manganese (Mn)-Total (mg/L)	0.0370	0.0146	0.637	0.688	0.00031
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.00937	0.00313	0.000744	0.0515	<0.000050 ^{RRV}
	Nickel (Ni)-Total (mg/L)	0.00122	0.00091	<0.00050	0.0042 ^{DLA}	0.00089
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.10	<0.050
	Potassium (K)-Total (mg/L)	6.63	2.92	1.94	33.2	<0.10
	Selenium (Se)-Total (mg/L)	0.00335	0.000653	0.000115	0.00593	<0.000050
	Silicon (Si)-Total (mg/L)	7.83	4.22	3.83	5.24	<0.10
	Silver (Ag)-Total (mg/L)	0.000011	<0.000010	0.000025	0.000037	<0.000010
	Sodium (Na)-Total (mg/L)	32.7	13.9	12.6	104	<0.050
	Strontium (Sr)-Total (mg/L)	2.07	0.586	0.449	5.61	<0.00020
	Sulfur (S)-Total (mg/L)	107	26.7	5.26	392	<0.50
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000020 ^{DLA}	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010 ^{DLM}	<0.00010 ^{DLM}	<0.00010	<0.00020 ^{DLA}	<0.00010
	Titanium (Ti)-Total (mg/L)	<0.0012	<0.00090	0.00349	<0.0039 ^{DLM}	<0.00030
	Uranium (U)-Total (mg/L)	0.00648	0.00162	0.000207	0.00720 ^{DLA}	<0.000010
	Vanadium (V)-Total (mg/L)	0.00097	0.00076	0.00064	<0.0010 ^{DLA}	<0.00050
	Zinc (Zn)-Total (mg/L)	0.0339	0.0050	0.0071	<0.0060 ^{DLA}	<0.0030
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0022	0.0047	0.0023	0.0031	<0.0010
	Antimony (Sb)-Dissolved (mg/L)	0.00011	<0.00010	<0.00010	0.00026	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00049	0.00040	0.00018	0.00051	<0.00010
	Barium (Ba)-Dissolved (mg/L)	0.116	0.0812	0.312	0.0704	<0.00010
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.027	0.016	0.015	0.212 ^{DLM}	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	0.0000217	0.0000094	0.0000146	<0.00013	<0.0000050 ^{RRV}
	Calcium (Ca)-Dissolved (mg/L)	207	71.2	83.5	358	0.082
	Chromium (Cr)-Dissolved (mg/L)	0.00026	<0.00010	<0.00010	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	0.00014	<0.00010	0.00052	0.00083	<0.00010 ^{RRV}
	Copper (Cu)-Dissolved (mg/L)	0.0630	0.0242	0.00164	0.0573	0.00038
	Iron (Fe)-Dissolved (mg/L)	0.028	0.015	0.446	0.012	<0.010
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0036	0.0014	0.0011	0.0155	<0.0010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2207177-6 Water 03-DEC-18 14:00 W8A	L2207177-7 Water 04-DEC-18 08:50 W3	L2207177-8 Water 04-DEC-18 09:25 W17	L2207177-9 Water 01-DEC-18 DUP	L2207177-10 Water 04-DEC-18 DUP
Grouping	Analyte					
WATER						
Total Metals	Magnesium (Mg)-Total (mg/L)	62.7	29.8	20.4	58.2	30.0
	Manganese (Mn)-Total (mg/L)	3.69	0.0574	0.0237	0.682	0.0507
	Mercury (Hg)-Total (mg/L)	<0.00010 ^{DLM}	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.0119	0.00481	0.00605	0.0505	0.00510
	Nickel (Ni)-Total (mg/L)	0.00150	0.00074	0.00063	0.0040	0.00075
	Phosphorus (P)-Total (mg/L)	0.092	<0.050	<0.050	<0.10 ^{DLA}	<0.050
	Potassium (K)-Total (mg/L)	8.32	2.27	3.51	34.1	2.30
	Selenium (Se)-Total (mg/L)	0.00608	0.000305	0.000285	0.00546	0.000348
	Silicon (Si)-Total (mg/L)	8.91	6.47	5.77	5.07	6.45
	Silver (Ag)-Total (mg/L)	0.000052	<0.000010	<0.000010	0.000025	<0.000010
	Sodium (Na)-Total (mg/L)	56.0	18.4	14.2	102	19.1
	Strontium (Sr)-Total (mg/L)	2.98	0.788	0.705	5.51	0.780
	Sulfur (S)-Total (mg/L)	135	22.1	22.1	389	21.7
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000020 ^{DLA}	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00020 ^{DLA}	<0.00010
	Titanium (Ti)-Total (mg/L)	0.0125	0.00116	<0.00030	<0.0030 ^{DLM}	0.00033
	Uranium (U)-Total (mg/L)	0.00521	0.00305	0.00237	0.00726	0.00310
	Vanadium (V)-Total (mg/L)	0.00329	0.00058	0.00058	<0.0010 ^{DLA}	0.00060
	Zinc (Zn)-Total (mg/L)	0.382	<0.0030	<0.0030	<0.0060 ^{DLA}	<0.0030
	Zirconium (Zr)-Total (mg/L)	0.00061	<0.00030	<0.00030	<0.00030	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0100	0.0022	0.0019	0.0047	0.0011
	Antimony (Sb)-Dissolved (mg/L)	0.00010	<0.00010	<0.00010	0.00028	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00056	0.00024	0.00034	0.00049	0.00024
	Barium (Ba)-Dissolved (mg/L)	0.181	0.0722	0.0690	0.0672	0.0692
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.038	0.024	0.023	0.206	0.026
	Cadmium (Cd)-Dissolved (mg/L)	0.000376	0.0000201 ^{DTMF}	<0.0000050	<0.00014 ^{DLM}	0.0000088
	Calcium (Ca)-Dissolved (mg/L)	245	64.1	67.8	360	64.2
	Chromium (Cr)-Dissolved (mg/L)	0.00059	<0.00010	0.00023	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	0.00091	<0.00010	<0.00010	0.00082	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.0746	0.00218	0.00722	0.0583	0.00210
	Iron (Fe)-Dissolved (mg/L)	0.334	0.021	<0.010	0.014	0.016
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0050	0.0035	0.0016	0.0153	0.0036

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2207177-1 Water 01-DEC-18 10:45 W62	L2207177-2 Water 01-DEC-18 11:00 W16	L2207177-3 Water 01-DEC-18 09:45 W10	L2207177-4 Water 01-DEC-18 10:25 W12	L2207177-5 Water 01-DEC-18 09:50 F-BL
Grouping	Analyte					
WATER						
Dissolved Metals	Magnesium (Mg)-Dissolved (mg/L)	55.8	22.2	18.5	63.9	<0.10 ^{RRV}
	Manganese (Mn)-Dissolved (mg/L)	0.0316	0.00255	0.597	0.693	0.00030
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00943	0.00334	0.000840	0.0543	<0.000050
	Nickel (Ni)-Dissolved (mg/L)	0.00124	0.00078	<0.00050	0.00419	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	7.08	3.15	2.03	37.9	<0.10
	Selenium (Se)-Dissolved (mg/L)	0.00442	0.000873	0.000235 ^{DTC}	0.00643	<0.000050
	Silicon (Si)-Dissolved (mg/L)	7.90	4.30	3.86	5.35	<0.050
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	0.000011	<0.000010
	Sodium (Na)-Dissolved (mg/L)	35.0	15.1	13.3	110	<0.050
	Strontium (Sr)-Dissolved (mg/L)	2.24	0.701	0.534	6.43	0.00092 ^{RRV}
	Sulfur (S)-Dissolved (mg/L)	107	25.6	5.26	390	<0.50
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00588	0.00154	0.000205	0.00659	<0.000010
	Vanadium (V)-Dissolved (mg/L)	0.00064	<0.00050 ^{DLB}	<0.00050	<0.00050 ^{DLB}	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0303	<0.0040 ^{DLB}	0.0059	<0.0040 ^{DLB}	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2207177-6 Water 03-DEC-18 14:00 W8A	L2207177-7 Water 04-DEC-18 08:50 W3	L2207177-8 Water 04-DEC-18 09:25 W17	L2207177-9 Water 01-DEC-18 DUP	L2207177-10 Water 04-DEC-18 DUP
Grouping	Analyte					
WATER						
Dissolved Metals	Magnesium (Mg)-Dissolved (mg/L)	67.9	33.3	21.6	64.5	32.3
	Manganese (Mn)-Dissolved (mg/L)	3.61	0.144 ^{DTMF}	0.0144	0.700	0.0568
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.0125	0.00517	0.00580	0.0547	0.00546
	Nickel (Ni)-Dissolved (mg/L)	0.00145	0.00085	0.00070	0.00417	0.00090
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	10.1	2.70	3.78	37.7	3.11
	Selenium (Se)-Dissolved (mg/L)	0.00750	0.000536 ^{DTMF}	0.000422 ^{DTC}	0.00621	0.000451
	Silicon (Si)-Dissolved (mg/L)	8.41	6.54	6.04	5.23	6.37
	Silver (Ag)-Dissolved (mg/L)	0.000016	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	61.5	21.6	15.2	110	21.6
	Strontium (Sr)-Dissolved (mg/L)	3.44	0.898	0.737	6.44	0.909
	Sulfur (S)-Dissolved (mg/L)	129	21.2	20.6	386	24.9
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.0012 ^{DLM}	<0.00030	<0.00030	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00506	0.00290	0.00230	0.00651	0.00289
	Vanadium (V)-Dissolved (mg/L)	0.00155	<0.00050 ^{DLB}	<0.00050	<0.00050 ^{DLB}	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.286	<0.010	<0.0010	<0.0030	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	0.00064	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Zinc (Zn)-Dissolved	MB-LOR	L2207177-10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2207177-10, -7, -8
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2207177-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2207177-10, -7, -8
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2207177-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2207177-10, -7, -8
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2207177-10, -7, -8
Matrix Spike	Silicon (Si)-Dissolved	MS-B	L2207177-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2207177-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2207177-10, -7, -8
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2207177-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2207177-10, -7, -8
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2207177-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2207177-10, -7, -8
Matrix Spike	Barium (Ba)-Total	MS-B	L2207177-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Total	MS-B	L2207177-5
Matrix Spike	Boron (B)-Total	MS-B	L2207177-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L2207177-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L2207177-5
Matrix Spike	Copper (Cu)-Total	MS-B	L2207177-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2207177-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2207177-5
Matrix Spike	Manganese (Mn)-Total	MS-B	L2207177-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Potassium (K)-Total	MS-B	L2207177-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Potassium (K)-Total	MS-B	L2207177-5
Matrix Spike	Silicon (Si)-Total	MS-B	L2207177-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Total	MS-B	L2207177-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Total	MS-B	L2207177-5
Matrix Spike	Strontium (Sr)-Total	MS-B	L2207177-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L2207177-5
Matrix Spike	Sulfur (S)-Total	MS-B	L2207177-1, -10, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLB	Detection Limit Raised. Analyte detected at comparable level in Method Blank.
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DTC	Dissolved concentration exceeds total. Results were confirmed by re-analysis.
DTMF	Dissolved concentration exceeds total for field-filtered metals sample. Metallic contaminants may have been introduced to dissolved sample during field filtration.
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			

Reference Information

BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
BR-L-IC-N-VA	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
F-IC-N-VA	Water	Fluoride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Weston et al.			
NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			

Reference Information

NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
SO4-IC-N-VA	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)
This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".			
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.			
TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.			
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-12-05 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

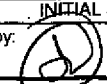
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



L2207177-COFC

COC Number: 2018-12-05 A

Page 1 of 1

Report To Contact and company name below will appear on the final report		Report Format / Distribution		Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply											
Company:	Minto Explorations Ltd.	Select Report Format:	☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)	Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply											
Contact:	Minto Environment - Coordinator	Quality Control (QC) Report with Report	☒ YES ☐ NO	PRIORITY (Business Days)	4 day [P4] ☐				1 Business day [E1] ☐				EMERGENCY		
Phone:	1-604-759-4659	☒ Compare Results to Criteria on Report - provide details below if box checked	3 day [P3] ☐				Same Day, Weekend or Statutory holiday [E0] ☐								
Company address below will appear on the final report		Select Distribution:	☒ EMAIL ☐ MAIL ☐ FAX		2 day [P2] ☐										
Street:	2100-510 West Georgia St.	Email 1 or Fax	mintoenvironment@mintomine.com	Date and Time Required for all E&P TATs: dd-mm-yy hh:mm											
City/Province:	Vancouver, British Columbia	Email 2		For tests that can not be performed according to the service level selected, you will be contacted.											
Postal Code:	V6B 0M3	Email 3		Analysis Request											
Invoice To	Same as Report To ☐ YES ☒ NO	Invoice Distribution		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below											
	Copy of Invoice with Report ☐ YES ☒ NO	Select Invoice Distribution:	☒ EMAIL ☐ MAIL ☐ FAX												
Company:	Minto Explorations Ltd.	Email 1 or Fax	ap@mintomine.com												
Contact:	Ruth Cayetano	Email 2													
Project Information		Oil and Gas Required Fields (client use)													
ALS Account # / Quote #:		AFE/Cost Center:	PO#												
Job #:		Major/Minor Code:	Routing Code:												
PO / AFE:	229096 (WUL)	Requisitioner:													
LSD:		Location:													
ALS Lab Work Order # (lab use only)		ALS Contact:	Shane Stack	Sampler:									Number of Containers		
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mm-yy)	Time (hh:mm)	Sample Type	pH / Conductivity / Alkalinity / Anions	Total Suspended Solids (TSS)	Total Dissolved Solids (TDS)	Total Metals (TM), Hardness	Dissolved Metals (DM) (Filtered and preserved)	Total Mercury, Hardness	Dissolved Mercury (1) (Filtered + preserved)	Total Nutrients (Ammonia)		Dissolved Organic Carbon (DOC)	
	W62	1-Dec-18	10:45	Water	R	R	R	R	R	R	R	R			6
	W16	1-Dec-18	11:00	Water	R	R	R	R	R	R	R	R			7
	W10	1-Dec-18	9:45	Water	R	R	R	R	R	R	R	R			6
	W12	1-Dec-18	10:25	Water	R	R	R	R	R	R	R	R			6
	F-BL	1-Dec-18	9:50	Water	R	R	R	R	R	R	R	R			7
	W8A	3-Dec-18	14:00	Water	R	R	R	R	R	R	R	R			6
	W3	4-Dec-18	8:50	Water	R	R	R	R	R	R	R	R			7
	W17	4-Dec-18	9:25	Water	R	R	R	R	R	R	R	R			7
	DUP	1-Dec-18		Water	R	R	R	R	R	R	R	R		6	
	DUP	4-Dec-18		Water	R	R	R	R	R	R	R	R		7	
Drinking Water (DW) Samples¹ (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)		* SAMPLE CONDITION AS RECEIVED (lab use only) *											
Are samples taken from a Regulated DW System? ☐ YES ☒ NO				Frozen ☐ SIF Observations Yes ☐ No ☐											
Are samples for human drinking water use? ☐ YES ☒ NO				Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐											
				Cooling Initiated ☒											
				INITIAL COOLER TEMPERATURES °C: 5.0 FINAL COOLER TEMPERATURES °C: 5											
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)		FINAL SHIPMENT RECEPTION (lab use only)											
Released by: Patrick McGinty	Date: 12/5/2018	Time:	Received by: 	Date: DEC 6, 2018	Time: 13:31	Received by: H.A.	Date: 12/7	Time: 12:45							

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY

YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 17-DEC-18
Report Date: 28-DEC-18 17:49 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2211283
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-12-15 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2211283-1 Water 11-DEC-18 11:15 W3	L2211283-2 Water 11-DEC-18 14:00 W8A	L2211283-3 Water 12-DEC-18 16:10 W17	L2211283-4 Water 12-DEC-18 DUP	
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	584	1690	549	540	
	Hardness (as CaCO3) (mg/L)	297	917	288	281	
	pH (pH)	7.77	7.19	8.02	8.03	
	Total Suspended Solids (mg/L)	<3.0	11.5	<3.0	<3.0	
	TDS (Calculated) (mg/L)	326	1120	311	307	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	241	575	211	209	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Total (as CaCO3) (mg/L)	241	575	211	209	
	Ammonia, Total (as N) (mg/L)	0.0091	0.377	0.0080	0.0100	
	Chloride (Cl) (mg/L)	4.30	15.2	6.50	6.44	
	Nitrate and Nitrite (as N) (mg/L)	0.170	5.20	0.0724	0.0697	
	Nitrate (as N) (mg/L)	0.170	4.57	0.0724	0.0697	
	Nitrite (as N) (mg/L)	<0.0010	0.627	<0.0010	<0.0010	
	Sulfate (SO4) (mg/L)	57.7	350	58.5	58.2	
	Anion Sum (meq/L)	6.16	19.6	5.62	5.58	
	Cation Sum (meq/L)	6.82	21.3	6.53	6.39	
	Cation - Anion Balance (%)	5.1	4.2	7.5	6.7	
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	5.35		9.58	9.78	
Total Metals	Aluminum (Al)-Total (mg/L)	0.0141	0.0464	0.0045	0.0051	
	Antimony (Sb)-Total (mg/L)	<0.00010	0.00013	<0.00010	<0.00010	
	Arsenic (As)-Total (mg/L)	0.00025	0.00062	0.00039	0.00040	
	Barium (Ba)-Total (mg/L)	0.0651	0.173	0.0662	0.0679	
	Beryllium (Be)-Total (mg/L)	<0.000020	0.000022	<0.000020	<0.000020	
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Total (mg/L)	0.025	0.036	0.023	0.023	
	Cadmium (Cd)-Total (mg/L)	0.0000056	0.000272	<0.0000050	0.0000054	
	Calcium (Ca)-Total (mg/L)	59.5	229	68.3	72.1	
	Chromium (Cr)-Total (mg/L)	0.00013	0.00078	0.00013	0.00015	
	Cobalt (Co)-Total (mg/L)	<0.00010	0.00089	<0.00010	<0.00010	
	Copper (Cu)-Total (mg/L)	0.00232	0.114	0.00807	0.00853	
	Iron (Fe)-Total (mg/L)	0.039	1.00	0.027	0.029	
	Lead (Pb)-Total (mg/L)	<0.000050	0.000093	<0.000050	<0.000050	
	Lithium (Li)-Total (mg/L)	0.0036	0.0051	0.0018	0.0018	
	Magnesium (Mg)-Total (mg/L)	31.5	71.5	22.0	23.0	
	Manganese (Mn)-Total (mg/L)	0.0566	3.63	0.0296	0.0307	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2211283-1 Water 11-DEC-18 11:15 W3	L2211283-2 Water 11-DEC-18 14:00 W8A	L2211283-3 Water 12-DEC-18 16:10 W17	L2211283-4 Water 12-DEC-18 DUP	
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	0.0000080	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Total (mg/L)	0.00494	0.0115	0.00614	0.00615	
	Nickel (Ni)-Total (mg/L)	0.00086	0.00166	0.00074	0.00076	
	Phosphorus (P)-Total (mg/L)	<0.050	0.071	<0.050	<0.050	
	Potassium (K)-Total (mg/L)	2.32	8.51	3.69	3.68	
	Selenium (Se)-Total (mg/L)	0.000298	0.00487	0.000349	0.000347	
	Silicon (Si)-Total (mg/L)	6.46	8.84	5.86	5.91	
	Silver (Ag)-Total (mg/L)	<0.000010	0.000031	<0.000010	<0.000010	
	Sodium (Na)-Total (mg/L)	18.7	58.6	14.3	15.1	
	Strontium (Sr)-Total (mg/L)	0.793	2.97	0.709	0.712	
	Sulfur (S)-Total (mg/L)	21.6	137	21.8	22.0	
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Total (mg/L)	<0.00090 ^{DLM}	0.00316	<0.00030	<0.00030	
	Uranium (U)-Total (mg/L)	0.00276	0.00496	0.00213	0.00220	
	Vanadium (V)-Total (mg/L)	<0.00050	0.00203	<0.00050	<0.00050	
	Zinc (Zn)-Total (mg/L)	<0.0030	0.691	<0.0030	<0.0030	
	Zirconium (Zr)-Total (mg/L)	<0.00030	0.00059	<0.00030	<0.00030	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0013	0.0076	0.0017	0.0020	
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	0.00010	<0.00010	<0.00010	
	Arsenic (As)-Dissolved (mg/L)	0.00022	0.00051	0.00034	0.00037	
	Barium (Ba)-Dissolved (mg/L)	0.0702	0.187	0.0736	0.0702	
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	0.026	0.037	0.023	0.023	
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	0.000301	<0.0000050	<0.0000050	
	Calcium (Ca)-Dissolved (mg/L)	63.8	247	75.3	73.5	
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00082	0.00014	0.00012	
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00097	<0.00010	<0.00010	
	Copper (Cu)-Dissolved (mg/L)	0.00207	0.0801	0.00817	0.00815	
	Iron (Fe)-Dissolved (mg/L)	0.018	0.348	0.016	0.016	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.0035	0.0048	0.0016	0.0016	
	Magnesium (Mg)-Dissolved (mg/L)	33.3	72.6	24.2	23.6	
	Manganese (Mn)-Dissolved (mg/L)	0.0479	4.11	0.0237	0.0232	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2211283-1 Water 11-DEC-18 11:15 W3	L2211283-2 Water 11-DEC-18 14:00 W8A	L2211283-3 Water 12-DEC-18 16:10 W17	L2211283-4 Water 12-DEC-18 DUP	
Grouping	Analyte						
WATER							
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Dissolved (mg/L)	0.00493	0.0112	0.00635	0.00610		
	Nickel (Ni)-Dissolved (mg/L)	0.00080	0.00150	0.00079	0.00076		
	Phosphorus (P)-Dissolved (mg/L)	<0.050	0.051	<0.050	<0.050		
	Potassium (K)-Dissolved (mg/L)	2.23	8.27	3.79	3.74		
	Selenium (Se)-Dissolved (mg/L)	0.000322	0.00548	0.000354	0.000279		
	Silicon (Si)-Dissolved (mg/L)	6.33	8.49	5.64	5.69		
	Silver (Ag)-Dissolved (mg/L)	<0.000010	0.000015	<0.000010	<0.000010		
	Sodium (Na)-Dissolved (mg/L)	19.1	58.7	15.7	15.7		
	Strontium (Sr)-Dissolved (mg/L)	0.816	3.25	0.822	0.790		
	Sulfur (S)-Dissolved (mg/L)	20.5	121	19.4	19.8		
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010		
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010		
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00090 ^{DLM}	<0.00030	<0.00030		
	Uranium (U)-Dissolved (mg/L)	0.00286	0.00528	0.00236	0.00238		
	Vanadium (V)-Dissolved (mg/L)	<0.00050	0.00158	<0.00050	<0.00050		
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	0.229	<0.0010	<0.0010		
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	0.00070	<0.00030	<0.00030		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Dissolved Organic Carbon	MS-B	L2211283-1, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2211283-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2211283-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2211283-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2211283-1, -2, -3, -4
Matrix Spike	Barium (Ba)-Total	MS-B	L2211283-1, -2, -3, -4
Matrix Spike	Boron (B)-Total	MS-B	L2211283-2
Matrix Spike	Calcium (Ca)-Total	MS-B	L2211283-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Total	MS-B	L2211283-2
Matrix Spike	Cobalt (Co)-Total	MS-B	L2211283-2
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2211283-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2211283-2
Matrix Spike	Manganese (Mn)-Total	MS-B	L2211283-1, -2, -3, -4
Matrix Spike	Manganese (Mn)-Total	MS-B	L2211283-2
Matrix Spike	Nickel (Ni)-Total	MS-B	L2211283-2
Matrix Spike	Potassium (K)-Total	MS-B	L2211283-2
Matrix Spike	Sodium (Na)-Total	MS-B	L2211283-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Total	MS-B	L2211283-2
Matrix Spike	Strontium (Sr)-Total	MS-B	L2211283-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Total	MS-B	L2211283-2
Matrix Spike	Sulfur (S)-Total	MS-B	L2211283-1, -2, -3, -4
Matrix Spike	Sulfur (S)-Total	MS-B	L2211283-2
Matrix Spike	Uranium (U)-Total	MS-B	L2211283-2
Matrix Spike	Nitrate (as N)	MS-B	L2211283-1, -2, -3, -4

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			

Reference Information

EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 µm), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Weston et al.			
NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
SO4-IC-N-VA	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)
This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".			
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.			
TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Reference Information

Laboratory Definition Code	Laboratory Location
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VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
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Chain of Custody Numbers:

2018-12-15 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lw - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 19-DEC-18
Report Date: 02-JAN-19 18:06 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2212831
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-12-19 A
Legal Site Desc:

Selam Worku
Account Manager

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ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2212831-1 Water 18-DEC-18 08:20 W3	L2212831-2 Water 18-DEC-18 08:40 W17	L2212831-3 Water 18-DEC-18 09:00 W8A	L2212831-4 Water 18-DEC-18 10:30 W15	L2212831-5 Water 18-DEC-18 16:00 UG1
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	572	535	1620	2030	1900
	Hardness (as CaCO3) (mg/L)	277	259	873	1190	1030
	pH (pH)	8.11	8.26	7.69	7.96	7.89
	Total Suspended Solids (mg/L)	3.2	12.6	38.0	6.8	24.0
	TDS (Calculated) (mg/L)	323	305	1110	1540	1550
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	245	216	608	573	180
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	245	216	608	573	180
	Ammonia, Total (as N) (mg/L)	0.0103	0.0102	0.443	0.210	1.69
	Chloride (Cl) (mg/L)	4.37	6.75	15.6	9.5	14.6
	Nitrate and Nitrite (as N) (mg/L)	0.173	0.0706	4.12	39.3	2.65
	Nitrate (as N) (mg/L)	0.173	0.0706	3.10	39.2	2.33
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	1.02	0.094	0.313
	Sulfate (SO4) (mg/L)	59.2	60.3	335	544	950
	Anion Sum (meq/L)	6.26	5.77	19.9	25.8	24.0
	Cation Sum (meq/L)	6.42	5.90	20.6	26.0	24.0
	Cation - Anion Balance (%)	1.3	1.1	1.8	0.4	0.1
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	5.27	10.0		26.4	
Total Metals	Aluminum (Al)-Total (mg/L)	0.0144	0.285	0.175	0.0191	0.411
	Antimony (Sb)-Total (mg/L)	<0.00010	0.00013	0.00022	0.00019	0.00016
	Arsenic (As)-Total (mg/L)	0.00025	0.00067	0.00075	0.00073	0.00086
	Barium (Ba)-Total (mg/L)	0.0699	0.113	0.196	0.269	0.0250
	Beryllium (Be)-Total (mg/L)	<0.000020	0.000022	0.000028	<0.000020	0.000029
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.026	0.023	0.038	0.013	0.325
	Cadmium (Cd)-Total (mg/L)	0.0000067	0.0000628	0.000333	0.000113	0.000426
	Calcium (Ca)-Total (mg/L)	57.3	65.6	227	318	337
	Chromium (Cr)-Total (mg/L)	0.00012	0.00039	0.00108	0.00030	0.00032
	Cobalt (Co)-Total (mg/L)	<0.00010	0.00064	0.00116	0.00029	0.00069
	Copper (Cu)-Total (mg/L)	0.00293	0.0525	0.170	0.0718	0.133
	Iron (Fe)-Total (mg/L)	0.038	1.39	2.03	0.159	0.768
	Lead (Pb)-Total (mg/L)	<0.000050	0.00266	0.000199	<0.000050	0.000276
	Lithium (Li)-Total (mg/L)	0.0035	0.0017	0.0050	0.0030	0.0088
	Magnesium (Mg)-Total (mg/L)	35.6	23.9	76.3	108	46.7
	Manganese (Mn)-Total (mg/L)	0.0633	1.52	4.34	0.319	0.140

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2212831-6 Water 18-DEC-18 16:20 UG4	L2212831-7 Water 18-DEC-18 DUP			
Grouping	Analyte						
WATER							
Physical Tests	Conductivity (uS/cm)		1820	533			
	Hardness (as CaCO3) (mg/L)		943	266			
	pH (pH)		8.09	8.25			
	Total Suspended Solids (mg/L)		7.2	4.2			
	TDS (Calculated) (mg/L)		1430	308			
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)		183	217			
	Alkalinity, Carbonate (as CaCO3) (mg/L)		<1.0	<1.0			
	Alkalinity, Hydroxide (as CaCO3) (mg/L)		<1.0	<1.0			
	Alkalinity, Total (as CaCO3) (mg/L)		183	217			
	Ammonia, Total (as N) (mg/L)		0.0970	0.0061			
	Chloride (Cl) (mg/L)		26.0	6.71			
	Nitrate and Nitrite (as N) (mg/L)		0.504	0.0683			
	Nitrate (as N) (mg/L)		0.439	0.0683			
	Nitrite (as N) (mg/L)		0.066	<0.0010			
	Sulfate (SO4) (mg/L)		876	59.9			
	Anion Sum (meq/L)		22.7	5.77			
	Cation Sum (meq/L)		21.6	6.05			
	Cation - Anion Balance (%)		-2.3	2.4			
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)			10.2			
Total Metals	Aluminum (Al)-Total (mg/L)		0.0263	0.144			
	Antimony (Sb)-Total (mg/L)		<0.00010	0.00010			
	Arsenic (As)-Total (mg/L)		0.00120	0.00051			
	Barium (Ba)-Total (mg/L)		0.0175	0.0869			
	Beryllium (Be)-Total (mg/L)		0.000026	<0.000020			
	Bismuth (Bi)-Total (mg/L)		<0.000050	<0.000050			
	Boron (B)-Total (mg/L)		0.139	0.025			
	Cadmium (Cd)-Total (mg/L)		0.000234	0.0000311			
	Calcium (Ca)-Total (mg/L)		306	65.4			
	Chromium (Cr)-Total (mg/L)		0.00012	0.00024			
	Cobalt (Co)-Total (mg/L)		0.00027	0.00031			
	Copper (Cu)-Total (mg/L)		0.0666	0.0291			
	Iron (Fe)-Total (mg/L)		0.114	0.765			
	Lead (Pb)-Total (mg/L)		0.00101	0.00109			
	Lithium (Li)-Total (mg/L)		0.0079	0.0016			
	Magnesium (Mg)-Total (mg/L)		50.9	23.0			
	Manganese (Mn)-Total (mg/L)		0.106	0.646			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2212831-1 Water 18-DEC-18 08:20 W3	L2212831-2 Water 18-DEC-18 08:40 W17	L2212831-3 Water 18-DEC-18 09:00 W8A	L2212831-4 Water 18-DEC-18 10:30 W15	L2212831-5 Water 18-DEC-18 16:00 UG1
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	0.0000172	<0.0000050	0.0000075
	Molybdenum (Mo)-Total (mg/L)	0.00532	0.00702	0.0111	0.00618	0.0169
	Nickel (Ni)-Total (mg/L)	0.00091	0.00206	0.00178	0.00166	0.00081
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	0.088	<0.050	<0.050
	Potassium (K)-Total (mg/L)	2.35	3.57	8.61	11.9	7.36
	Selenium (Se)-Total (mg/L)	0.000377	0.000419	0.00472	0.0140	0.00150
	Silicon (Si)-Total (mg/L)	6.80	6.60	9.47	12.9	8.16
	Silver (Ag)-Total (mg/L)	<0.000010	0.000021	0.000049	<0.000010	0.000023
	Sodium (Na)-Total (mg/L)	20.4	15.3	62.1	45.9	77.4
	Strontium (Sr)-Total (mg/L)	0.825	0.752	3.16	3.24	7.95
	Sulfur (S)-Total (mg/L)	22.7	22.1	129	203	359
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	0.000011
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010 ^{DLM}	<0.00010
	Titanium (Ti)-Total (mg/L)	0.00056	0.0145	0.0105	<0.0015	0.0324
	Uranium (U)-Total (mg/L)	0.00276	0.00219	0.00507	0.00673	0.00931
	Vanadium (V)-Total (mg/L)	<0.00050	0.00182	0.00318	0.00067	0.00206
	Zinc (Zn)-Total (mg/L)	<0.0030	0.0378	0.496	0.0127	0.0195
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	0.00064	0.00033	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0030	0.0537	0.0081	0.0066	0.0048
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00016	0.00014
	Arsenic (As)-Dissolved (mg/L)	0.00022	0.00038	0.00053	0.00069	0.00071
	Barium (Ba)-Dissolved (mg/L)	0.0681	0.0700	0.171	0.247	0.0172
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.024	0.022	0.036	0.012	0.296
	Cadmium (Cd)-Dissolved (mg/L)	0.0000082	0.0000101	0.000267	0.0000988	0.000341
	Calcium (Ca)-Dissolved (mg/L)	59.1	68.4	232	321	346
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00013	0.00064	0.00023	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	0.00103	0.00027	0.00042
	Copper (Cu)-Dissolved (mg/L)	0.00199	0.00758	0.0758	0.0614	0.0683
	Iron (Fe)-Dissolved (mg/L)	0.018	0.014	0.350	0.050	<0.010
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0035	0.0016	0.0051	0.0031	0.0093
	Magnesium (Mg)-Dissolved (mg/L)	31.5	21.3	71.4	95.1	40.8
Manganese (Mn)-Dissolved (mg/L)	0.0512	0.0216	4.24	0.300	0.114	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2212831-6 Water 18-DEC-18 16:20 UG4	L2212831-7 Water 18-DEC-18 DUP		
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	0.0000078	<0.0000050			
	Molybdenum (Mo)-Total (mg/L)	0.0178	0.00630			
	Nickel (Ni)-Total (mg/L)	<0.00050	0.00131			
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050			
	Potassium (K)-Total (mg/L)	4.11	3.42			
	Selenium (Se)-Total (mg/L)	0.00177	0.000410			
	Silicon (Si)-Total (mg/L)	7.14	6.11			
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010			
	Sodium (Na)-Total (mg/L)	70.9	14.7			
	Strontium (Sr)-Total (mg/L)	6.25	0.746			
	Sulfur (S)-Total (mg/L)	322	22.2			
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010			
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010			
	Titanium (Ti)-Total (mg/L)	<0.0018 ^{DLM}	0.00751			
	Uranium (U)-Total (mg/L)	0.00691	0.00217			
	Vanadium (V)-Total (mg/L)	<0.00050	0.00098			
	Zinc (Zn)-Total (mg/L)	0.0111	0.0176			
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030			
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD			
	Dissolved Metals Filtration Location	FIELD	FIELD			
	Aluminum (Al)-Dissolved (mg/L)	0.0053	<0.0010			
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010			
	Arsenic (As)-Dissolved (mg/L)	0.00097	0.00040			
	Barium (Ba)-Dissolved (mg/L)	0.0154	0.0727			
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020			
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050			
	Boron (B)-Dissolved (mg/L)	0.128	0.023			
	Cadmium (Cd)-Dissolved (mg/L)	0.000183	0.0000093			
	Calcium (Ca)-Dissolved (mg/L)	307	70.7			
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010			
	Cobalt (Co)-Dissolved (mg/L)	0.00021	<0.00010			
	Copper (Cu)-Dissolved (mg/L)	0.0451	0.00791			
	Iron (Fe)-Dissolved (mg/L)	0.014	0.013			
	Lead (Pb)-Dissolved (mg/L)	0.000626	<0.000050			
	Lithium (Li)-Dissolved (mg/L)	0.0083	0.0016			
	Magnesium (Mg)-Dissolved (mg/L)	42.7	21.7			
	Manganese (Mn)-Dissolved (mg/L)	0.0913	0.0226			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2212831-1 Water 18-DEC-18 08:20 W3	L2212831-2 Water 18-DEC-18 08:40 W17	L2212831-3 Water 18-DEC-18 09:00 W8A	L2212831-4 Water 18-DEC-18 10:30 W15	L2212831-5 Water 18-DEC-18 16:00 UG1
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	0.0000098	0.0000063	0.0000061
	Molybdenum (Mo)-Dissolved (mg/L)	0.00516	0.00638	0.0116	0.00619	0.0177
	Nickel (Ni)-Dissolved (mg/L)	0.00079	0.00074	0.00160	0.00140	0.00061
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	2.39	3.71	9.52	12.3	7.70
	Selenium (Se)-Dissolved (mg/L)	0.000313	0.000350	0.00509	0.0145	0.00148
	Silicon (Si)-Dissolved (mg/L)	6.54	5.80	8.97	12.5	7.18
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	0.000019	<0.000010	0.000014
	Sodium (Na)-Dissolved (mg/L)	18.7	14.4	61.6	43.3	71.5
	Strontium (Sr)-Dissolved (mg/L)	0.846	0.788	3.32	3.38	8.51
	Sulfur (S)-Dissolved (mg/L)	20.8	20.7	125	189	353
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00090 ^{DLM}	<0.00060 ^{DLM}	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00310	0.00245	0.00577	0.00750	0.0101
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	0.00165	<0.00050	0.00052
	Zinc (Zn)-Dissolved (mg/L)	0.0013	0.0028	0.387	0.0101	0.0124
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	0.00070	0.00032	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2212831-6 Water 18-DEC-18 16:20 UG4	L2212831-7 Water 18-DEC-18 DUP			
Grouping	Analyte						
WATER							
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	0.0000055	<0.0000050				
	Molybdenum (Mo)-Dissolved (mg/L)	0.0184	0.00650				
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	0.00072				
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050				
	Potassium (K)-Dissolved (mg/L)	4.10	3.81				
	Selenium (Se)-Dissolved (mg/L)	0.00177	0.000279				
	Silicon (Si)-Dissolved (mg/L)	7.09	5.82				
	Silver (Ag)-Dissolved (mg/L)	0.000011	<0.000010				
	Sodium (Na)-Dissolved (mg/L)	61.5	14.6				
	Strontium (Sr)-Dissolved (mg/L)	6.71	0.813				
	Sulfur (S)-Dissolved (mg/L)	313	21.4				
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010				
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010				
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030				
	Uranium (U)-Dissolved (mg/L)	0.00785	0.00252				
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050				
	Zinc (Zn)-Dissolved (mg/L)	0.0083	0.0029				
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Copper (Cu)-Dissolved	MB-LOR	L2212831-1, -2, -3, -4, -5, -6, -7
Method Blank	Thallium (Tl)-Dissolved	MB-LOR	L2212831-1, -2, -3, -4, -5, -6, -7
Laboratory Control Sample	Phosphorus (P)-Total	MES	L2212831-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Dissolved Organic Carbon	MS-B	L2212831-1, -2, -4, -7
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2212831-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2212831-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2212831-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2212831-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Barium (Ba)-Total	MS-B	L2212831-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Calcium (Ca)-Total	MS-B	L2212831-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2212831-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Manganese (Mn)-Total	MS-B	L2212831-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Molybdenum (Mo)-Total	MS-B	L2212831-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Potassium (K)-Total	MS-B	L2212831-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Sodium (Na)-Total	MS-B	L2212831-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Strontium (Sr)-Total	MS-B	L2212831-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Sulfur (S)-Total	MS-B	L2212831-1, -2, -3, -4, -5, -6, -7

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Reference Information

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 µm), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
----------------------------	---------------------

VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
----	---

Reference Information

Chain of Custody Numbers:

2018-12-19 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lw - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



12212831-COFC

COC Number: 2018-12-19 A

Page 1 of 1

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[illegible]

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2014 FROM



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 27-DEC-18
Report Date: 08-JAN-19 15:28 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2214457
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-12-26 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2214457-1 Water 25-DEC-18 09:10 W3	L2214457-2 Water 25-DEC-18 09:35 W17	L2214457-3 Water 25-DEC-18 14:35 W8A	L2214457-4 Water 25-DEC-18 DUP	L2214457-5 Water 26-DEC-18 TB-L
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	546	516	1570	546	<2.0
	Hardness (as CaCO3) (mg/L)	272	255	863	271	<0.50 ^{HTC}
	pH (pH)	8.13	8.22	7.76	8.12	5.41
	Total Suspended Solids (mg/L)	<3.0	<3.0	76.1	<3.0	<3.0
	TDS (Calculated) (mg/L)	327	307	1100	324	<1.0
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	254	221	600	250	<1.0
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	254	221	600	250	<1.0
	Ammonia, Total (as N) (mg/L)	0.0179	0.0068	0.392	0.0158	
	Chloride (Cl) (mg/L)	4.40	6.72	16.1	4.38	<0.50
	Nitrate and Nitrite (as N) (mg/L)	0.165	0.0643	3.86	0.169	<0.0051
	Nitrate (as N) (mg/L)	0.165	0.0643	2.88	0.169	<0.0050
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	0.982	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	59.3	60.1	334	59.3	<0.30
	Anion Sum (meq/L)	6.44	5.85	19.7	6.36	<0.10
	Cation Sum (meq/L)	6.33	5.84	20.4	6.31	<0.10
	Cation - Anion Balance (%)	-0.8	-0.1	1.8	-0.4	0.0
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	13.0	18.4		12.4	
Total Metals	Aluminum (Al)-Total (mg/L)	0.0350	0.0390	0.288	0.0774	<0.0030
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	0.00019	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00026	0.00041	0.00075	0.00022	<0.00010
	Barium (Ba)-Total (mg/L)	0.0676	0.0717	0.174	0.0663	<0.00010
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	0.000024	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.026	0.023	0.038	0.026	<0.010
	Cadmium (Cd)-Total (mg/L)	0.0000060	0.0000121	0.000268	0.0000092	<0.0000050
	Calcium (Ca)-Total (mg/L)	54.9	62.0	216	53.8	<0.050
	Chromium (Cr)-Total (mg/L)	0.00012	0.00015	0.00124	0.00019	<0.00010
	Cobalt (Co)-Total (mg/L)	<0.00010	0.00012	0.00109	0.00011	<0.00010
	Copper (Cu)-Total (mg/L)	0.00266	0.0127	0.173	0.00388	<0.00050
	Iron (Fe)-Total (mg/L)	0.081	0.126	2.11	0.146	<0.010
	Lead (Pb)-Total (mg/L)	<0.000050	0.000188	0.000312	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	0.0035	0.0016	0.0049	0.0035	<0.0010
	Magnesium (Mg)-Total (mg/L)	28.7	20.4	62.0	28.7	<0.10
	Manganese (Mn)-Total (mg/L)	0.0863	0.214	3.86	0.102	<0.00010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID	L2214457-1	L2214457-2	L2214457-3	L2214457-4	L2214457-5
		Description	Water	Water	Water	Water	Water
		Sampled Date	25-DEC-18	25-DEC-18	25-DEC-18	25-DEC-18	26-DEC-18
		Sampled Time	09:10	09:35	14:35		
		Client ID	W3	W17	W8A	DUP	TB-L
Grouping	Analyte						
WATER							
Total Metals	Mercury (Hg)-Total (mg/L)		<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)		0.00526	0.00609	0.0110	0.00518	<0.000050
	Nickel (Ni)-Total (mg/L)		0.00094	0.00086	0.00171	0.00100	<0.00050
	Phosphorus (P)-Total (mg/L)		<0.050	<0.050	0.110	<0.050	<0.050
	Potassium (K)-Total (mg/L)		2.39	3.79	8.62	2.37	<0.10
	Selenium (Se)-Total (mg/L)		0.000352	0.000347	0.00437	0.000357	<0.000050
	Silicon (Si)-Total (mg/L)		6.68	6.11	9.82	6.74	<0.10
	Silver (Ag)-Total (mg/L)		<0.000010	<0.000010	0.000080	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)		20.0	15.1	60.1	19.0	<0.050
	Strontium (Sr)-Total (mg/L)		0.813	0.727	3.09	0.792	<0.00020
	Sulfur (S)-Total (mg/L)		21.7	21.5	130	21.3	<0.50
	Thallium (Tl)-Total (mg/L)		<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)		<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)		0.00162	0.00199	0.0159	0.00376	<0.00030
	Uranium (U)-Total (mg/L)		0.00288	0.00226	0.00540	0.00282	<0.000010
	Vanadium (V)-Total (mg/L)		<0.00050	0.00060	0.00354	0.00057	<0.00050
	Zinc (Zn)-Total (mg/L)		<0.0030	0.0047	0.672	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)		<0.00030	<0.00030	0.00065	<0.00030	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location		FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location		FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	DLB	<0.0030	<0.0030	<0.0080	<0.0040	
	Antimony (Sb)-Dissolved (mg/L)		<0.00010	<0.00010	0.00010	<0.00010	
	Arsenic (As)-Dissolved (mg/L)		0.00022	0.00036	0.00056	0.00021	
	Barium (Ba)-Dissolved (mg/L)		0.0637	0.0669	0.185	0.0670	
	Beryllium (Be)-Dissolved (mg/L)		<0.000020	<0.000020	<0.000020	<0.000020	
	Bismuth (Bi)-Dissolved (mg/L)		<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)		0.024	0.022	0.037	0.025	
	Cadmium (Cd)-Dissolved (mg/L)		0.0000079	<0.0000050	0.000244	0.0000094	
	Calcium (Ca)-Dissolved (mg/L)		57.6	67.8	232	56.9	
	Chromium (Cr)-Dissolved (mg/L)		<0.00010	0.00010	0.00065	<0.00010	
	Cobalt (Co)-Dissolved (mg/L)		<0.00010	<0.00010	0.00095	<0.00010	
	Copper (Cu)-Dissolved (mg/L)		0.00174	0.00732	0.0681	0.00174	
	Iron (Fe)-Dissolved (mg/L)		0.024	0.013	0.332	0.027	
	Lead (Pb)-Dissolved (mg/L)		<0.000050	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)		0.0034	0.0016	0.0051	0.0036	
	Magnesium (Mg)-Dissolved (mg/L)		31.1	20.8	69.0	31.4	
	Manganese (Mn)-Dissolved (mg/L)		0.0668	0.0385	4.38	0.0695	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2214457-1 Water 25-DEC-18 09:10 W3	L2214457-2 Water 25-DEC-18 09:35 W17	L2214457-3 Water 25-DEC-18 14:35 W8A	L2214457-4 Water 25-DEC-18 DUP	L2214457-5 Water 26-DEC-18 TB-L
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	0.0000061	<0.0000050	
	Molybdenum (Mo)-Dissolved (mg/L)	0.00518	0.00632	0.0113	0.00527	
	Nickel (Ni)-Dissolved (mg/L)	0.00087	0.00074	0.00142	0.00091	
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Potassium (K)-Dissolved (mg/L)	2.34	3.69	9.20	2.37	
	Selenium (Se)-Dissolved (mg/L)	0.000291	0.000370	0.00489	0.000275	
	Silicon (Si)-Dissolved (mg/L)	5.88	5.48	8.20	6.25	
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	0.000018	<0.000010	
	Sodium (Na)-Dissolved (mg/L)	19.3	14.8	61.5	18.9	
	Strontium (Sr)-Dissolved (mg/L)	0.849	0.785	3.37	0.867	
	Sulfur (S)-Dissolved (mg/L)	20.4	20.9	122	21.4	
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00090 ^{DLM}	<0.00030	
	Uranium (U)-Dissolved (mg/L)	0.00288	0.00219	0.00533	0.00296	
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	0.00155	<0.00050	
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	0.531	<0.0010	
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	0.00073	<0.00030	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Aluminum (Al)-Dissolved	MB-LOR	L2214457-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2214457-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2214457-1, -2, -3, -4
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2214457-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2214457-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2214457-1, -2, -3, -4
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2214457-1, -2, -3, -4
Matrix Spike	Barium (Ba)-Total	MS-B	L2214457-1, -2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Total	MS-B	L2214457-1, -2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2214457-1, -2, -3, -4, -5
Matrix Spike	Sodium (Na)-Total	MS-B	L2214457-1, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Total	MS-B	L2214457-1, -2, -3, -4, -5
Matrix Spike	Sulfur (S)-Total	MS-B	L2214457-1, -2, -3, -4, -5

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLB	Detection Limit Raised. Analyte detected at comparable level in Method Blank.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
HTC	Hardness was calculated from Total Ca and/or Mg concentrations and may be biased high (dissolved Ca/Mg results unavailable).
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			

Reference Information

HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
SO4-IC-N-VA	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)
This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".			
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.			
TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.			
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
----------------------------	---------------------

VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
----	---

Chain of Custody Numbers:

2018-12-26 A

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lw - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2214457-COFC

COC Number: 2018-12-26 A

Page 1 of 1

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Report To						Contact and company name below will appear on the final report								Report Format / Distribution							Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply												
Company:						Minto Explorations Ltd.						Select Report Format: ☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)							Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply														
Contact:						Minto Environment - Coordinator						Quality Control (QC) Report with Report ☒ YES ☐ NO							PRIORITY (Business Days) 4 day [P4] ☐ 3 day [P3] ☐ 2 day [P2] ☐ EMERGENCY 1 Business day [E1] ☐ Same Day, Weekend or Statutory holiday [E0] ☐														
Phone:						1-604-759-4659						☒ Compare Results to Criteria on Report - provide details below if box checked																					
												Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX																					
Street:						2100-510 West Georgia St.						Email 1 or Fax mintoenvironment@mintomine.com							Date and Time Required for all E&P TATs:														
City/Province:						Vancouver, British Columbia						Email 2							For tests that can not be performed according to the service level selected, you will be contacted.														
Postal Code:						V6B 0M3						Email 3							Analysis Request														
Invoice To												Invoice Distribution												Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below									
Same as Report To ☐ YES ☒ NO												Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX																					
Copy of Invoice with Report ☐ YES ☒ NO												Email 1 or Fax ap@mintomine.com																					
Company:						Minto Explorations Ltd.						Email 2																					
Contact:						Ruth Cayetano																											
Project Information												Oil and Gas Required Fields (client use)																					
ALS Account # / Quote #:												AFE/Cost Center:						PO#															
Job #:												Major/Minor Code:						Routing Code:															
PO / AFE: 229096 (WUL)												Requisitioner:																					
LSD:												Location:																					
ALS Lab Work Order # (lab use only)												ALS Contact: Shane Stack				Sampler: EB/CB/CR																	
ALS Sample # (lab use only)		Sample Identification and/or Coordinates (This description will appear on the report)						Date (dd-mmm-yy)		Time (hh:mm)		Sample Type												Number of Containers									
		W3						25-Dec-18		9:10		Water																					
		W17						25-Dec-18		9:35		Water																					
		W8A						25-Dec-18		14:35		Water																					
		DUP						25-Dec-18				Water																					
		TB-L						26-DEC-18				WATER																					
Drinking Water (DW) Samples ¹ (client use)						Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)										SAMPLE CONDITION AS RECEIVED (lab use only)																	
Are samples taken from a Regulated DW System? ☐ YES ☒ NO																Frozen ☐ SIF Observations Yes ☐ No ☐																	
Are samples for human drinking water use? ☐ YES ☒ NO																Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐																	
																Cooling Initiated ☒																	
																INITIAL COOLER TEMPERATURES °C																	
																FINAL COOLER TEMPERATURES °C																	
SHIPMENT RELEASE (client use)						INITIAL SHIPMENT RECEPTION (lab use only)										FINAL SHIPMENT RECEPTION (lab use only)																	
Released by: Chad Bustin				Date: Dec 26th, 2018				Time:		Received by:				Date: DEC 27, 2018		Time: 09:17		Received by: HA				Date: 12/28		Time: 11:50am									

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 EBON



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 02-JAN-19
Report Date: 11-JAN-19 15:49 (MT)
Version: FINAL REV. 2

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2215744
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2019-01-02A
Legal Site Desc:

Heather McKenzie
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2215744-1 water 01-JAN-19 08:00 W3	L2215744-2 water 31-DEC-18 15:00 W17	L2215744-3 water 31-DEC-18 14:30 W8A	L2215744-4 water 31-DEC-18 DUP	
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	551	520	1590	521	
	Hardness (as CaCO3) (mg/L)	276	256	860	260	
	pH (pH)	8.34	8.33	7.98	8.32	
	Total Suspended Solids (mg/L)	3.5	6.1	36.5	<3.0	
	TDS (Calculated) (mg/L)	331	311	1140	313	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	250	222	667	222	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	4.8	4.4	<1.0	4.0	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Total (as CaCO3) (mg/L)	254	226	667	226	
	Ammonia, Total (as N) (mg/L)	0.0155	0.0084	0.384	0.0070	
	Chloride (Cl) (mg/L)	4.43	6.64	16.8	6.63	
	Nitrate and Nitrite (as N) (mg/L)	0.168	0.0623	3.13	0.0614	
	Nitrate (as N) (mg/L)	0.168	0.0623	2.03	0.0614	
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	1.11	<0.0010	
	Sulfate (SO4) (mg/L)	60.3	60.8	331	60.7	
	Anion Sum (meq/L)	6.48	5.97	20.9	5.97	
	Cation Sum (meq/L)	6.42	5.85	20.4	5.97	
	Cation - Anion Balance (%)	-0.5	-1.1	-1.1	0.0	
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	5.02	10.0		9.66	
Total Metals	Aluminum (Al)-Total (mg/L)	0.0449	0.0321	0.148	0.0065	
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	0.00019	<0.00010	
	Arsenic (As)-Total (mg/L)	0.00026	0.00043	0.00075	0.00040	
	Barium (Ba)-Total (mg/L)	0.0695	0.0721	0.200	0.0686	
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Total (mg/L)	0.025	0.022	0.036	0.022	
	Cadmium (Cd)-Total (mg/L)	0.0000066	0.0000104	0.000363	<0.0000050	
	Calcium (Ca)-Total (mg/L)	60.8	70.1	239	69.1	
	Chromium (Cr)-Total (mg/L)	0.00015	0.00015	0.00144	0.00013	
	Cobalt (Co)-Total (mg/L)	<0.00010	0.00014	0.00114	<0.00010	
	Copper (Cu)-Total (mg/L)	0.00333	0.0119	0.143	0.00916	
	Iron (Fe)-Total (mg/L)	0.095	0.502	1.53	0.052	
	Lead (Pb)-Total (mg/L)	<0.000050	0.000201	0.000233	<0.000050	
	Lithium (Li)-Total (mg/L)	0.0038	0.0018	0.0054	0.0018	
	Magnesium (Mg)-Total (mg/L)	31.6	22.4	73.1	22.2	
	Manganese (Mn)-Total (mg/L)	0.0945	0.210	4.81	0.0618	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2215744-1 water 01-JAN-19 08:00 W3	L2215744-2 water 31-DEC-18 15:00 W17	L2215744-3 water 31-DEC-18 14:30 W8A	L2215744-4 water 31-DEC-18 DUP	
Grouping	Analyte						
WATER							
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	0.0000064	0.0000101	<0.0000050		
	Molybdenum (Mo)-Total (mg/L)	0.00546	0.00635	0.0104	0.00651		
	Nickel (Ni)-Total (mg/L)	0.00101	0.00100	0.00313	0.00086		
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	0.089	<0.050		
	Potassium (K)-Total (mg/L)	2.32	3.59	9.03	3.60		
	Selenium (Se)-Total (mg/L)	0.000316	0.000363	0.00374	0.000308		
	Silicon (Si)-Total (mg/L)	6.42	5.79	9.00	5.74		
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	0.000067	<0.000010		
	Sodium (Na)-Total (mg/L)	19.0	14.5	59.8	14.4		
	Strontium (Sr)-Total (mg/L)	0.839	0.769	3.18	0.780		
	Sulfur (S)-Total (mg/L)	21.7	21.3	118	22.0		
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010		
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	0.00018	<0.00010		
	Titanium (Ti)-Total (mg/L)	0.00202	<0.0015 ^{DLM}	<0.0072 ^{DLM}	0.00033		
	Uranium (U)-Total (mg/L)	0.00281	0.00216	0.00546	0.00221		
	Vanadium (V)-Total (mg/L)	0.00050	0.00055	0.00303	<0.00050		
	Zinc (Zn)-Total (mg/L)	<0.0030	0.0051	0.413	<0.0030		
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	0.00071	<0.00030		
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD		
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD		
	Aluminum (Al)-Dissolved (mg/L)	0.0014	0.0014	0.0066	0.0016		
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	0.00011	<0.00010		
	Arsenic (As)-Dissolved (mg/L)	0.00020	0.00035	0.00051	0.00037		
	Barium (Ba)-Dissolved (mg/L)	0.0731	0.0730	0.203	0.0761		
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020		
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050		
	Boron (B)-Dissolved (mg/L)	0.024	0.021	0.034	0.021		
	Cadmium (Cd)-Dissolved (mg/L)	0.0000065	<0.0000050	0.000220	<0.0000050		
	Calcium (Ca)-Dissolved (mg/L)	60.5	68.0	229	68.7		
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	0.00069	<0.00010		
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	0.00106	<0.00010		
	Copper (Cu)-Dissolved (mg/L)	0.00175	0.00718	0.0641	0.00764		
	Iron (Fe)-Dissolved (mg/L)	0.030	0.016	0.323	0.018		
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050		
	Lithium (Li)-Dissolved (mg/L)	0.0036	0.0016	0.0049	0.0016		
	Magnesium (Mg)-Dissolved (mg/L)	30.3	20.9	69.8	21.4		
	Manganese (Mn)-Dissolved (mg/L)	0.0668	0.0391	4.38	0.0434		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID	L2215744-1	L2215744-2	L2215744-3	L2215744-4	
		Description	water	water	water	water	
		Sampled Date	01-JAN-19	31-DEC-18	31-DEC-18	31-DEC-18	
		Sampled Time	08:00	15:00	14:30		
		Client ID	W3	W17	W8A	DUP	
Grouping	Analyte						
WATER							
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	0.0000067	<0.0000050		
	Molybdenum (Mo)-Dissolved (mg/L)	0.00579	0.00618	0.0106	0.00647		
	Nickel (Ni)-Dissolved (mg/L)	0.00083	0.00074	0.00182	0.00069		
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050		
	Potassium (K)-Dissolved (mg/L)	2.42	3.70	9.17	3.98		
	Selenium (Se)-Dissolved (mg/L)	0.000326	0.000321	0.00397	0.000369		
	Silicon (Si)-Dissolved (mg/L)	6.67	5.78	8.90	5.86		
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	0.000017	<0.000010		
	Sodium (Na)-Dissolved (mg/L)	19.3	14.8	64.7	15.6		
	Strontium (Sr)-Dissolved (mg/L)	0.859	0.712	3.13	0.765		
	Sulfur (S)-Dissolved (mg/L)	20.0	19.3	105	18.7		
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010		
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010		
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00090 ^{DLM}	<0.00030		
	Uranium (U)-Dissolved (mg/L)	0.00325	0.00241	0.00579	0.00247		
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	0.00164	<0.00050		
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	0.488	<0.0010		
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	0.00072	<0.00030		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2215744-1, -2, -3, -4
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2215744-1
Matrix Spike	Boron (B)-Dissolved	MS-B	L2215744-1
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2215744-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2215744-1
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2215744-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2215744-1
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2215744-1, -2, -3, -4
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2215744-1
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2215744-1, -2, -3, -4
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2215744-1
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2215744-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2215744-1
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2215744-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2215744-1
Matrix Spike	Aluminum (Al)-Total	MS-B	L2215744-1, -2, -3, -4
Matrix Spike	Barium (Ba)-Total	MS-B	L2215744-1, -2, -3, -4
Matrix Spike	Boron (B)-Total	MS-B	L2215744-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Total	MS-B	L2215744-1, -2, -3, -4
Matrix Spike	Copper (Cu)-Total	MS-B	L2215744-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2215744-1, -2, -3, -4
Matrix Spike	Manganese (Mn)-Total	MS-B	L2215744-1, -2, -3, -4
Matrix Spike	Potassium (K)-Total	MS-B	L2215744-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Total	MS-B	L2215744-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Total	MS-B	L2215744-1, -2, -3, -4
Matrix Spike	Sulfate (SO4)	MS-B	L2215744-1, -2, -3, -4

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

Reference Information

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-SCREEN-VA Water Conductivity Screen (Internal Use Only) APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 µm), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

Reference Information

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
----------------------------	---------------------

VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
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Chain of Custody Numbers:

2019-01-02A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

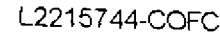
Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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Page 1 of 1

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WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white-report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

6/10/2016 1:59:01

Appendix E – 2018 Water Balance and Water Quality Model Summary for the Minto Mine

Memo

To:	Deborah Flemming	Client:	Minto Explorations Ltd.
From:	Soren Jensen, Kaitlyn Kooy	Project No:	1CM002.065
Cc:	Dylan MacGregor (SRK)	Date:	March 28, 2019
Subject:	2018 Water Balance and Water Quality Model Summary for the Minto Mine Site		

1 Introduction and Background

This memorandum provides a summary of the 2018 water balance and water quality model updates for the Minto Mine site. The update covers the period January 1, 2018 through December 31, 2018.

The water balance update includes a review and summary of precipitation, flow and water inventory data for the Mine site. The water quality update includes a comparison of water quality data collected in 2018 to water quality model predictions for Phase VII of the Mine development. Water quality predictions for the Main Pit Tailings Management Facility (MPTMF) and the Water Storage Pond (WSP) are provided for 2018 and for the post-closure period when predicted concentrations are the same from year to year (steady state concentrations).

In October 2018, Minto ended the mill operation and commenced care and maintenance of the mine. Over the next few years, the water quality in the MPTMF and the WSP are expected to trend toward the post-closure predictions.

2 Water Balance Update

2.1 Precipitation

Table 1 shows a summary of monthly precipitation measured at the Mine site between October 2017 and December 2018 along with precipitation data from the regional station at Carmacks, YT (Climate ID: 2100301)¹, which is located 77 km Southwest of the Minto Mine. In the past, the meteorological station at Pelly Ranch (Climate ID 2100880)¹ located 25 km north of Minto was used as a regional reference station. However, the published data record from Pelly Ranch ends in March 2015 so the Carmacks Station was used instead.

Minto's Campbell Scientific meteorological station measures total precipitation using a Geonor gauge and a tipping bucket rain gauge. From October through May, the tipping bucket is equipped with a snowfall conversion adaptor, which allows it to measure snowfall as snow water

¹ Data obtained from Meteorological Service of Canada, Environment Canada.

equivalent. The Geonor precipitation gauge collects precipitation in a bucket and records precipitation by measuring the weight of the bucket. In the winter months, the bucket is partially filled with an antifreeze solution that melts any snow collected.

In 2018, the total precipitation measurement collected by the Geonor gauge were faulty for most of the year. Therefore, the monthly precipitation reported for site are based on measurements collected by the tipping bucket gauge. Figure 1 shows monthly precipitation recorded by the two gauges as well as total precipitation recorded at Carmacks.

Table 1: Precipitation Records for the Minto Mine Site and Carmacks

		Campbell Scientific Station (Minto)		
Year	Month	Tipping Bucket Gauge	Geonor Gauge ^A	Carmacks
				(Climate ID
		mm/month	mm/month	mm/month
2017	Oct	4.7	17.9	25.2
2017	Nov	7.9	7.9	21.2
2017	Dec	4.7	4.7	8.8
2018	Jan	7.0	n/a	9.2
2018	Feb	8.6	n/a	13.4
2018	Mar	14.6	n/a	15.8
2018	Apr	5.0	n/a	1.9
2018	May	6.9	n/a	5.3
2018	Jun	38.5	n/a	28.6
2018	Jul	20.7	n/a	11.3
2018	Aug	44.7	n/a	72.7
2018	Sept	22.9	n/a	13.1
2018	Oct	10.6	n/a	15.0
2018	Nov	8.6	n/a	8.9
2018	Dec	6.7	n/a	3.2
SUM Hydrological		192.1	n/a	216.3
Nov. 2017 to Oct.				

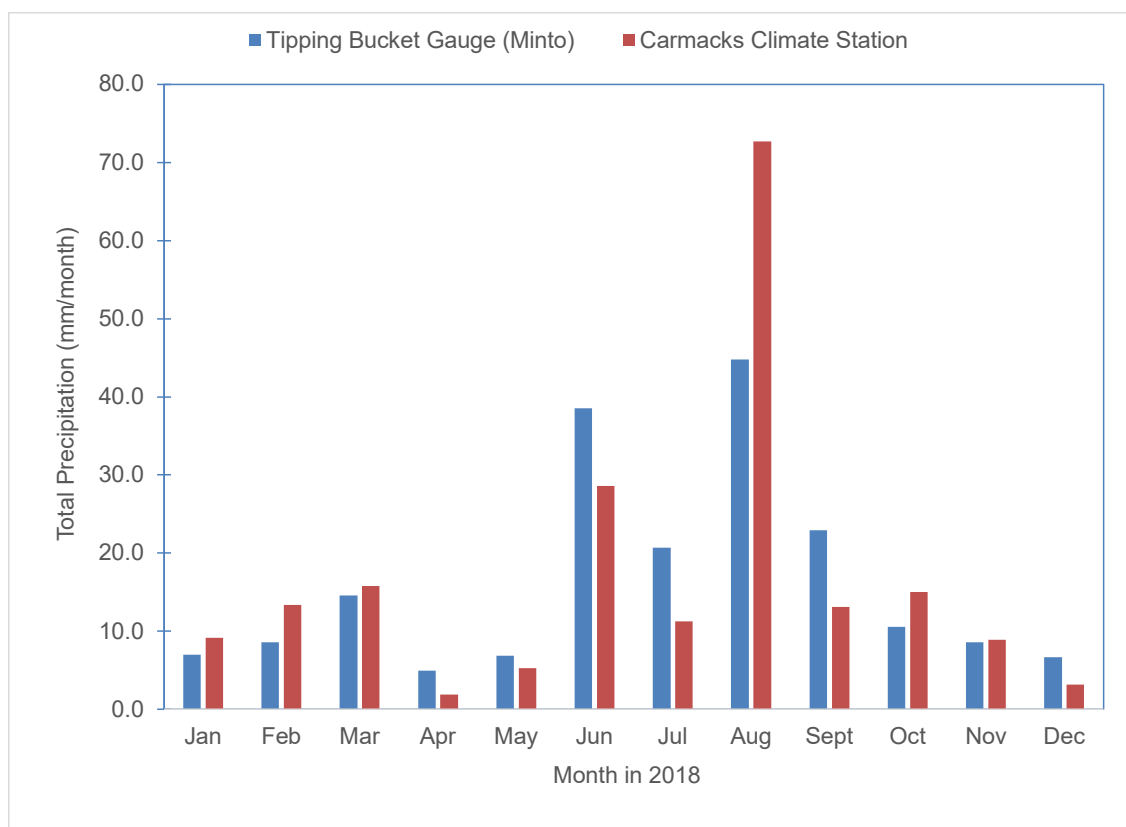
Source: Minto Site Data: X:\01_SITES\Minto\1CM002.024_Water_Balance_Support\2015_Water_Balance_Update\Minto Water Balance\2017 Met Station Data Summary.xlsx

Notes:

A: Data obtained from Meteorological Service of Canada, Environment Canada.

Approximately 192 mm of precipitation was measured at the Mine site in the 2018 hydrological year, which was lower than total precipitation measured in 2016 (242 mm) and 2017 (210 mm). Total annual precipitation of 192 mm roughly corresponds to a 1 in 100 dry year. This is the fifth year in a row that total annual precipitation at Minto has been lower than average.

Precipitation measured by the tipping bucket gauge at Minto and total precipitation measurement at Carmacks are in good agreement considering that the stations are located 77 km apart. The total annual precipitation at Carmacks is a little higher but still indicative of a very dry year. Precipitation measured at Carmacks was higher than at Minto in August but lower in June and July.



X:\01_SITES\Minto\1CM002.024_Water_Balance_Support\2018 Water Balance Update\2018 Met Station Data Summary.xlsx

Figure 1: 2017 Monthly Total Precipitation Measurements at Minto and at Carmacks

2.2 Snow Course Data

Snow course surveys were completed at four established snow survey stations at the Mine site in 2018. Table 2 shows a summary of the snow survey data (i.e. an average of the results from the four stations) from 2009 to 2018. The depth and water equivalent of the snow pack provides an indication of the volume of surface runoff that must be managed the following freshet. In March, April and May 2018, approximately 320,000 m³ of surface runoff was collected from catchments at the Mine site upstream of the Water Storage Dam. This volume corresponds to roughly 30 mm of runoff. In comparison, approximately 20 mm of runoff was collected during freshet in 2017, which is consistent with the fact that the April 2017 snowpack was 40% lower than the April 2018 snowpack.

Table 2: Summary of Snow Survey Data for the Minto Mine Site

Year	February	March	April
	Water Equivalent (mm)	Water Equivalent (mm)	Water Equivalent (mm)
2009	92.7	110.0	150.7
2010	107.7	120.7	56.0
2011	106.0	141.7	111.7
2012	111.0	127.0	132.7
2013	91.3	106.0	62.7
2014	84.3	99.7	67.3
2015	90.3	76.6	67.8
2016	80.3	80.7	n/a
2017	79.0	72.7	59.3
2018	60.0	69.4	101.1

Source: X:\01_SITES\Minto\1CM002.024_Water_Balance_Support\2018 Water Balance Update\2018 Snow Survey Field Data.xlsx

2.3 Water Management

Water that is suitable for release into Minto Creek is conveyed to the Water Storage Pond (WSP), while water collected from active mine areas is routed to the Main Pit Tailings Management Facility (MPTMF) or the Area 2 Pit Tailings Management Facility (A2PTMF). Since November 2012, the MPTMF has also been used for subaqueous deposition of tailings. Deposition of mine water and tailings (subaqueous) to the A2PTMF commenced in April 2015.

Other water management features on the Mine site include:

- WSP: reservoir for water that meets discharge criteria and is destined for discharge to Minto Creek.
- W15 sump: collects surface runoff and seepage from:
 - The Southwest Waste Dump;
 - Part of the Main Waste Dump; and
 - Adjacent undisturbed catchments.

In 2018, water collected at W15 was routed to the Main Pit TMF from late April until May 21st at which time it was conveyed to the WSP from until August 20th. At that time the W15 water was again directed to the Main Pit TMF. Approximately 50% of the catchment that reports to W15 is covered by waste rock.

- W35 sump: collects surface runoff from the minimally disturbed southern catchments. Water collected at W35 in 2018 was piped to the Area 2 Pit TMF from late April until May 13th at which time it was directed to WSP. On September 2nd, the W35 sump water was redirected to the Area 2 Pit TMF.
- W62 sump (formerly known as W36 or W37 sump): collects surface runoff and seepage from the mill valley, including contributions from the Dry Stack Tailings Storage Facility. Water collected at the W62 sump is pumped to the MPTMF.

- Tailings Diversion Ditch: diverts water from (W35 Sump) minimally disturbed southern catchments to the WSP (can also be routed to the MPTMF).

2.4 2018 Water Balance

Table 3 summarizes the monthly water and tailings inventory in Minto's MPTMF and A2PTMF as well as water inventory in the WSP. In 2018, the water inventory in the MPTMF increased by approximately 7,000 m³, while the water inventory in A2PTMF increased by roughly 524,000 m³. The WSP water inventory increased by about 9,000 m³ between January 1 and December 31, 2018.

Table 4 shows a summary of the 2018 water balance for the Mine site. The total surface runoff collected on site was estimated to be 567,000 m³ based on the change in the water inventory and the known volume of water released to Minto Creek. The total catchment upstream of the Water Storage Dam measures approximately 1,040 ha. Therefore, 567,000 m³ of runoff from 1,040 ha gives a unit yield of approximately 54 mm/year.

The water and load balance model used for forecasting surface runoff volumes uses a site-wide annual average runoff coefficient, which has been derived based on previous years' water balance results. The runoff coefficient is estimated based on the total annual precipitation as follows:

- For dry years with less than 190 mm total precipitation: runoff coefficient = 0.15.
- For average to wet years with more than 309 mm total precipitation: runoff coefficient = 0.30.
- Runoff coefficients for years with total precipitation between 190 mm and 309 mm: interpolated values between 0.15 and 0.30.

In 2018 (hydraulic year) the estimated total precipitation was 192 mm (Table 1), which corresponds to a modelled runoff coefficient of 0.15. The site-wide runoff coefficient, based on the 2017 water balance (measured flows, water inventory and total precipitation), is:

$$\text{Annual Yield} / \text{Total Annual Precipitation} = \text{Runoff Coefficient} \rightarrow 54 \text{ mm} / 192 \text{ mm} = \mathbf{0.28}$$

The calculated value for the annual site-wide runoff coefficient is higher than the runoff coefficient estimated by the water balance model. However, the site-wide runoff coefficient is similar to the coefficient calculated in previous, slightly wetter years. The runoff coefficient calculated last year, another very dry year, was 0.27. Therefore, the method used by the water balance model to estimate runoff in dry years is likely too conservative (i.e. conservatively dry) and may have to be revised for future model runs.

Table 3: 2018 Water Inventory and Release to Minto Creek

Month/	MPTMF Volume Occupied (Water + Tailings) ^A	Change in MPTMF Water Inventory	Tailings Solids Deposition in MPTMF	A2PTMF Volume Occupied (Water + Tailings) ^A	Change in A2PTMF Water Inventory	Tailings Solids Deposition in A2PTMF	WSP Volume ^A	Change in WSP Water Inventory
Year	m ³	m ³ /month	BCM/month	m ³	m ³ /month	BCM/month	m ³	m ³ /month
Jan-18	3,903,000	103,000	0	1,259,000	-40,000	45,000	72,000	-7,000
Feb-18	4,005,000	-23,000	0	1,264,000	140,000	42,000	65,000	-5,000
Mar-18	3,982,000	-33,000	0	1,447,000	-14,000	45,000	61,000	-5,000
Apr-18	3,950,000	-71,000	0	1,478,000	77,000	44,000	56,000	4,000
May-18	3,878,000	82,000	0	1,599,000	82,000	36,000	60,000	24,000
Jun-18	3,960,000	6,000	0	1,716,000	11,000	24,000	84,000	6,000
Jul-18	3,966,000	-24,000	0	1,751,000	18,000	25,000	90,000	-2,000
Aug-18	3,942,000	-28,000	0	1,794,000	13,000	27,000	88,000	5,000
Sep-18	3,914,000	-51,000	0	1,834,000	125,000	24,000	93,000	-2,000
Oct-18	3,864,000	-13,000	0	1,983,000	36,000	13,000	91,000	-3,000
Nov-18	3,851,000	11,000	0	2,032,000	87,000	0	88,000	-5,000
Dec-18	3,862,000	48,000	0	2,120,000	-12,000	0	83,000	-2,000
Jan-19	3,909,000			2,107,000			81,000	
SUM		7,000			524,000	325,000		9,000

Source: X:\01_SITES\Minto\1CM002.024_Water_Balance_Support\2018_Water_Balance_Update\2012018 Water Balance Update REV00 SRJ.xlsx

Notes:

A – on the first day of the month.

Table 4: Water Balance Summary of the Minto Mine Site, 2018 (Jan to Dec)

	Units	Main Pit TMF	Area 2 Pit TMF	WSP
Volume Change 2017 (water + tailings)	m ³	7,000	849,000	9,000
Tailings Deposited, total	BCM	-	325,000	-
Water Volume Change 2017	m ³	7,000	524,000	9,000
Estimated Groundwater Inflow	m ³	-	-	-
Total Water Inventory Increase in 2017	m³	560,000		
Total Water Discharged to Minto Creek	m ³	27,000		
Total Site-Wide Yield in 2017	m³	587,000		

Source: X:\01_SITES\Minto\1CM002.024_Water_Balance_Support\2018_Water_Balance_Update\2018 Water Balance Update REV00 KNK.xlsx

3 Water Quality Model Update

3.1 Solid Phase Geochemistry

The neutralization potential ratio (NPR) and copper content of waste rock and tailings were reviewed in order to identify any new trends in the solid phase geochemistry that may have developed since the last source term update. Significant changes in the solid phase geochemistry would indicate a need for further analysis of the waste rock and tailings to generate new source terms that reflect the observed changes in the geochemistry.

No significant changes in geochemistry were observed in the properties of the waste rock in 2018 compared to similar materials produced in prior years (Figures 2 and 4). Therefore, no further evaluation of 2018 solid phase geochemistry was warranted.

The NPR and copper content of waste rock and tailings are shown in Figure 2 to Figure 5. The NPR of tailings solids appear to show a slightly increasing trend in 2018 (Figure 3) and copper concentrations a decreasing trend (Figure 5). Measured NPR was greater than 3 for all samples, which indicates that the tailings are not potentially acid generating.

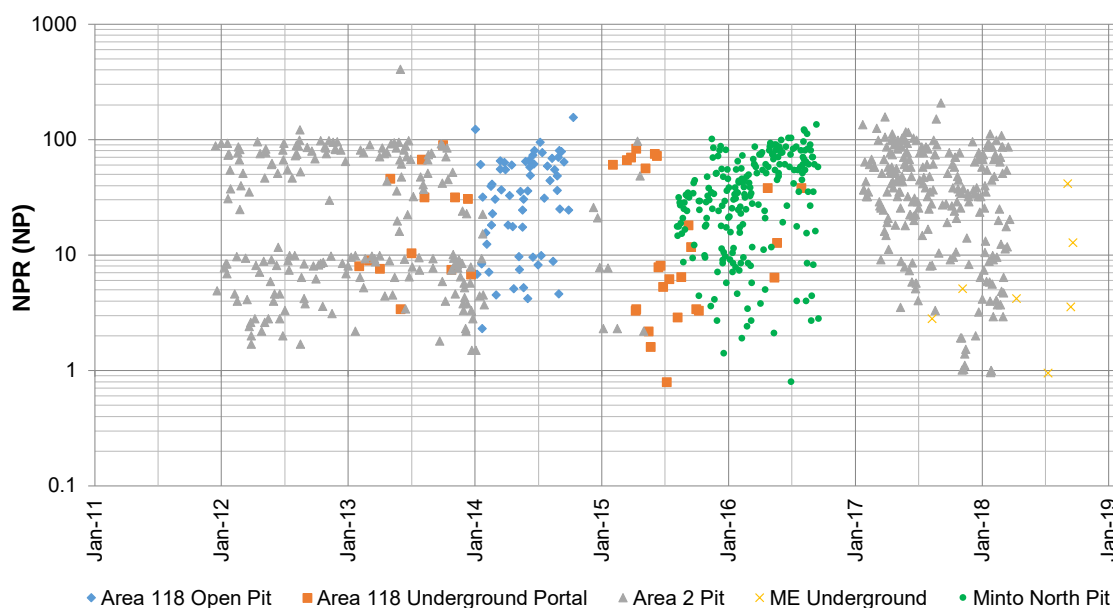


Figure 2: Waste Rock Neutralization Potential Ratio over Time

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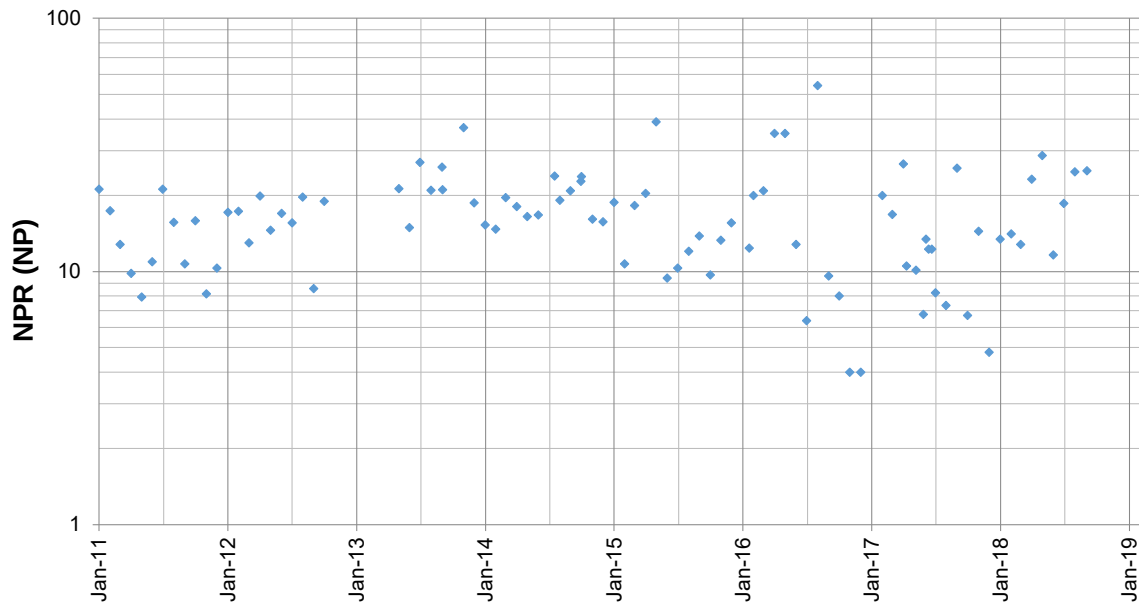


Figure 3: Tailings Neutralization Potential Ratio over Time

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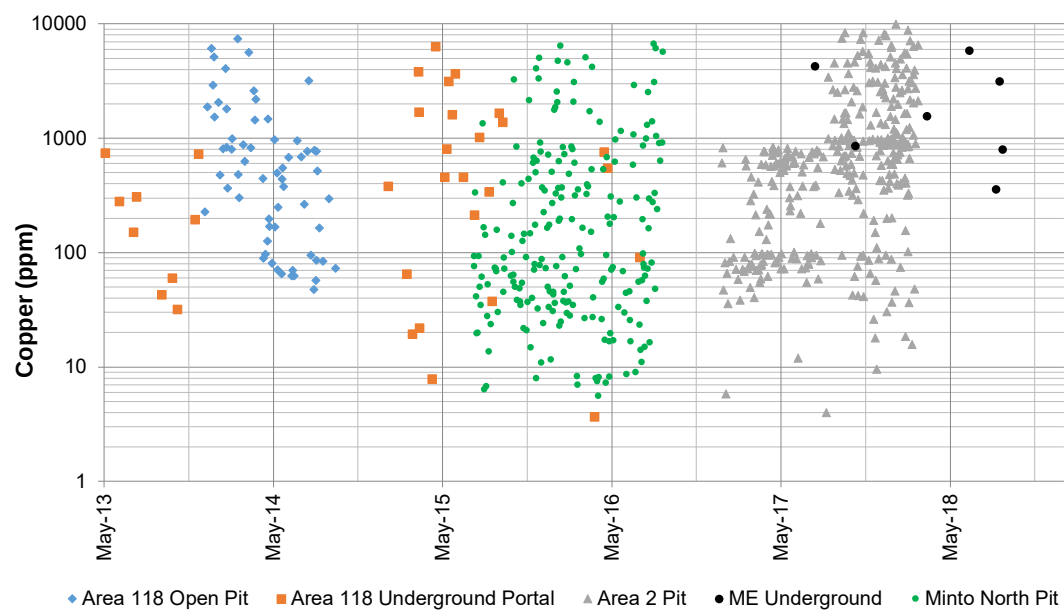


Figure 4: Waste Rock Copper Concentration over Time

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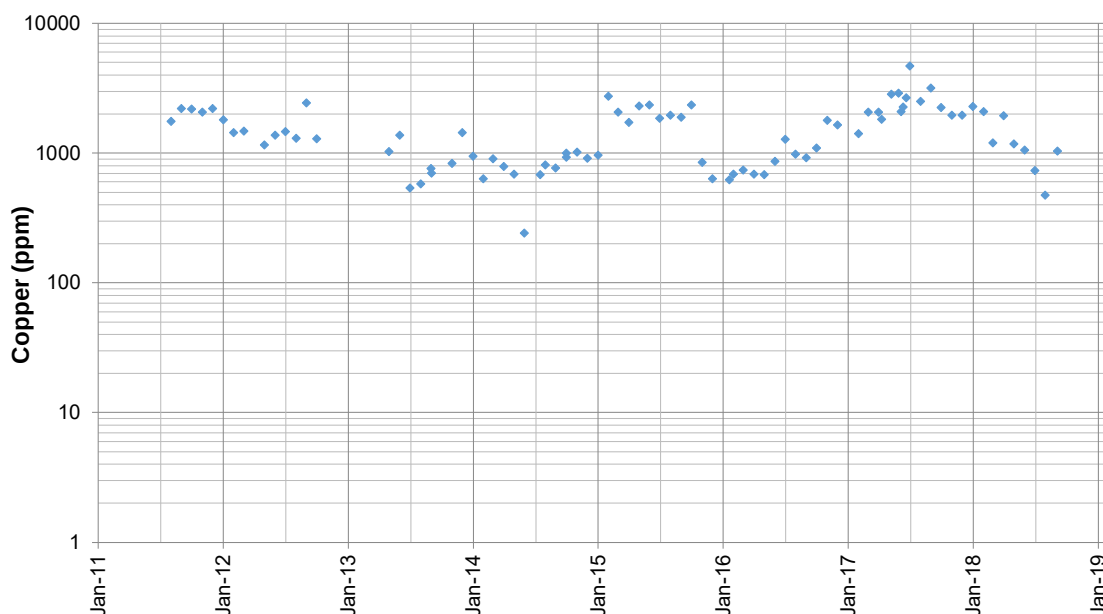


Figure 5: Tailings copper concentration over time

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3.2 Comparison of Measured Water Quality Data to Source Terms

3.2.1 Source Terms – Dry Stack Tailings Storage Facility

The Dry Stack Tailings Storage Facility (DSTSF) source terms used in the water and load balance model for the Minto were developed based on the observed water chemistry of samples collected at station W8 and W8A. This station was chosen because it had the highest concentrations of copper, cadmium, selenium, and sulfate during the period of record. The following points describe the source terms:

- Best Estimate source term: 50th percentile dissolved concentrations from W8A;
- Reasonable Worst Case source term: 95th percentile dissolved concentrations from W8A.

The Best Estimate and Reasonable Worst Case source terms were updated to include data to 2018 for comparison to the existing source terms. It was found that the updated source terms did not differ from the source terms used in the latest model revision, which included data up to and including 2016. Therefore, for consistency the original DSTSF source terms was be used in this 2018 update of the water balance and water quality model.

3.2.2 Source Terms – Waste Rock

The Main Waste Dump and the Southwest Waste Dump source terms used in the water and load balance model were defined based on observed water chemistry at station W15, which collects runoff from the Southwest Waste Dump. The latest model revision assigned Best Estimate waste rock source term as the 50th percentile dissolved concentrations at W15 until the end of 2016 and

the Reasonable Worst Case waste rock source term was the 95th percentile dissolved concentrations. Water quality data collected at W15 in 2018 followed the same trends as the historical data. Therefore, the original source term was used for the updated predictions presented here.

3.2.3 Source Term – Tailings Slurry

In 2018, sulfate concentrations in the Area 2 and Main Pit water decreased after reaching a peak in mid- to late 2017. In 2017, sulfate concentrations in the Area 2 and Main Pit water increased at a greater rate than in previous years, likely due to variability in sulfate loadings from tailings slurry.

In October 2018, the mill ceased operation. With the end of tailings deposition to the A2PTMF the load of sulfate to the pit water was significantly reduced. Therefore, the sulphate concentrations in the pit water is expected to continue to decrease.

3.3 Water Quality Model Results

Table 5 and 6 show revised model outputs from the water and load balance model for water quality in the Water Storage Pond (WSP) for 2018 and post-closure (best estimate and worst case) along with concentrations measured in 2018. Table 7 and 8 show revised model predictions of water quality in the MPTMF for 2018 and post-closure. Predictions for post-closure were selected to provide representative long-term indications of water quality trends. Predictions are for average precipitation conditions. The Water Use Licence (QZ14-031) effluent limits are also listed in the tables. Model runs started on 1 January 2016 and ended on 1 January 2045, at which point concentrations in the model roughly have reached steady state.

Water collected in the WSP includes clean (non-contact) runoff and effluent from Minto's water treatment plant. Median measured concentrations in the WSP in 2018 were lower than or comparable to the revised model predictions using best estimate source terms (Table 5), except for dissolved copper for which the measured median concentration was 31 µg/L compared to expected median concentrations of approximately 8 µg/L for the Best Estimate model scenario, but close to the predicted median concentration of 30 µg/L for the Reasonable Worst Case scenario (Table 6).

Dissolved copper concentrations in the WSP shows a decreasing trend between 2011 and 2015 followed by an increasing trend between 2015 and 2018 (Figure 6). The increase in copper concentrations in the WSP in 2018 was due to a reduction in the volume of treated MPTMF water that was pumped to the WSP. MPTMF water is treated using reverse osmosis, which removes nearly all dissolved copper.

Revised model predictions using reasonable worst case source terms are generally higher than comparable median and maximum measured values for the WSP, except for copper (Table 6).

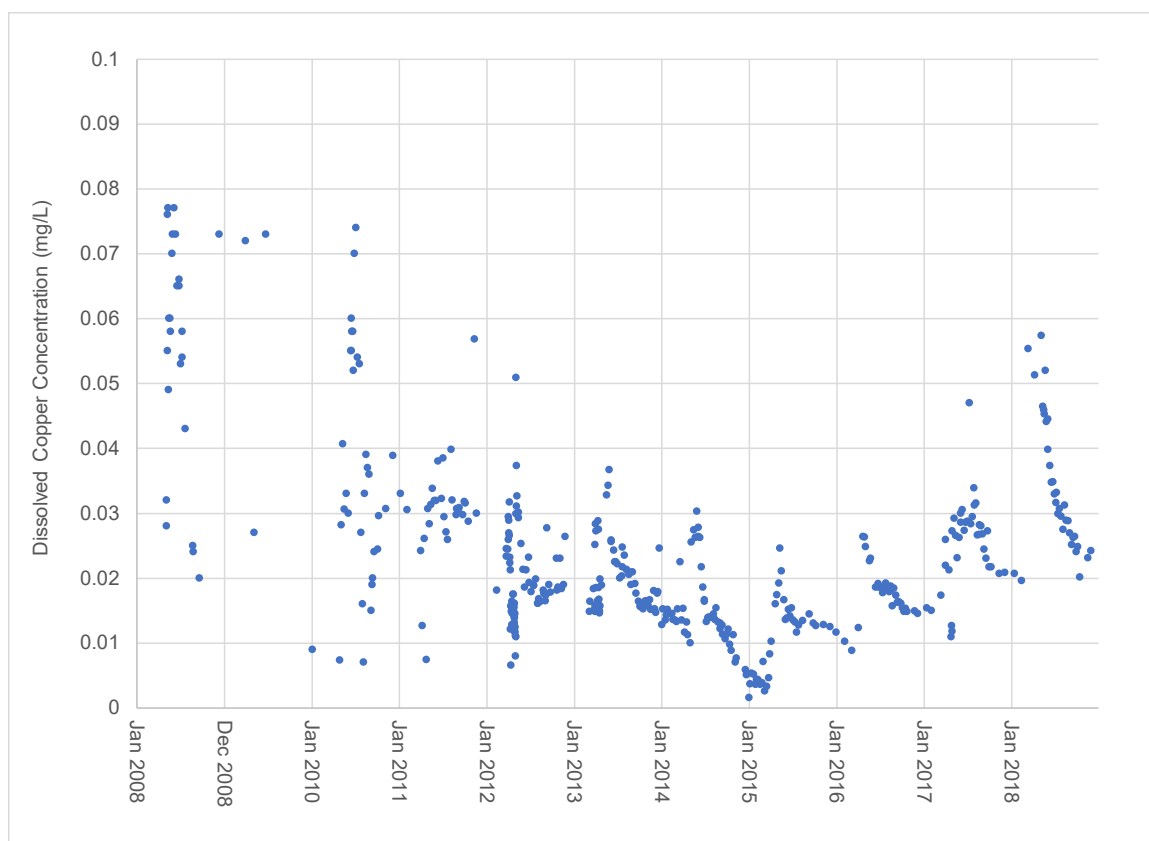


Figure 6 Dissolved Copper Concentrations in WSP (Station W16)

The MPTMF was historically the primary water reservoir on site. In the model, the free water in the MPTMF and A2PTMF are more or less considered to belong to the same reservoir due to the high rate of flow between the two reservoirs while the mill was operating. During the care and maintenance phase, concentrations in the MPTMF and the A2PTMF are expected to change independently due to the lower rate of water transfer between the two reservoirs. For 2018, a comparison of measured MPTMF water quality with concentrations predicted for pit water for the Phase V/VI environmental assessment provides a good measure of actual vs. expected geochemical performance of the site. The median of measured concentrations in the MPTMF are generally at or below predicted median values except for nitrite, which was 3 to 4 times higher than expected (Table 7). Nitrite is relatively unstable and is produced and consumed by biological activity in the pit. Therefore, concentration predictions for nitrite by a mass-conservative load balance model are generally not reliable. Water quality model predictions using reasonable worst-case source terms are higher than measured median and maximum concentrations, except for nitrite (Table 8).

The overall favorable agreement in the results tables below indicates that the revised source terms are appropriate for describing the existing geochemical performance and the actual water management practices on site. Best estimate source terms are intended to provide an indication of the general trend in water quality parameter concentrations but are not intended to capture maximum or outlier concentration values. Therefore, the median values of best estimate model predictions are compared to measured median values.

Table 5: WSP Water Quality Model Predictions and Measured Concentrations in 2018, Best Estimate

		WUL Effluent Limits (QZ14-031)	WSP Measured Water Quality (Station W16)	Modelling Predictions of Quality in WSP (Station W16)	
Year				2018	2018
			Median	Median	Median
Ammonia	mg/L	0.75	0.016	0.057	0.23
N-NO ₂	mg/L	0.18	0.0089	0.022	0.059
N-NO ₃	mg/L	27.3	1.5	2	1.2
Ag-Dissolved	Mg/L	0.0003	0.00001	0.000013	0.000049
Al-Dissolved	mg/L	0.3	0.012	0.032	0.28
As-Dissolved	mg/L	0.015	0.00042	0.00048	0.0021
Cd-Dissolved	mg/L	0.0014a	0.0000092	0.00002	0.000022
Cr-Dissolved	mg/L	0.003	0.00013	0.00069	0.0019
Cu-Dissolved	mg/L	0.06/0.039b	0.031	0.0084	0.013
Fe-Dissolved	mg/L	3.3	0.056	0.31	0.59
Pb-Dissolved	mg/L	0.012	0.00005	0.00015	0.00042
Mo-Dissolved	mg/L	0.219	0.0028	0.0014	0.0097
Ni-Dissolved	mg/L	0.33	0.0009	0.0012	0.0024
Se-Dissolved	mg/L	0.006	0.00075	0.00057	0.002
Zn-Dissolved	mg/L	0.09	0.001	0.0042	0.0035

Source: SRK, X:\01_SITES\Minto\1CM002.024_Water_Balance_Support\2018 Water Balance Update\Model_Results_20190320_REV00_SRJ.xlsx

Notes:

Analytical data from Minto's water quality monitoring program.

a) at 50 mg/L hardness.

b) Cu effluent standard is 0.06 when [DOC] @ W2 > 10 mg/L and 0.039 when [DOC] @ W2 ≤ 10 mg/L.

Table 6: WSP Water Quality Model Predictions and Measured Concentrations in 2018, Reasonable Worst Case

		WUL Effluent Limits (QZ14-031)	WSP Measured Water Quality (Station W16)		Modelling Predictions of Quality in WSP (Station W16)			
Year			2018		2018		Post-Closure	
			Median	Max	Median	Max	Median	Max
Ammonia	mg/L	0.75	0.016	0.1	0.25	0.29	0.83	1.6
N-NO2	mg/L	0.18	0.0089	0.022	0.18	0.22	0.12	0.23
N-NO3	mg/L	27.3	1.5	2	13	16	3.3	6.4
Ag-Dissolved	Mg/L	0.0003	0.00001	0.00001	0.000023	0.000025	0.000088	0.00021
Al-Dissolved	mg/L	0.3	0.012	0.049	0.11	0.14	0.55	1.2
As-Dissolved	mg/L	0.015	0.00042	0.00057	0.0011	0.0012	0.0047	0.011
Cd-Dissolved	mg/L	0.0014a	0.0000092	0.00015	0.000088	0.0001	0.000096	0.00024
Cr-Dissolved	mg/L	0.003	0.00013	0.00029	0.0013	0.0014	0.0036	0.0086
Cu-Dissolved	mg/L	0.06/0.039b	0.031	0.057	0.03	0.035	0.02	0.057
Fe-Dissolved	mg/L	3.3	0.056	0.21	1.1	1.2	1.4	3.9
Pb-Dissolved	mg/L	0.012	0.00005	0.00011	0.00028	0.00029	0.0018	0.004
Mo-Dissolved	mg/L	0.219	0.0028	0.004	0.0054	0.0061	0.03	0.071
Ni-Dissolved	mg/L	0.33	0.0009	0.0013	0.0029	0.0031	0.0054	0.015
Se-Dissolved	mg/L	0.006	0.00075	0.00096	0.0031	0.0038	0.0044	0.0084
Zn-Dissolved	mg/L	0.09	0.001	0.028	0.0092	0.01	0.0083	0.023

Source: SRK, X:\01_SITES\Minto\1CM002.024_Water_Balance_Support\2018 Water Balance Update\Model_Results_20190320_REV00_SRJ.xlsx

Notes:

Analytical data from Minto's water quality monitoring program.

- a) at 50 mg/L hardness.
- b) Cu effluent standard is 0.06 when [DOC] @ W2 > 10 mg/L and 0.039 when [DOC] @ W2 ≤ 10 mg/L.

Table 7: MPTMF Water Quality Model Predictions and Measured Concentrations in 2018, Best Estimate

		WUL Effluent Limits (QZ14-031)	MPTMF Measured Water Quality (Station W12)	Modelling Predictions of Quality in MPTMF (Station W12)	
Year				2018	2018
			Median	Median	Median
Ammonia	mg/L	0.75	4.2	4.4	0.079
N-NO2	mg/L	0.18	5.3	1.5	0.017
N-NO3	mg/L	27.3	5.7	33	0.38
Ag-Dissolved	Mg/L	0.0003	0.00002	0.000063	0.000057
Al-Dissolved	mg/L	0.3	0.0054	0.37	0.26
As-Dissolved	mg/L	0.015	0.00042	0.0026	0.0021
Cd-Dissolved	mg/L	0.0014a	0.00009	0.000087	0.00006
Cr-Dissolved	mg/L	0.003	0.0002	0.0022	0.0023
Cu-Dissolved	mg/L	0.06/0.039b	0.039	0.037	0.035
Fe-Dissolved	mg/L	3.3	0.02	0.48	0.71
Pb-Dissolved	mg/L	0.012	0.0001	0.00053	0.00051
Mo-Dissolved	mg/L	0.219	0.067	0.077	0.011
Ni-Dissolved	mg/L	0.33	0.0042	0.0034	0.0028
Se-Dissolved	mg/L	0.006	0.0072	0.016	0.0034
Zn-Dissolved	mg/L	0.09	0.0041	0.011	0.012

Source: SRK, X:\01_SITES\Minto\1CM002.024_Water_Balance_Support\2018 Water Balance Update\Model_Results_20190320_REV00_SRJ.xlsx

Notes:

Analytical data from Minto's water quality monitoring program.

- a) at 50 mg/L hardness.
- b) Cu effluent standard is 0.06 when [DOC] @ W2 > 10 mg/L and 0.039 when [DOC] @ W2 ≤ 10 mg/L.

Table 8: MPTMF Water Quality Model Predictions and Measured Concentrations in 2018, Reasonable Worst Case

		WUL Effluent Limits (QZ14-031)	MPTMF Measured Water Quality (Station W12)		Modelling Predictions of Quality in MPTMF (Station W12)			
Year			2018		2018		Post-Closure	
			Median	Max	Median	Max	Median	Max
Ammonia	mg/L	0.75	4.2	4.7	15	19	0.28	0.45
N-NO2	mg/L	0.18	5.3	8.5	3.1	4	0.037	0.057
N-NO3	mg/L	27.3	5.7	13	77	96	1.1	1.7
Ag-Dissolved	Mg/L	0.0003	0.00002	0.00002	0.00012	0.00013	0.000089	0.00012
Al-Dissolved	mg/L	0.3	0.0054	0.043	0.76	0.84	0.53	0.83
As-Dissolved	mg/L	0.015	0.00042	0.00054	0.0063	0.0066	0.0049	0.0063
Cd-Dissolved	mg/L	0.0014a	0.00009	0.00021	0.00035	0.00036	0.00031	0.00037
Cr-Dissolved	mg/L	0.003	0.0002	0.0013	0.0049	0.0051	0.0038	0.0048
Cu-Dissolved	mg/L	0.06/0.039b	0.039	0.074	0.09	0.093	0.077	0.098
Fe-Dissolved	mg/L	3.3	0.02	0.084	1.1	1.2	1.9	2.3
Pb-Dissolved	mg/L	0.012	0.0001	0.0021	0.0026	0.0028	0.0017	0.0025
Mo-Dissolved	mg/L	0.219	0.067	0.098	0.13	0.17	0.031	0.037
Ni-Dissolved	mg/L	0.33	0.0042	0.0065	0.0077	0.008	0.0067	0.0074
Se-Dissolved	mg/L	0.006	0.0072	0.013	0.025	0.031	0.008	0.01
Zn-Dissolved	mg/L	0.09	0.0041	0.011	0.033	0.035	0.03	0.036

Source: SRK, X:\01_SITES\Minto\1CM002.024_Water_Balance_Support\2018 Water Balance Update\Model_Results_20190320_REV00_SRJ.xlsx

Notes:

Analytical data from Minto's water quality monitoring program.

- a) at 50 mg/L hardness.
- b) Cu effluent standard is 0.06 when [DOC] @ W2 > 10 mg/L and 0.039 when [DOC] @ W2 ≤ 10 mg/L.

4 Closing

The summary of the updated water balance and water quality model for the Minto Mine was prepared in support of annual reporting. SRK would be pleased to address any questions or comments.

Appendix F – Minto and McGinty Creek 2018 Surface Hydrology Update

Hydrology

1. Introduction

In 2018, as part of the EMSRP, Minto monitored hydrological conditions at water quality stations including the following: stations within the operational mine area; stations downstream from the mine operational area that are influenced by mine effluent discharge; and reference stations downstream from the mine operational area that are not exposed to effluent. Hydrological monitoring is performed using a variety of methods including: manual discrete discharge measurements with combinations of flow meters, continuous stage measurements through the deployment of Solinst Level Loggers and Barometric Loggers and monitoring of an engineered flume.

Minto maintained and monitored 8 hydrometric stations located on Minto Creek and McGinty Creek as listed below and shown in Figure 1.

- Minto Creek
 1. W3: Flume downstream of the Water Storage Pond (WSP);
 2. MC1: Located in Minto Canyon – mid-catchment;
 3. W1: Located approximately 1 km upstream of Yukon River – lower catchment; and
 4. W7: Tributary on the south side of Minto Creek.
- McGinty Creek
 5. MN-0.5: West Tributary of McGinty Creek
 6. MN-1.5: Upper East Arm of McGinty Creek
 7. MN-2.5: East Tributary of McGinty Creek
 8. MN-4.5: McGinty Creek near the Mouth

The following sections will present the methods used to measure flow at the hydrometric program, the summary of each station's hydrometric program and recommendations for future monitoring.

2. Methods

Minto personnel conduct regular discrete discharge measurements and maintenance at the stations listed below. Additionally, these stations are equipped with Solinst Level Logger and Barometric Logger for continuous measurements. Table 2-1 provides an overview of instrumentation available and discrete measurement frequency at these stations.

Table 2-1: Summary of Hydrometric Program

Station	Watershed	Years Monitored	Frequency of Discrete Measurement	Instrumentation Available
W3	Minto Creek	2012-2018	Weekly	Flume, Data Logger
MC1	Minto Creek	2012-2018	Weekly	Staff Gauge, Data Logger
W1	Minto Creek	2012-2018	Weekly	Staff Gauge, Data Logger
W7	Minto Creek	2013-2018	Monthly	Staff Gauge, Data Logger
MN-0.5	McGinty Creek	2014-2018	Monthly	Staff Gauge, Data Logger
MN-1.5	McGinty Creek	2018	Monthly	Staff Gauge, Data Logger
MN-2.5	McGinty Creek	2014-2018	Monthly	Staff Gauge, Data Logger
MN-4.5	McGinty Creek	2011-2018	Monthly	Staff Gauge, Data Logger

Stream-gauge data is collected and managed throughout the open water season by the Minto personnel. Velocities are measured using a Hach FH950 handheld electromagnetic flowmeter. Velocity and water depth measurements are converted to flows using the area-velocity relationship methods. All hydrometric data, calculated flows and the time-series of recorded water levels and temperature data from the loggers were processed by Minto personnel under SRK guidance.

Level logger data were compared to the staff gauge readings, logger records for water level may have shifted over the course of the season due to repositioning, and data were corrected to match staff gauge measurements.

Stage-discharge relationships (rating curves) were created with discrete flow measurements and staff gauge readings. For stations with level loggers, discharges were determined over the course of the 2017 hydrometric season to calculate mean monthly flows and total monthly runoff.

3. Minto Creek

3.1 Station W3 – Flume below the Water Storage Pond Dam

W3 is located about 500 meters downstream of the water storage pond dam and consists of a built concrete flume. Solinst loggers record water levels and atmospheric pressure every 30 minutes, in addition water levels at the flume are recorded daily for most of the year.

Due to ice buildup around the flume, water levels were artificially high from January 1st to June 10th, and then again from December 5th to the end of the year. A summary of the level and flow data recorded at W3 are presented in Figures 2 to 5. This data provided the necessary information to correct the recorded stage data and in turn generate a stage discharge relationship which is used to calculate the creek discharge. The stage-discharge relationship is presented in Figure 3.

Figure 2 presents the recorded water levels and water temperature for Minto Creek at W3 from June to December 2018.

The 2018 hydrograph and discrete measurements are shown in Figure 4.

W3 is directly influenced by discharge from the Water Storage Pond to Minto Creek. A comparison of monthly flows at W3 and the discharge from the WSP is presented in Figure 5. As expected the flows recorded at W3 are slightly higher than the rate of discharge because of baseflow and runoff at W3. The data for the months when the flume was impacted by ice (January-May, November-December) have been estimated from historical data.

Water was discharged from the WSP intermittently from June 9th to August 30th, 2018.

Table 3-1 provides a summary of the average water temperature, flow, and total flow volume in 2018. The increased temperatures from October through to December are believed to have been influenced by the water heaters located in the constructed flume.

Table 3-2 summarizes the historical mean monthly flows to previous years of the hydrometric program.

Table 3-1: W3 2017 Hydrometric Data and Temperature Summary

Month	Period of Record (Day)	Mean Water Temperature (°C)	Mean Flow (m3/s)	Total Flow (m3)
Jan	31	-	*0.003	*8035.2
Feb	28	-	*0.00255	*6171.2
Mar	31	-	*0.00241	*6448
Apr	30	-	*0.00245	*6360
May	31	-	*0.01241	*33232
Jun	30	7.16	0.02810	32088.96
Jul	31	7.54	0.02198	79012.8
Aug	31	6.24	0.01531	6696
Sep	30	1.94	0.01271	7905.6
Oct	31	2.56	0.01243	8928
Nov	30	2.67	*0.00256	*6652.8
Dec	31	2.58	*0.00200	*5356.8
* Estimates from historical flow readings. Inaccurate Solinst Data				

Table 3-2: W3 Historical Mean Monthly Flow (m³/s)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2012¹	-	-	-	-	-	0.005	0.005	0.006	0.005	-	-	-
2013¹	-	-	-	-	-	0.003	0.004	0.004	0.004	-	-	-
2014¹	-	-	-	-	-	-	-	0.002	0.003	0.003	0.006	0.004
2015¹	0.003	0.006	0.006	0.057	0.086	0.003	0.003	0.003	0.004	0.004	0.006	0.026
2016¹	-	-	-	0.022	0.052	0.003	0.003	0.004	0.004	0.004	0.003	0.004
2017	0.003	0.02	0.01	0.01	0.016	0.018	0.006	0.008	0.007	0.012	0.01	0.015
2018	0.003	0.003	0.002	0.002	0.012	0.028	0.022	0.015	0.013	0.012		0.002

Note: 1 - Data based on previous Annual surface water hydrology analysis.

3.2 MC1 - Minto Creek Mid-Catchment

The hydrometric station MC1 on Minto Creek is located downstream of the W3 Flume and immediately upstream of the canyon along Minto Creek. The pressure transducer installed at this station recorded temperature and water levels at 15-minute intervals from June 5th to October 2nd (119 days). Figure 6 shows water level and temperature data for Minto Creek at MC1 from June 5th to October 2nd, 2018.

Over the course of the hydrometric program in 2018, numerous discrete discharge measurements were recorded in conjunction with water level readings recorded by both the pressure transducer and the staff gauge. This data provides the information necessary to generate a stage-discharge relationship which enables the computation of creek discharge for the recorded stage data. The stage-discharge relationship is presented in Figure 7.

The 2018 hydrograph and discrete measurements for MC1 are shown in Figure 8. In 2018, the maximum measured flow of 0.155 m³/s occurred on June 29th, 2018.

Table 3-3 provides a summary of the average water temperature, flow and total flow volume in 2018. The negative temperatures recorded in June and October indicate the end of spring and start of the freeze-up period. Table 3-4 summarizes the historical mean monthly flows to previous years of the hydrometric program.

Table 3-3: MC1 2018 Hydrometric Data and Temperature Summary

Month	Period of Record (Day)	Mean Water Temperature (°C)	Mean Flow (m ³ /s)	Total Flow (m3)
Jan	No Data			
Feb	No Data			
Mar	No Data			
Apr	No Data			
May	No Data			
Jun	25	-0.122	0.0721	119389
Jul	31	4.006	0.0164	43802
Aug	31	3.744	0.0249	66674
Sep	30	-0.040	0.0209	54077
Oct	3	-1.447	0.0120	1515.2
Nov	No Data			
Dec	No Data			

Note: Shaded cells indicate incomplete months of data

Table 3-4: MC1 Historical Mean Monthly Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2012 ¹	-	-	-	-	0.179	0.065	0.052	0.041	0.108	-	-	-
2013 ¹	-	-	-	-	0.358	0.085	0.103	0.44	0.089	0.064	-	-
2014 ¹	-	-	-	-	0.187	0.028	0.031	0.036	0.028	0.033	-	-
2015 ¹	-	-	-	-	0.862	0.014	0.028	0.042	0.035	0.031	-	-
2016 ¹	-	-	-	-	-	0.029	0.036	0.048	0.076	-	-	-
2017 ¹	-	-	-	-	0.102	0.074	0.018	0.010	0.028	0.029	-	-
2018	-	-	-	-	-	0.072	0.016	0.025	0.021	0.012	-	-

Note: 1 - Data based on previous Annual Surface water Hydrology Analysis.

Note: Shaded cells indicate incomplete months of data

3.3 W1 – Lower Minto Creek above Road Crossing

W1 station is located on the lower reach of Minto Creek before flowing into the Yukon River. In 2018, water level and temperature data were continuously measured and recorded every 15 minutes by the pressure transducer/data logger. Figure 9 shows Minto Creek at W1 water level and temperature data for the 109-day record from May 12th to October 3rd, 2018. During the summer 2018, this station dried up from July 10th to August 11th, and again from August 20th to 22nd, the data recorded during these periods were omitted from the figures. The lapses were recorded in the field and were identified in the temperature changes in the water temperature recorded by the levellogger.

The stage-discharge relationship for W1 is presented in Figure 10. The 2018 hydrograph and discrete measurements for W1 are shown in Figure 11. In 2018, the maximum measured flow during freshet was 0.292 m³/s occurred on May 12th, 2018. Figure 12 shows W1 and MC1 flows. W1 is located downstream of MC1 and it is expected that flows would be larger because it has a much larger catchment area than MC1. The surface area at W1 is wider and at low flows the HACH sensor is not covered leading to skewed discrete flow measurement. It was observed that flows during freshet and early spring were much higher at W1 and lower leading into fall. Water downstream of MC1 passes through a preferential pathway and by-passes W1. The creek dried up a few times during the season, July 10th to August 10th, and again August 19th to 22nd, 2018. Based on the temperature data, the creek seemed to have frozen on October 2nd.

Table 3-5 provides a summary of the average water temperature, flow and total flow volume in 2018. The negative temperatures recorded in October indicates the start of the freeze-up period. Table 3-6 summarizes the historical mean monthly flows to previous years of the hydrometric program. The history shows that freeze-up begins in October and that freshet typically occurs in April/May.

Table 3-5: W1 2018 Hydrometric Data and Temperature Summary

Month	Period of Record (Day)	Mean Water Temperature (°C)	Mean Flow (m³/s)	Total Flow (m³)
Jan	No Data			
Feb	No Data			
Mar	No Data			
Apr	No Data			
May	19	0.572	0.132	219508.0
Jun	30	2.756	0.0926	239942.6
Jul	10	6.311	0.0387	32778.6
Aug	18	4.643	0.0087	14343.1
Sep	30	0.771	0.0057	14834.1
Oct	2	-1.24	0.0020	247.9
Nov	No Data			
Dec	No Data			

Note: Shaded cells indicate incomplete months of data

Table 3-6: W1 Historical Mean Monthly Flow

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2012 ¹	-	-	-	-	0.296	0.073	0.052	0.051	0.078	0.056	-	-
2013 ¹	-	-	-	-	0.485	0.064	0.065	0.044	0.85	0.059	-	-
2014 ¹	-	-	-	-	0.138	0.022	0.02	0.014	0.31	0.025	-	-
2015 ¹	-	-	-	-	0.117	0.01	0.01	0.03	0.24	0.02	-	-
2016 ¹	-	-	-	0.252	0.047	0.02	0.017	0.024	0.043	0.026	-	-
2017 ¹	-	-	-	-	0.085	0.074	0.014	0.011	0.017	0.031	-	-
2018	-	-	-	-							-	-

Note: 1 - Data based on previous Annual Surface water Hydrology Analysis.

Note: Shaded cells indicate incomplete months of data

3.4 W7 – Tributary of Minto Creek

A staff gauge was installed at this station in the summer of 2013. Before the installation of the staff gauge, this station was regularly monitored for surface water quality. The staff gauge was damaged during the winter 2014 and repaired for the hydrometric program running in 2015. In 2016, no stage measurements were continuously recorded but several discrete discharge measurements were conducted during the open water season. In early June 2017, a staff gauge and loggers were installed at this site, which was continued during the 2018 season, a continuous water level and temperature were recorded as presented in Figure 13. Table 3-7 provides a summary of the average water temperature, flow and total flow volume in 2018.

Table 3-8 presents the summary of historically measured flows at W7, based on discrete measurements before 2017, and based on continuous pressure readings for 2017 and 2018. A rating curve was initiated in the 2017 hydrometric season, with limited data points the curve showed inconsistencies between discrete and pressure logger measurements, due to changes in the scheduling of measurements, more data points were collected in 2018, the curve is rudimentary but presented in Figure 14. It is the hope that with more data being collected the curve will become more accurate over the years. The loggers were installed July 4th and recorded water level and temperature every 30 minutes until September 30th.

The 2018 hydrograph and discrete measurements for W7 are shown in Figure 15.

As per recommended in 2017, the 2018 discrete measurements were conducted on a bi-weekly basis to help establish a more accurate Stage-Discharge curve. This should be continued in the 2019 season as it proved helpful.

Table 3-7: W7 2018 Hydrometric Data and Temperature Summary

Month	Period of Record (Day)	Mean Water Temperature (°C)	Mean Flow (m ³ /s)	Total Flow (m ³)
Jan	No Data			
Feb	No Data			
Mar	No Data			
Apr	No Data			
May	No Data			
Jun	No Data			
Jul	27	3.44	0.0067	16044.3
Aug	31	3.66	0.0071	18968.0
Sep	30	0.92	0.0073	18810.8
Oct	No Data			
Nov	No Data			
Dec	No Data			

Note: Shaded cells indicate incomplete months of data

Table 3-8: W7 Historical Mean Monthly Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2013¹	-	-	-	-	-	-	0.013	0.031	0.019	0.006	-	-
2014¹	-	-	-	-	0.112	-	-	-	-	-	-	-
2015¹	-	-	-	-	-	0.006	0.004	0.011	0.011	0.029	-	-
2016¹	-	-	-	-	-	0.006	0.010	0.010	0.013	0.010	-	-
2017¹	-	-	-	-	-	0.002	0.003	0.003	0.004	0.004	-	-
2018	-	-	-	-	-	-	0.006	0.007	0.007			

Note: 1 - Data based on previous Annual Surface water Hydrology Analysis.

Note: Shaded cells indicate incomplete months of data

4. McGinty Creek Hydrology

In 2018, hydrological monitoring on McGinty Creek was conducted as per the schedule outlined in the EMSRP station MN-1.5 was added to the monitoring station with continuous measurements. During the 2018 monitoring period, Minto Mine maintained and collected data from the following four hydrometric stations along McGinty Creek.

At the hydrometric stations, Solinst Level Loggers and Barometric Loggers were used in conjunction with staff gauge readings and manual flow measurements to produce volumetric flow rates conducted monthly during flow season.

4.1 Station MN-0.5 – West Tributary of McGinty Creek

MN-0.5 station is located on the upper west stem of McGinty Creek. In 2018, water level and temperature data were continuously measured and recorded every 30 minutes by a pressure transducer/data logger. Figure 16 shows McGinty Creek at MN-0.5 water level and temperature data for the 124-day record from June 11 to October 13, 2018.

A stage-discharge relationship was established for MN-0.5 but it has limited flow data and corresponding staff gauge reading, hence is was not very accurate, the stage curve is presented in Figure 17. Additional flow measurements through the years will be required to establish a stage-discharge curve for the station with greater accuracy.

Table 4-1 provides a summary of the average water temperature, flow and total flow volume in 2018 while table 4-2 provides a summary historical measured flows at MN-0.5. These flows are based on discrete measurements only.

Table 4-1: MN-1.5 2018 Hydrometric Data and Temperature Summary

Month	Period of Record (Day)	Mean Water Temperature (°C)	Mean Flow (m ³ /s)	Total Flow (m ³)
Jan	No Data			
Feb	No Data			
Mar	No Data			
Apr	No Data			
May	No Data			
Jun	19	0.522	0.0302	50269.2
Jul	31	4.015	0.0160	42824.2
Aug	31	3.914	0.0210	56234.8
Sep	30	0.722	0.0246	63840.9
Oct	13	-0.397	0.0400	43120.6
Nov	No Data			
Dec	No Data			

Note: Shaded cells indicate incomplete months of data

Table 4-2: MN-0.5 Historical Mean Monthly Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2014 ¹	-	-	-	-	0.045	-	-	-	-	-	-	-
2015 ¹	-	-	-	-	0.035	0.013	0.054	0.098	0.029	0.025	-	-
2016 ¹	-	-	-	-	0.28	0.016	0.01	0.016	0.035	0.018	-	-
2017 ¹	-	-	-	-	-	0.017	0.023	0.020	0.017	0.019	-	-
2018	-	-	-	-	-	0.030	0.016	0.021	0.025	0.040	-	-

Note: 1 - Data based on previous Annual Surface water Hydrology Analysis.

Note: Shaded cells indicate incomplete months of data

4.2 Station MN-1.5 – Upper East Tributary of McGinty Creek

The station MN-1.5 was set-up with a continuous monitoring station for the 2018 season. A levellogger and a barologger were launched on July 5th, 2018. This station is monitored monthly for sampling and discrete hydrometric measurements. The staff gauge was installed on July 5th, as a newly monitored station the rating curve had a large error, as monitoring continues the stage curve will become more accurate. The stage and water temperature hydrograph for continuous monitoring throughout the 2018 season is presented in Figure 18. The hydrometric data and temperature for the season at MN-1.5 is presented below in table 4-3. The stream seems to have frozen over around October 1st, 2018.

Table 4-3: MN-1.5 2018 Recorded Discrete Flow Measurement (m³/s)

Month	Period of Record (Day)	Mean Water Temperature (°C)	Mean Flow (m ³ /s)	Total Flow (m ³)
Jan	No Data			
Feb	No Data			
Mar	No Data			
Apr	No Data			
May	No Data			
Jun	No Data			
Jul	25	7.313	0.0008	1784.2
Aug	31	5.687	0.0012	3122.1
Sep	30	1.510	0.0017	4288.1
Oct	13	-0.698	0.0091	9896.9
Nov	No Data			
Dec	No Data			

Note: Shaded cells indicate incomplete months of data

4.2 Station MN-2.5 – East Tributary of McGinty Creek

MN-2.5 station is located on the lower stem of McGinty Creek. In 2018, water level and temperature data were continuously measured and recorded every 30 minutes by a pressure transducer/data logger. Figure 19 shows McGinty Creek at MN-2.5 water level and temperature data for the 99-day record from July 6th to October 13th, 2018.

A stage-discharge relationship was established for MN-2.5 but due to limited data flow and corresponding staff gauge reading it is not an accurate curve, with continuous monitoring more data will fill the curve and improve the accuracy.

Table 4-4 provides a summary of historical measured flows at MN-2.5. These flows are based on discrete measurements until 2016, the pressure loggers were used for 2017-2018.

Table 4-4: MN-2.5 Historical Mean Monthly Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2014 ¹	-	-	-	-	0.032	-	-	-	-	-	-	-
2015 ¹	-	-	-	-	0.015	0.003	0.011	0.038	0.01	0.01	-	-
2016 ¹	-	-	-	0.034	0.008	-	-	0.009	0.014	0.003	-	-
2017 ¹	-	-	-	-	-	0.011	0.010	0.007	0.004	0.013	-	-
2018	-	-	-	-	-	-	0.011	0.014	0.014	0.019		

Note: 1 - Data based on previous Annual Surface water Hydrology Analysis.

Note: Shaded cells indicate incomplete months of data

4.3 Station MN-4.5 - McGinty Creek near the Mouth

MN-4.5 station is located on the lower reach of McGinty Creek before flowing into the Yukon River. In 2018, water level and temperature data were continuously measured and recorded every 30 minutes by the pressure transducer/data logger. Figure 20 shows McGinty Creek at MN-4.5 water level and temperature data for the 140-day record from May 26 to October 13, 2018.

The stage-discharge relationship for MN-4.5 is presented in Figure 21. The 2018 hydrograph and discrete measurements for MN-4.5 are shown in Figure 22. In 2018, the maximum measured flow of 0.06 m³/s occurred on September 15th, 2018. Upon analysis of the temperature and flow variance, it is probable that the creek was very low and the levellogger was out of the water from July 27th to August 7th, 2018.

Table 4-5 provides a summary of the average water temperature, flow and total flow volume in 2018. Table 4-6 summarizes the historical mean monthly flows from previous years of the hydrometric program.

Table 4-5: MN-4.5 2018 Hydrometric Data and Temperature Summary

Month	Period of Record (Day)	Mean Water Temperature (°C)	Mean Flow (m³/s)	Total Flow (m³)
Jan	No Data			
Feb	No Data			
Mar	No Data			
Apr	No Data			
May	5	1.010	0.0312	14487.7
Jun	30	2.696	0.0214	55598.3
Jul	31	5.086	0.0055	14636.8
Aug	31	5.577	0.0207	55544.9
Sep	30	1.260	0.0222	57607.9
Oct	13	-0.245	0.0059	6390.8
Nov	No Data			
Dec	No Data			

Note: Shaded cells indicate incomplete months of data

Table 4-6: MN-4.5 Historical Mean Monthly Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2011 ¹	-	-	-	-	0.444	0.093	0.125	0.134	0.068	0.045	-	-
2012 ¹	-	-	-	0.212	0.023	0.18	0.082	0.053	0.109	-	-	-
2013 ¹	-	-	-	-	-	0.054	0.103	0.093	0.116	-	-	-
2014 ¹	-	-	-	-	0.23	0.041	0.037	0.026	0.046	-	-	-
2015 ¹	-	-	-	-	-	0.013	0.046	0.049	0.029	0.029	-	-
2016 ¹	-	-	-	-	0.017	0.015	0.026	0.028	0.028	0.01	-	-
2017 ¹	-	-	-	-	0.079	0.12	0.027	0.003	0.012	0.079	-	-
2018	-	-	-	-	0.031	0.021	0.006	0.021	0.022	0.006	-	-

Note: 1 - Data based on previous Annual Surface water Hydrology Analysis.

Note: Shaded cells indicate incomplete months of data

5. Hydrology QA/QC

Detailed procedures for hydrology monitoring at the Minto Mine are detailed in the *Minto Mine Surface Water Hydrology SOP*. In 2018, Minto environmental staff conducted a duplicate of hydrometric measurements at random station every week, to reach a 10% QAQC.



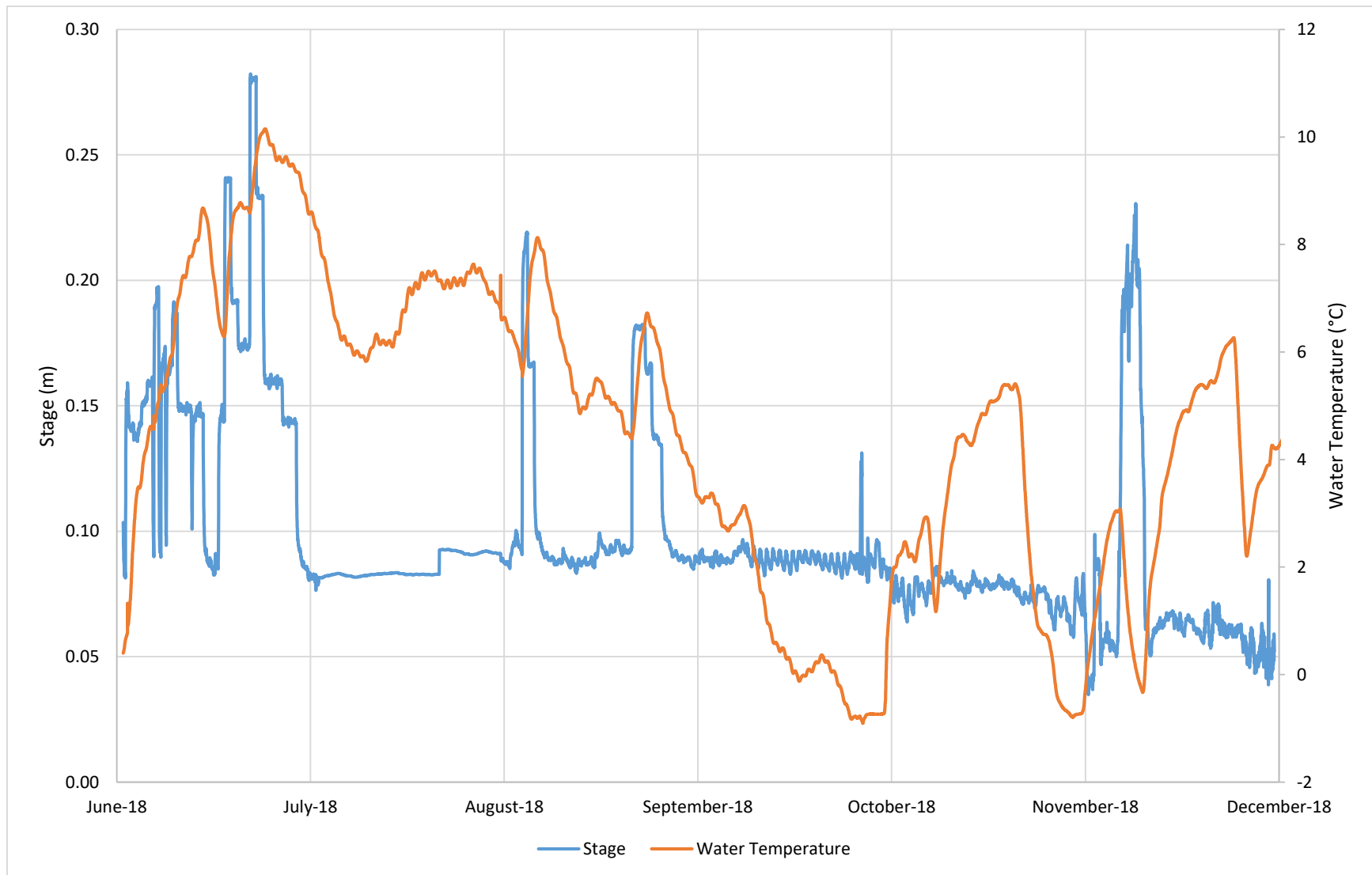


Figure 2. W3 Hydrograph Stage and Water Temperature

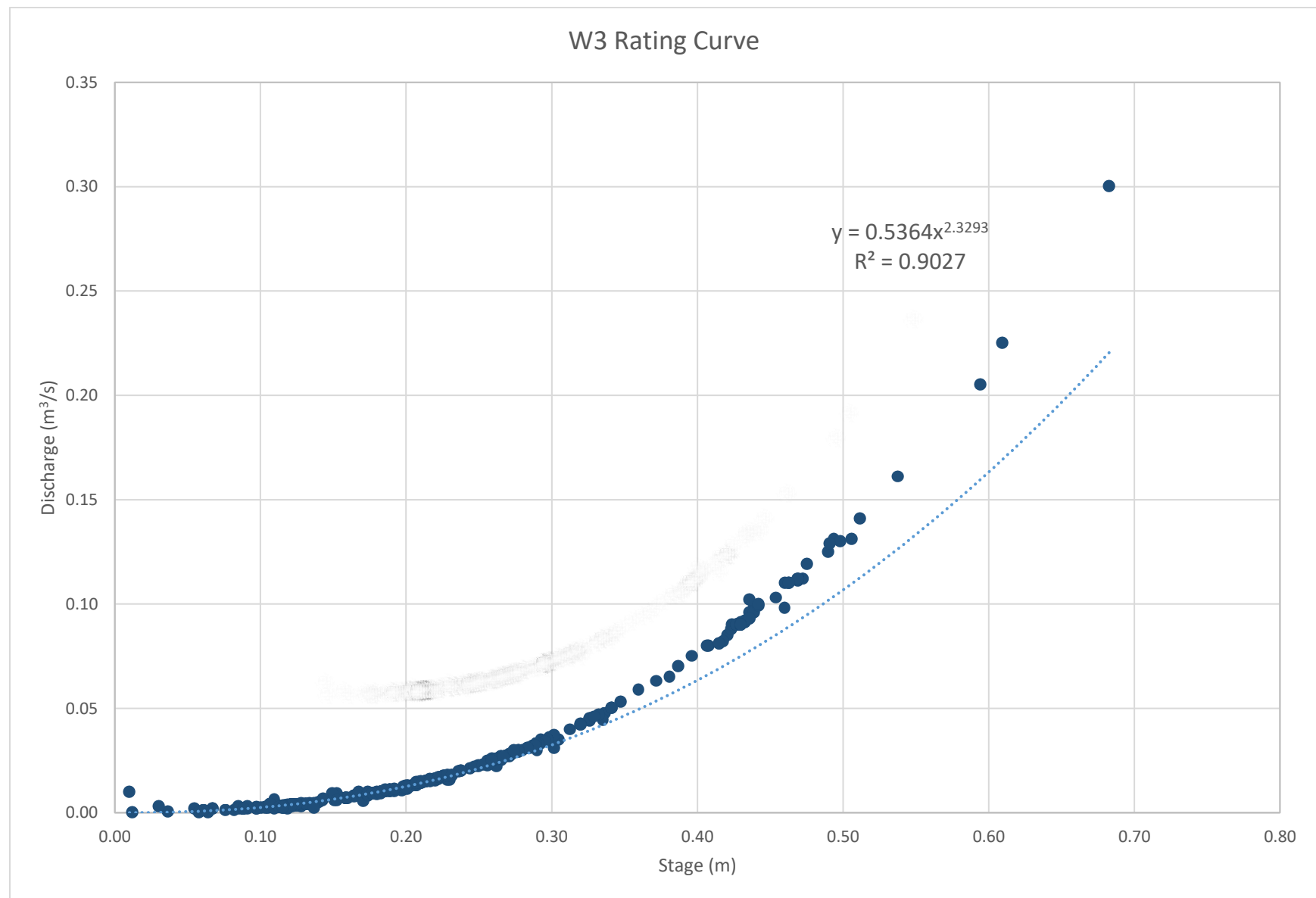


Figure 3: W3 Rating Curve

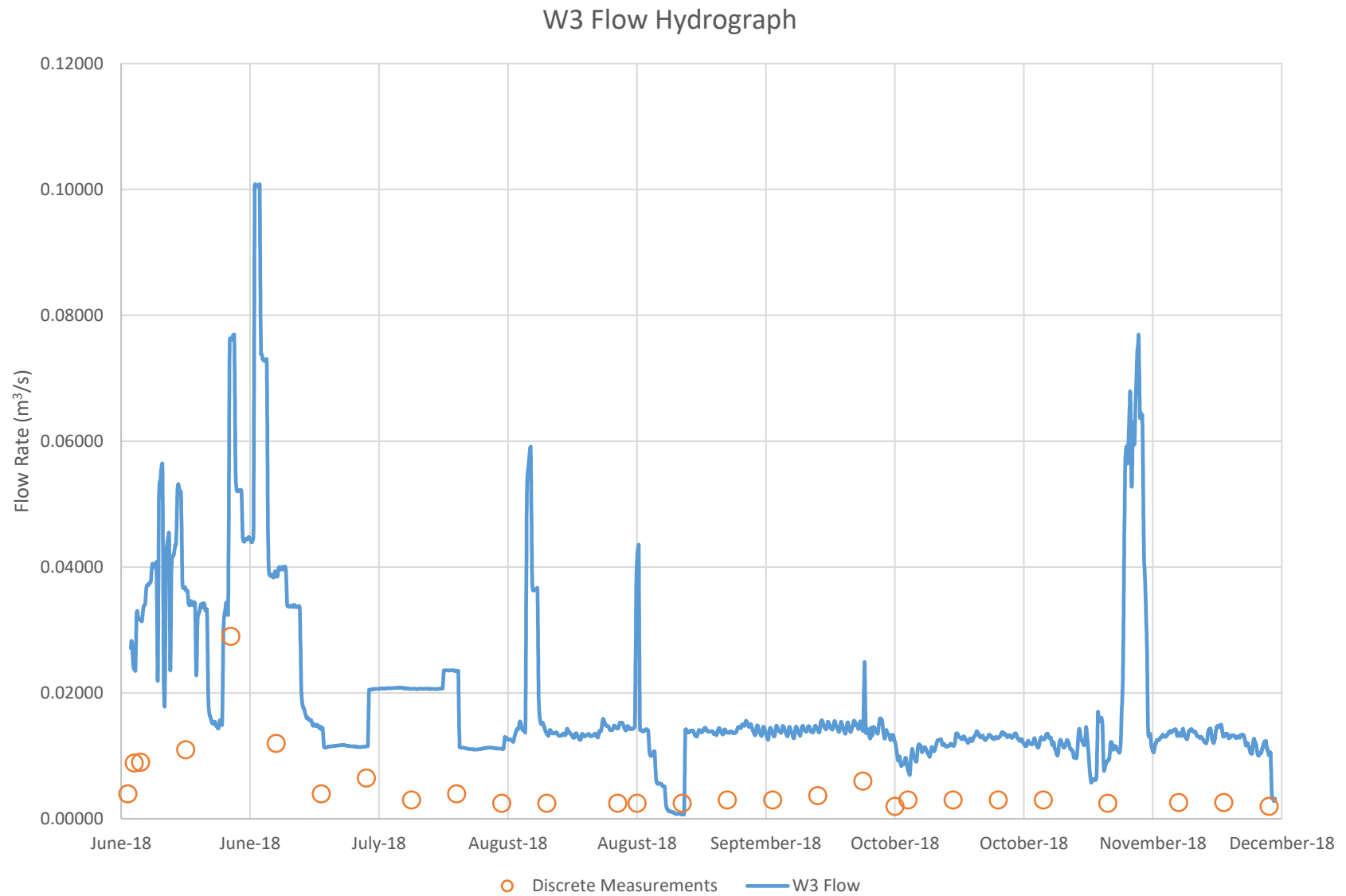


Figure 4: W3 Flow Hydrograph

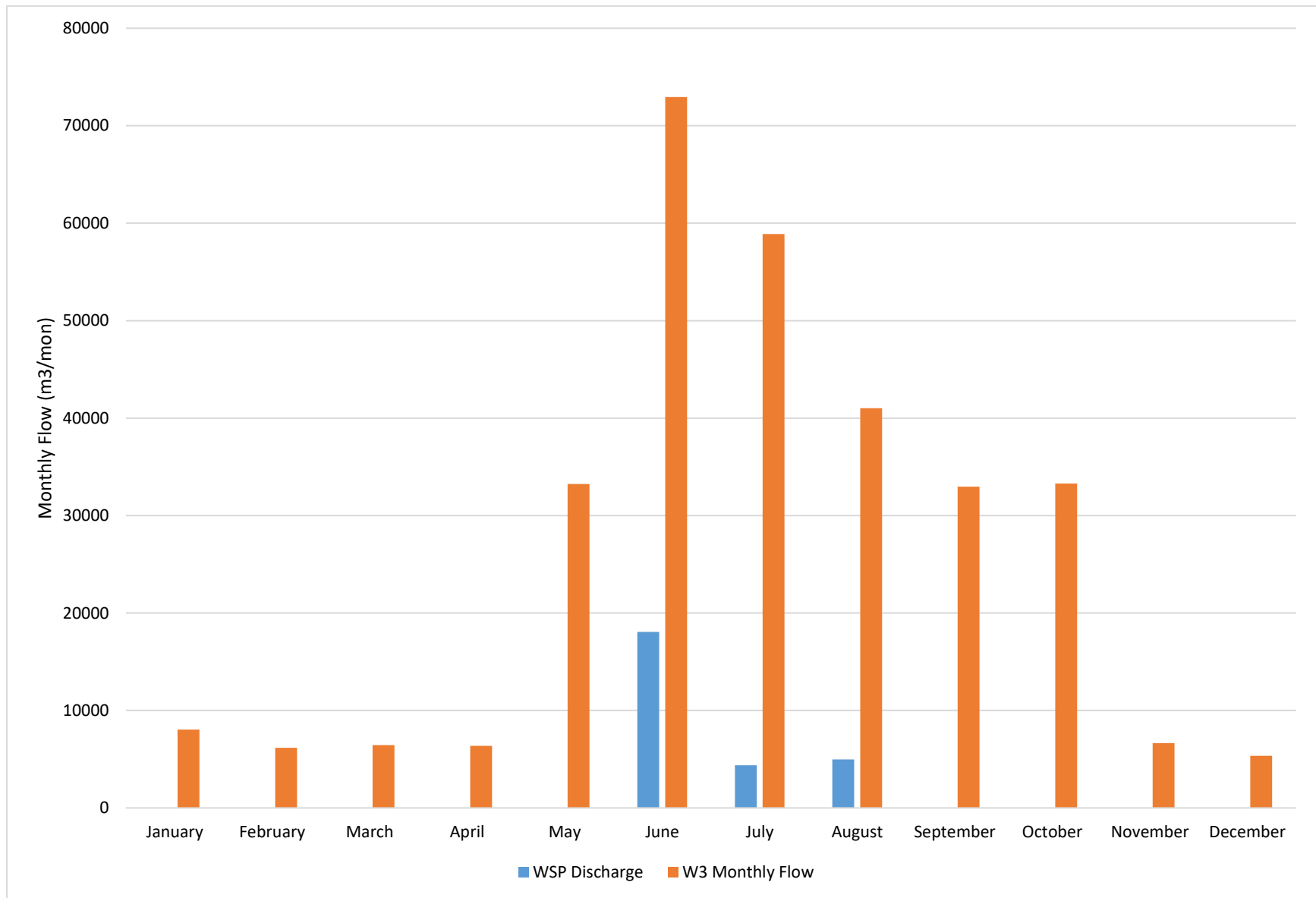


Figure 5. Monthly WSP Discharge and Flows at W3

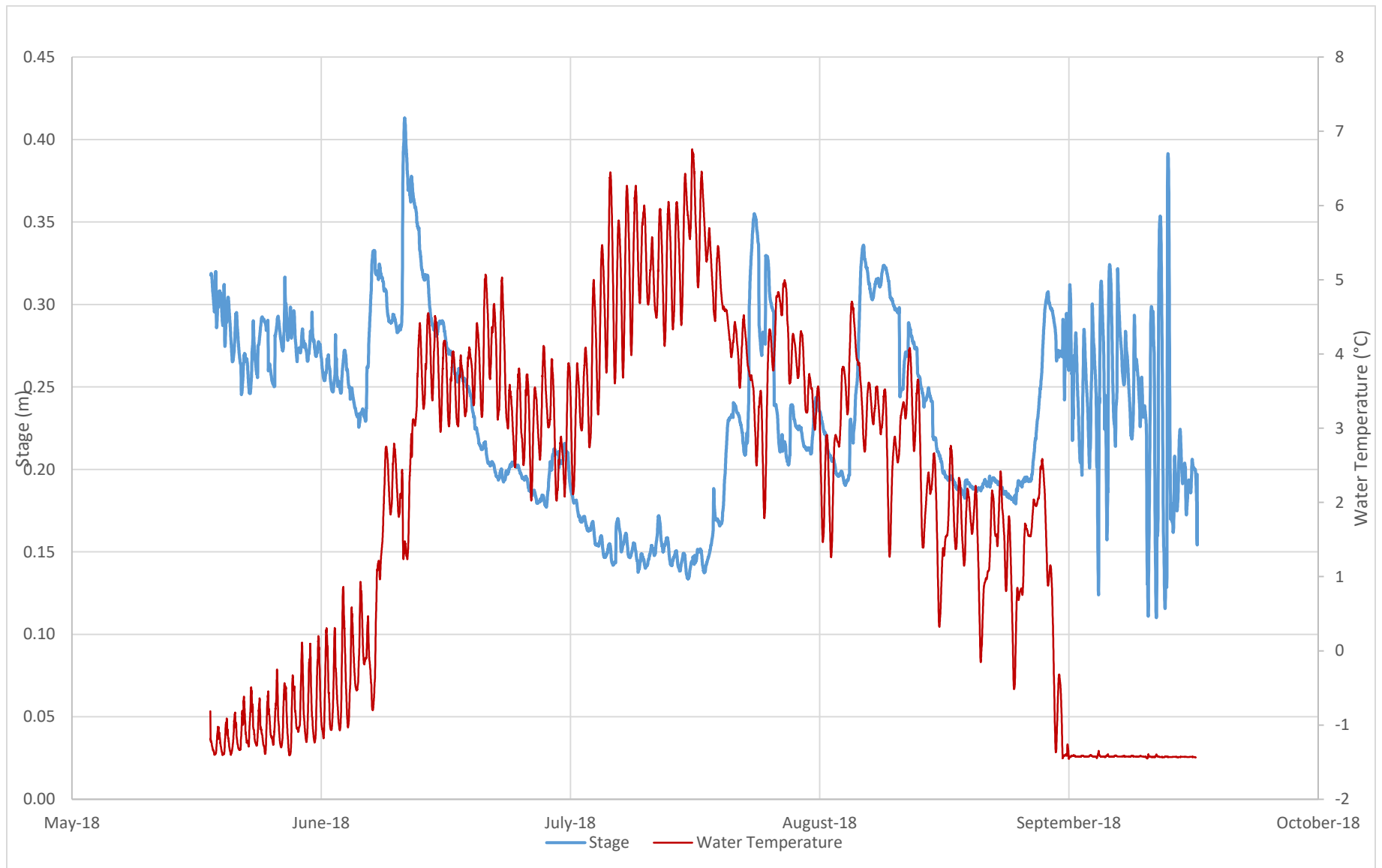


Figure 6: MC1 Stage and Temperature Hydrograph

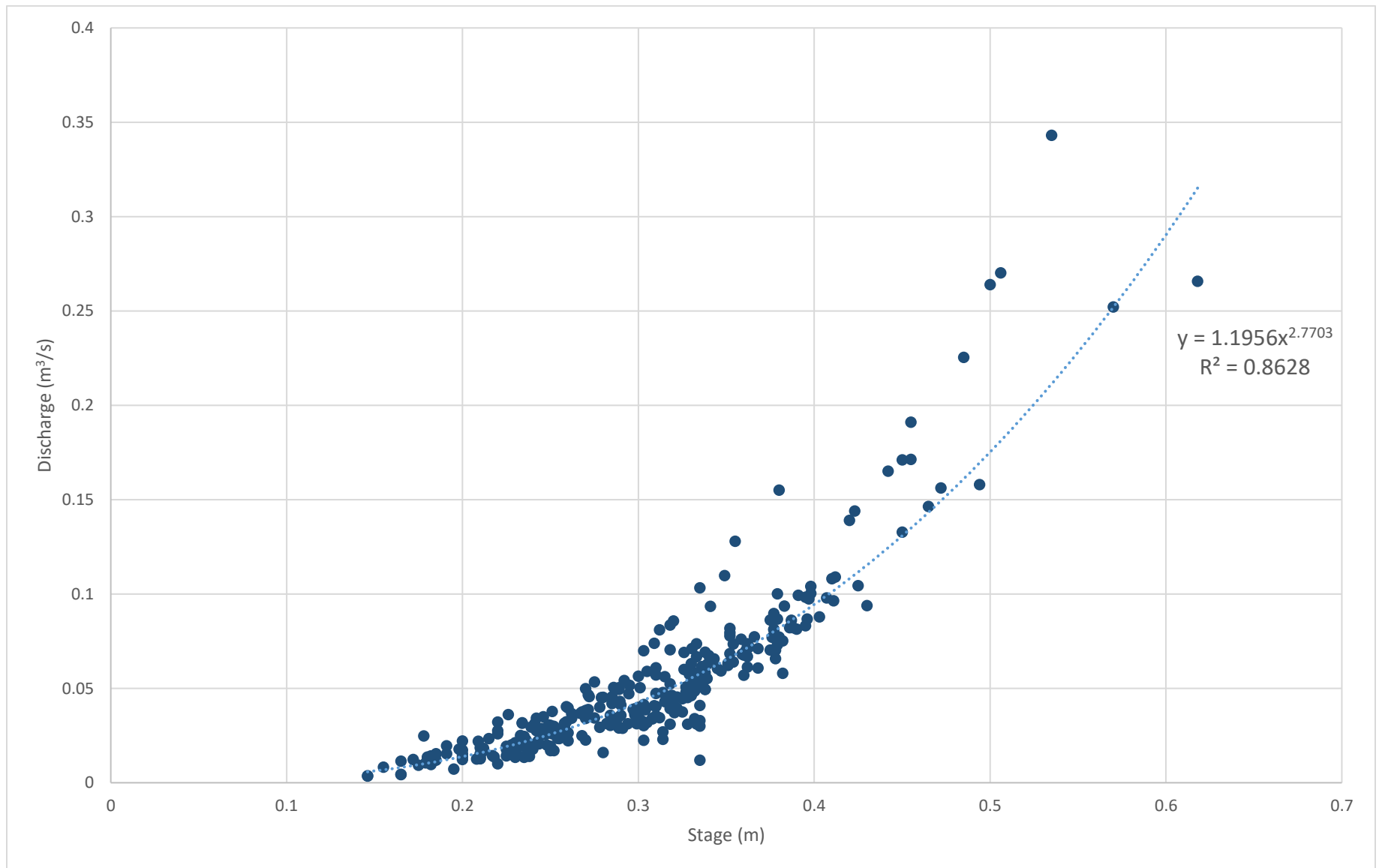


Figure 7: MC1 Rating Curve

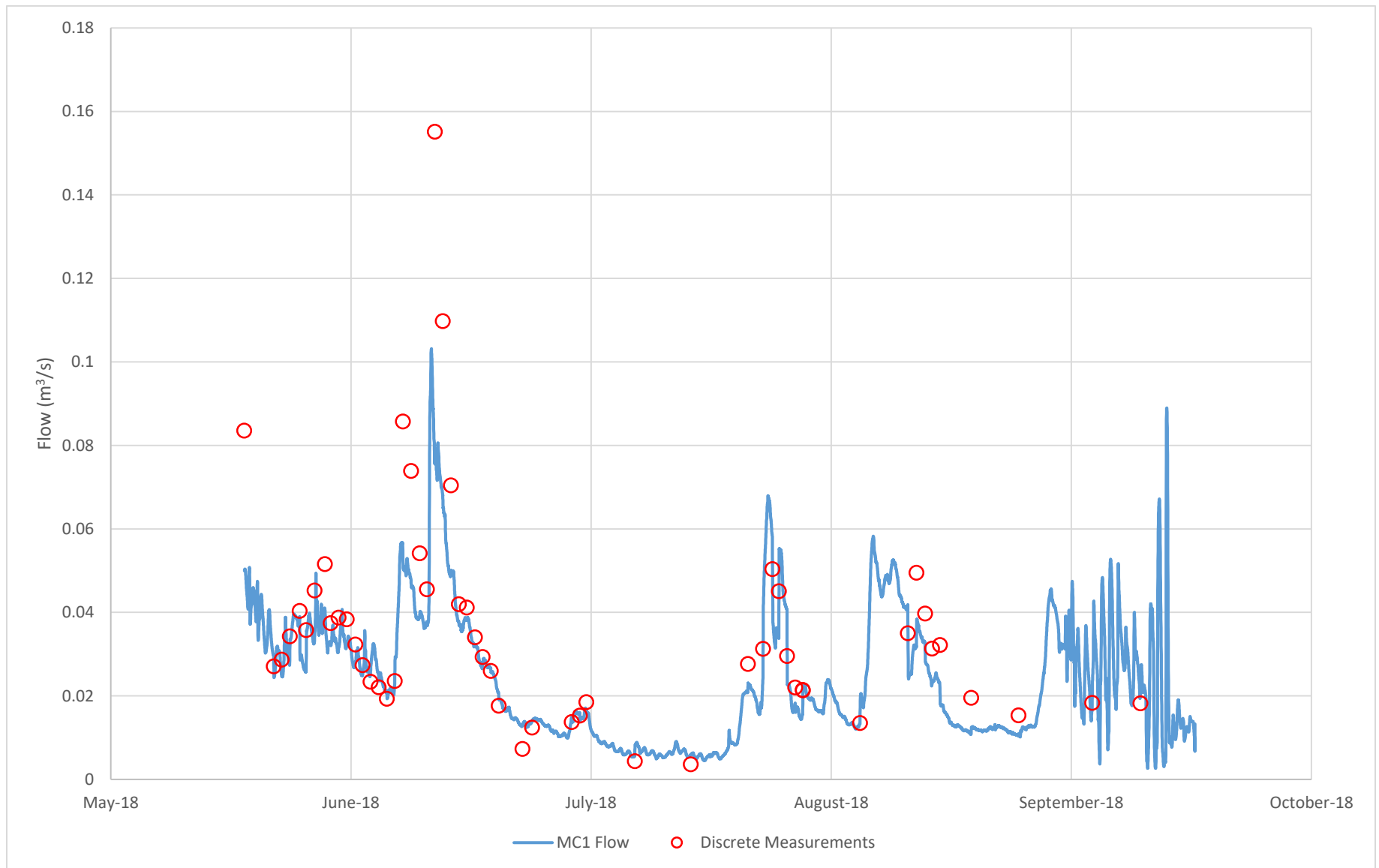


Figure 8: MC1 Flow Hydrograph

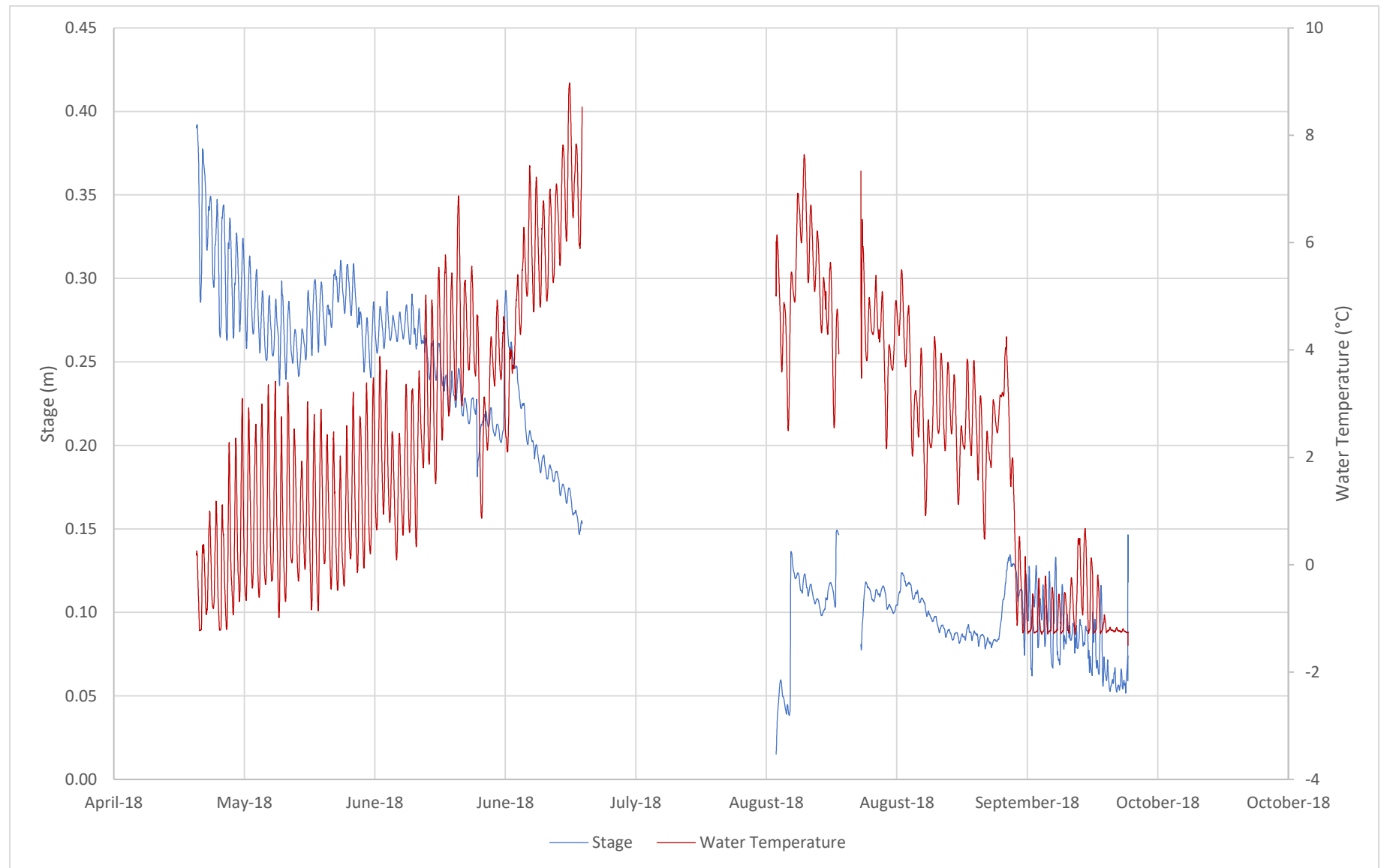


Figure 9: W1 Stage and Temperature Hydrograph

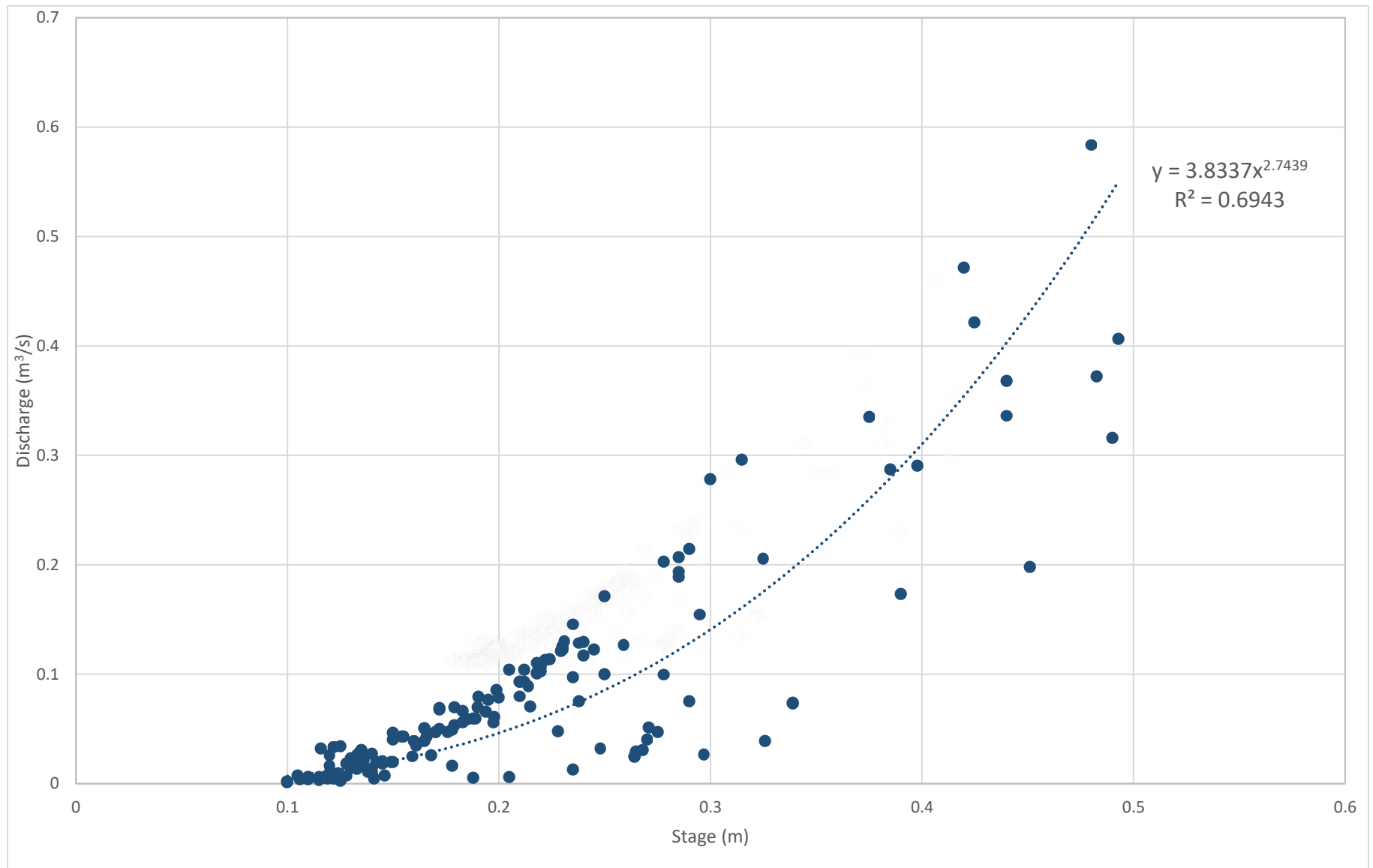


Figure 10: W1 Rating Curve

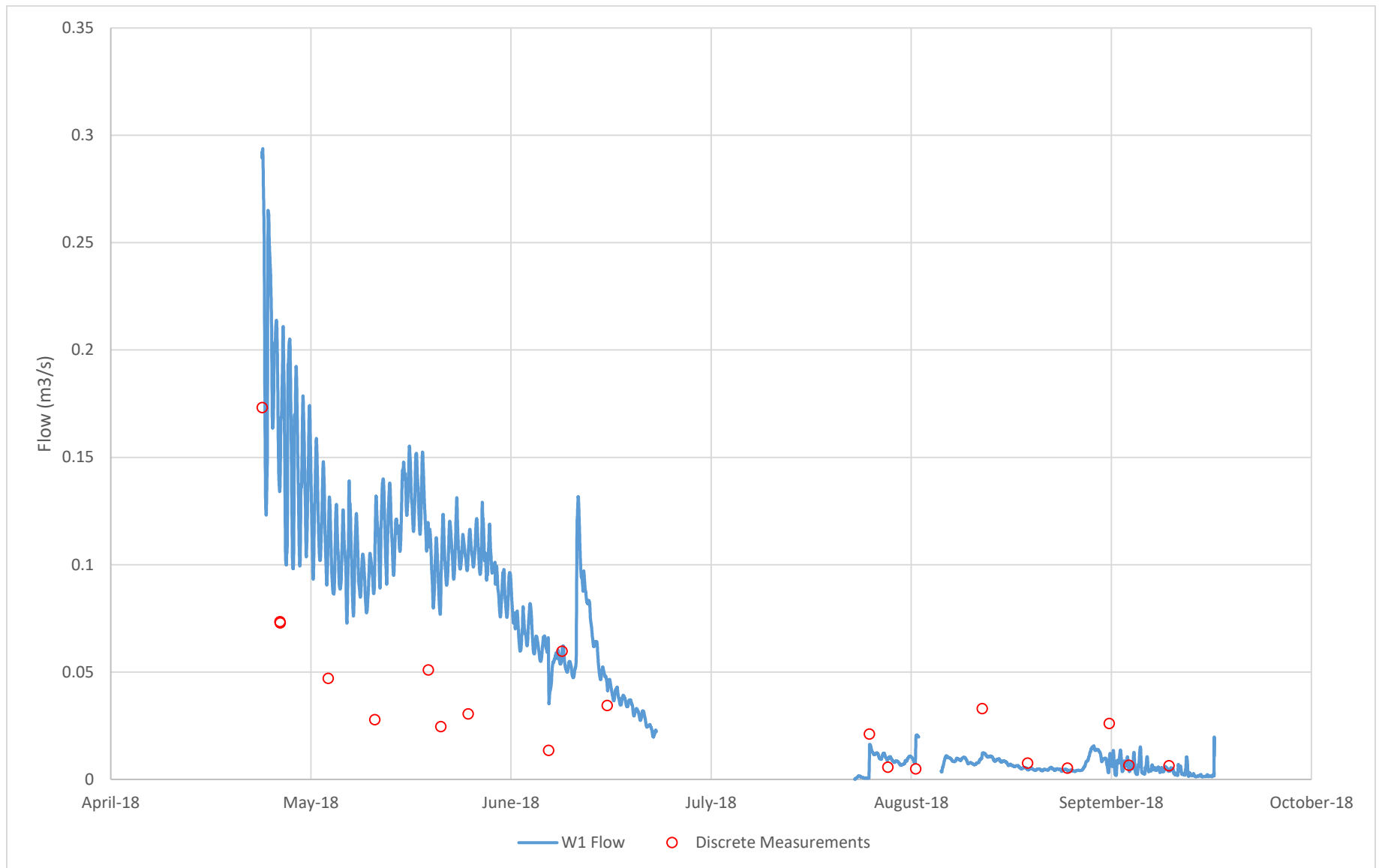


Figure 11: W1 Flow Hydrograph

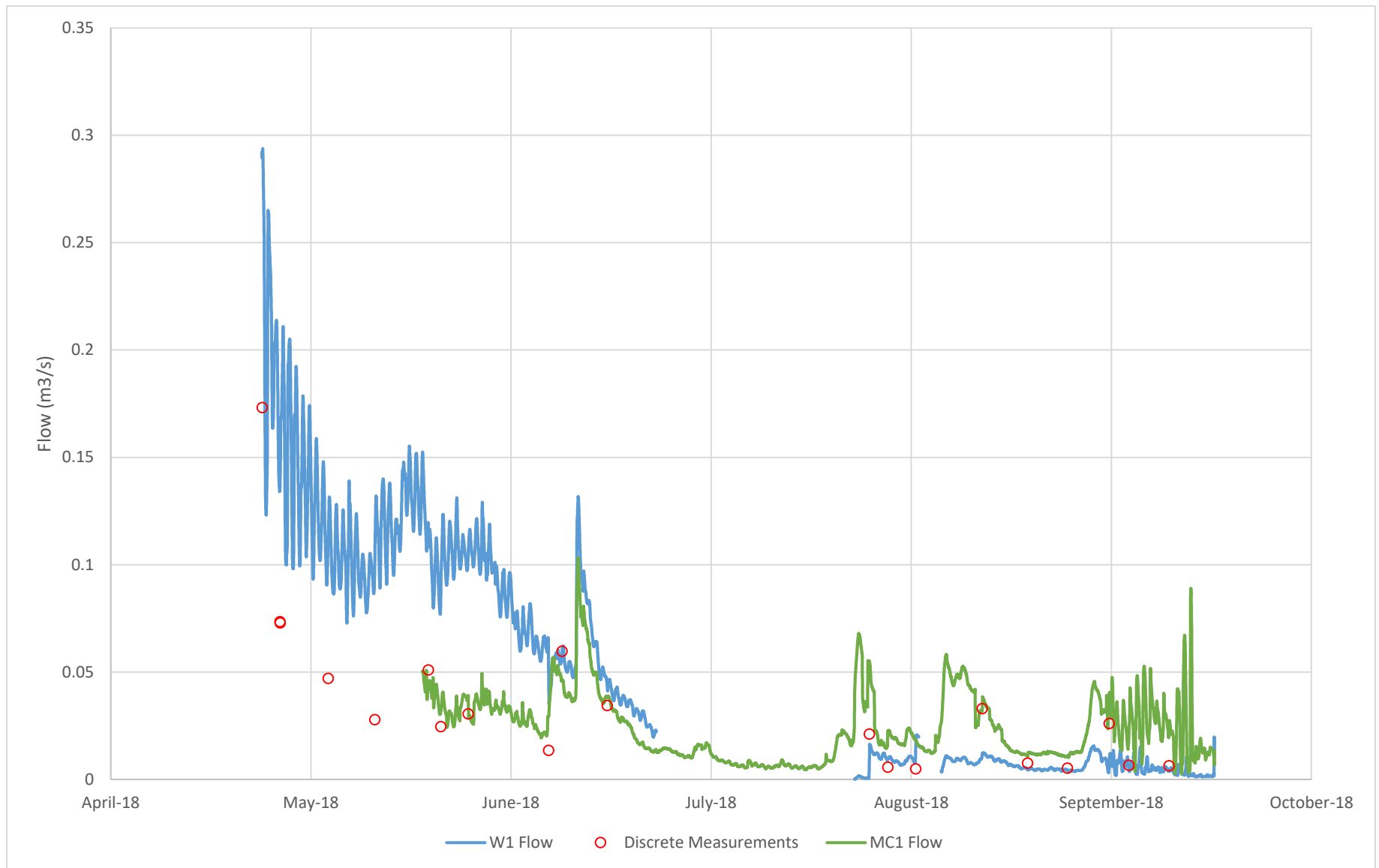


Figure 12: W1 Flow Hydrograph Comparison with MC1 Flow

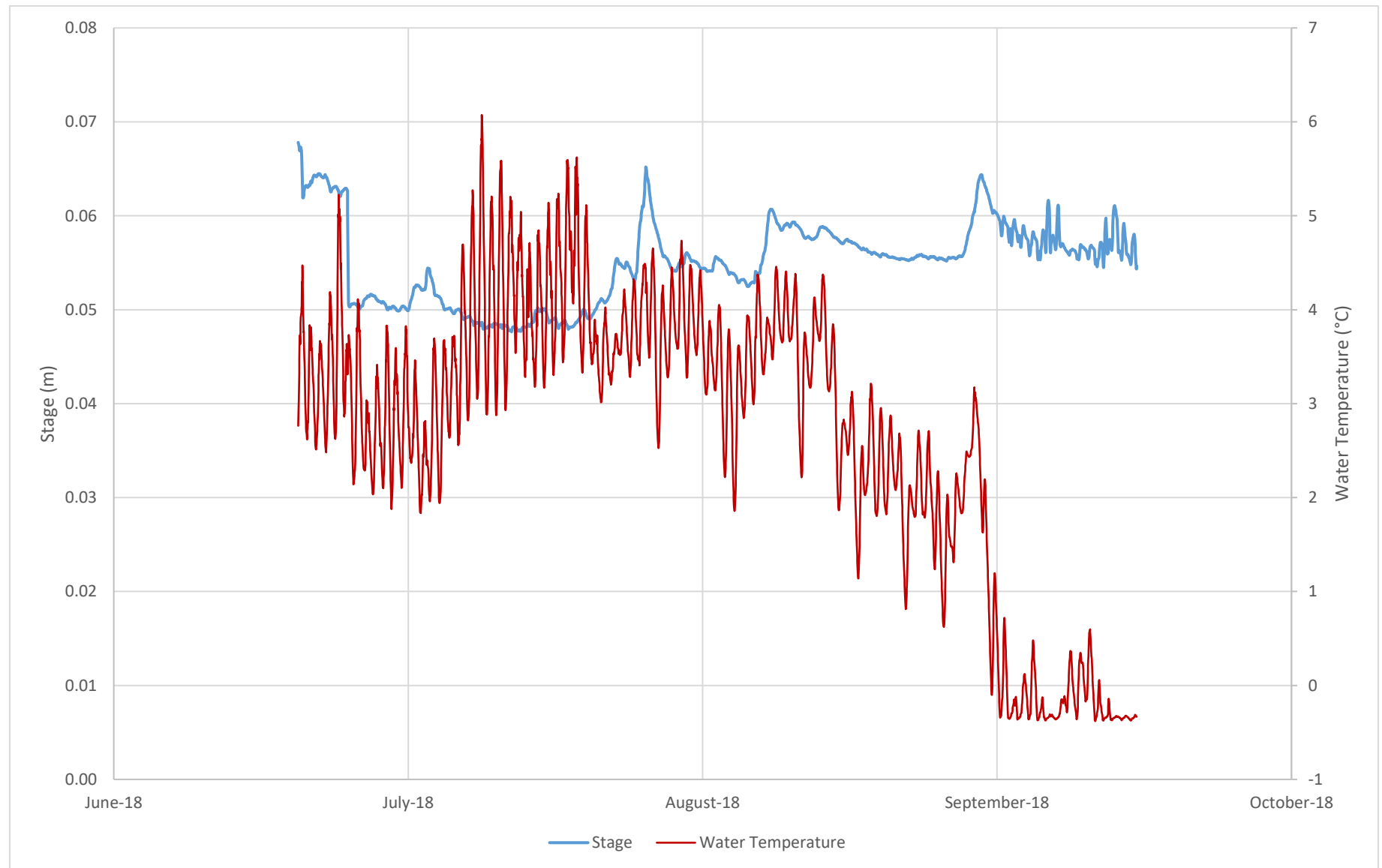


Figure 13: W7 Stage and Temperature Hydrograph

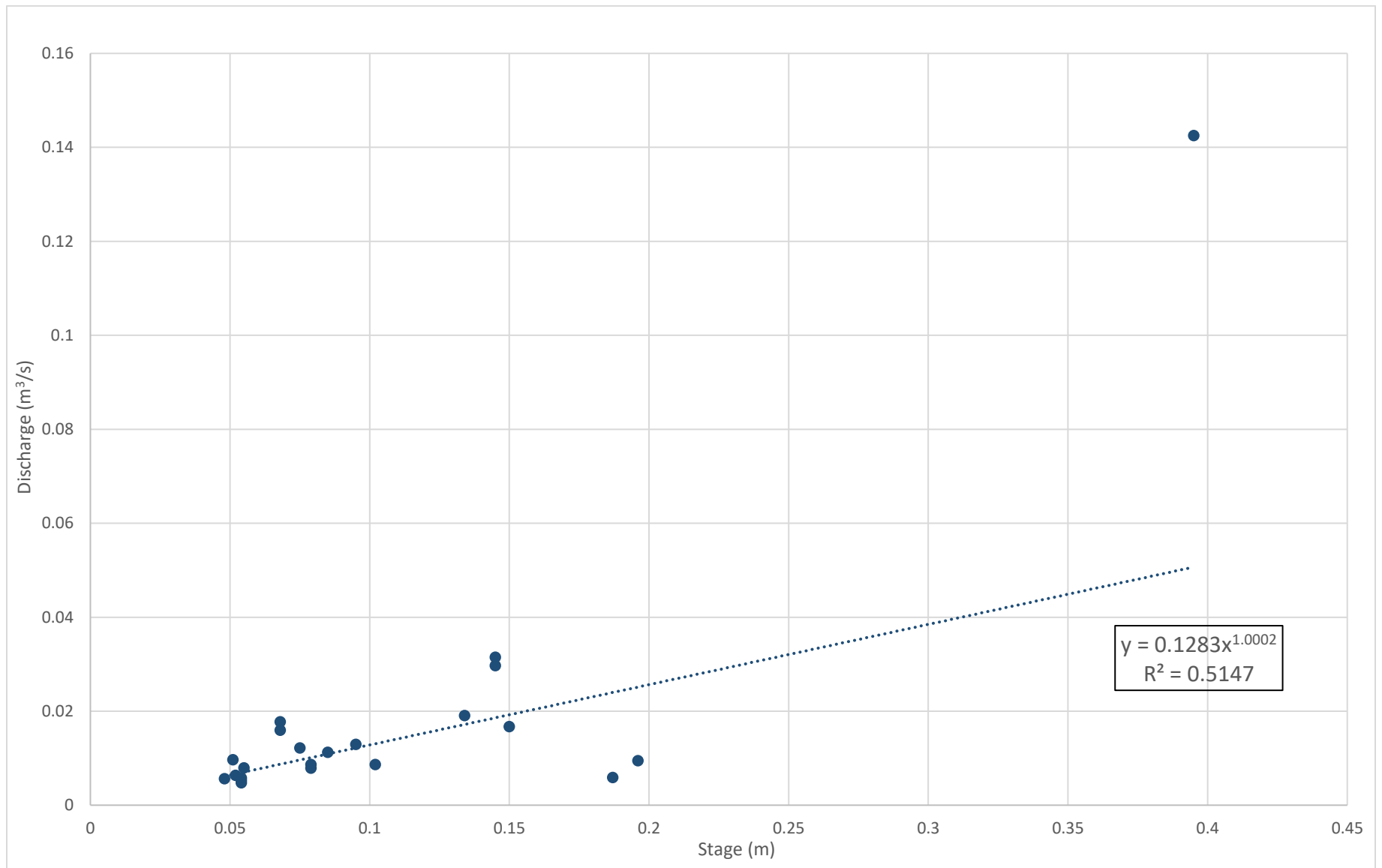


Figure 14: W7 Rating Curve

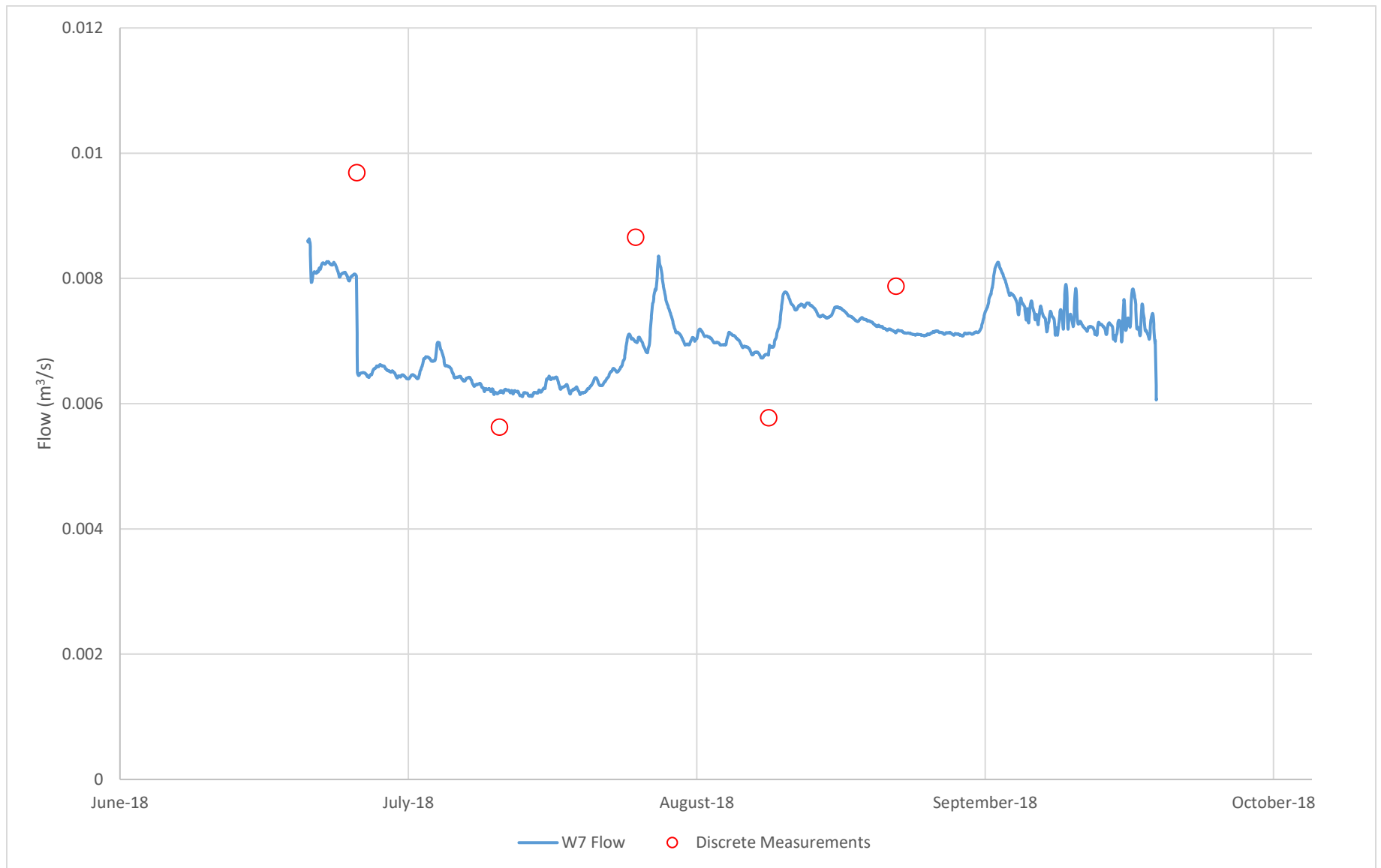


Figure 15: W7 Flow Hydrograph

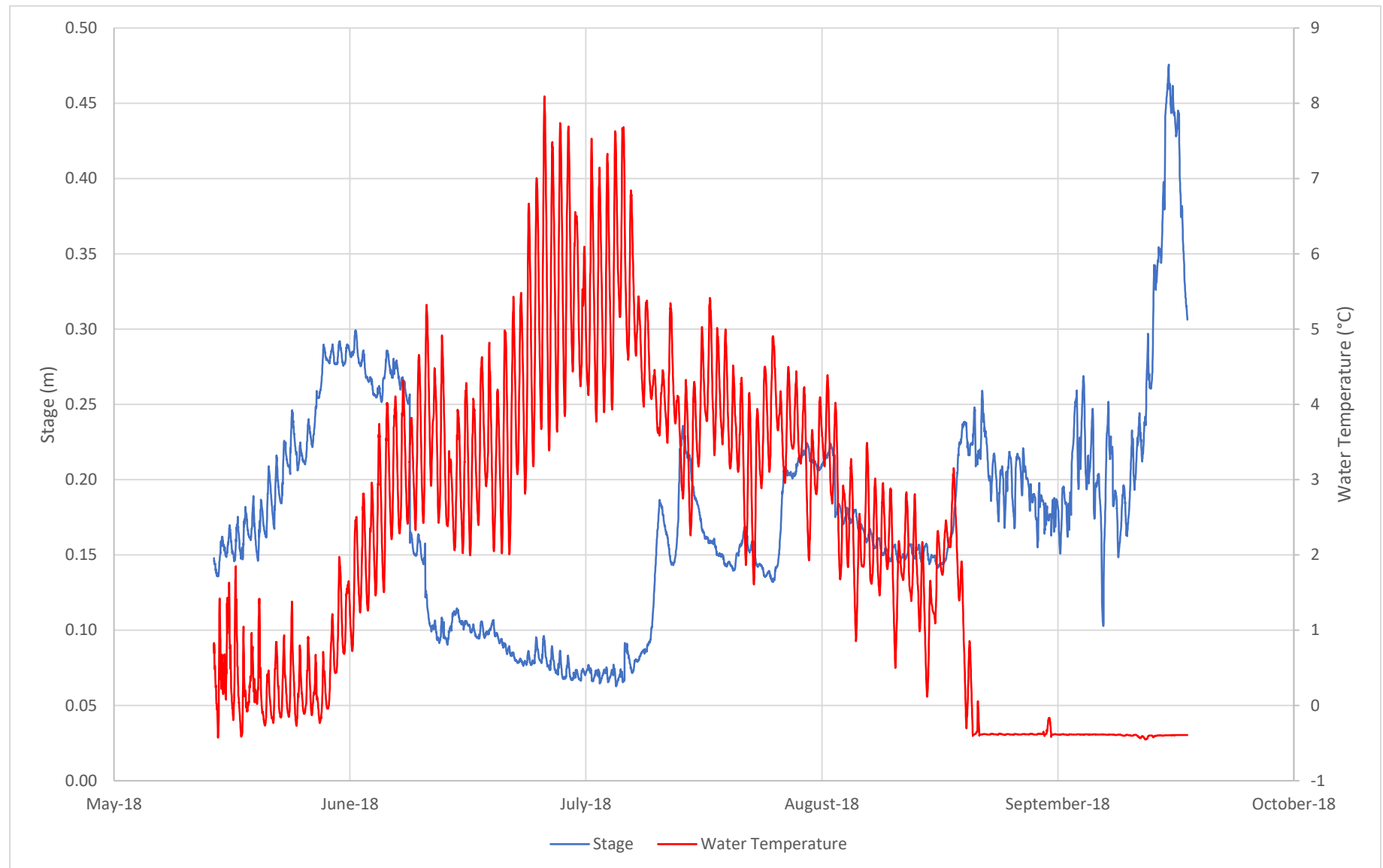


Figure 16: MN-0.5 Stage and Temperature Hydrograph

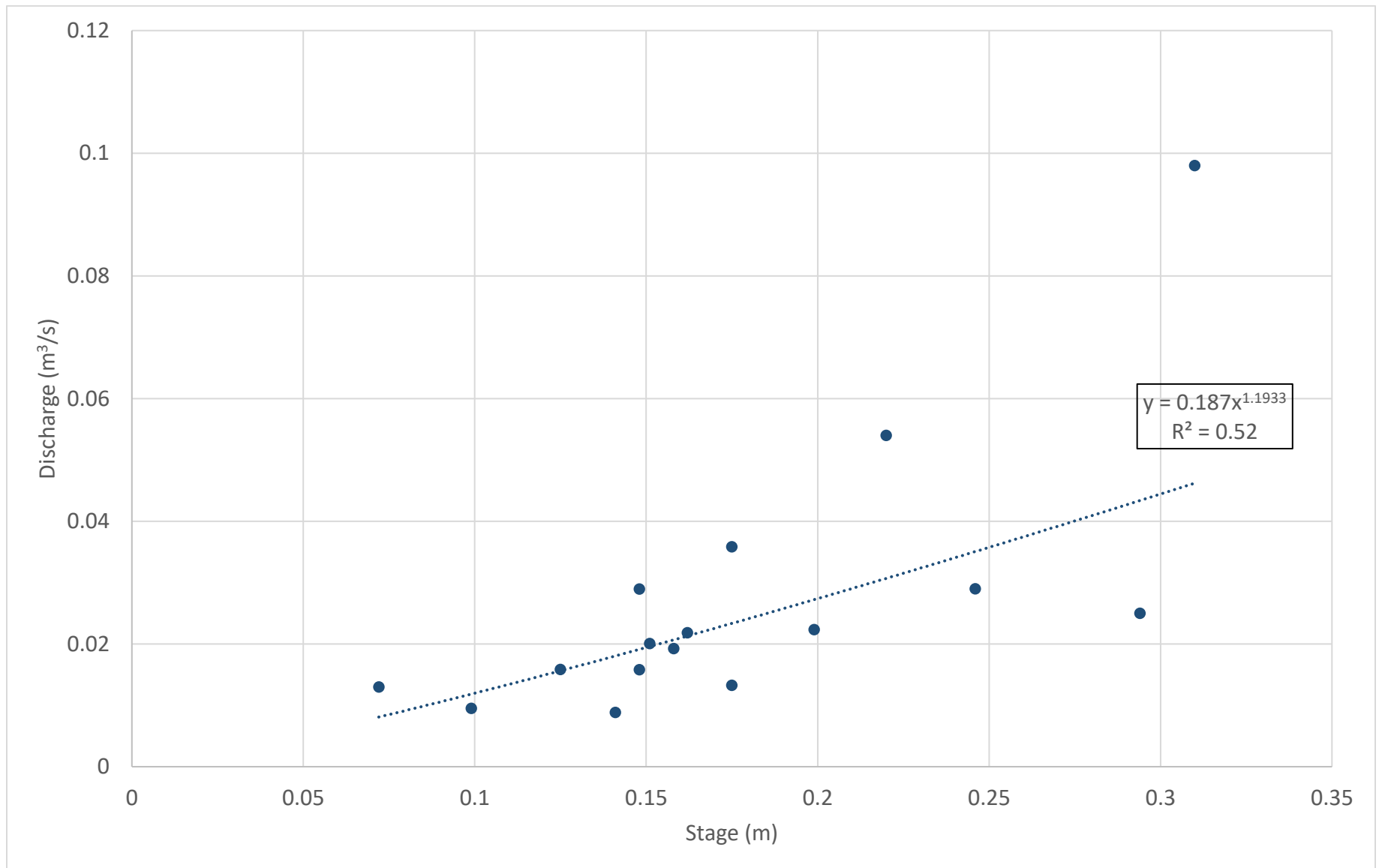


Figure 17: MN-0.5 Rating Curve

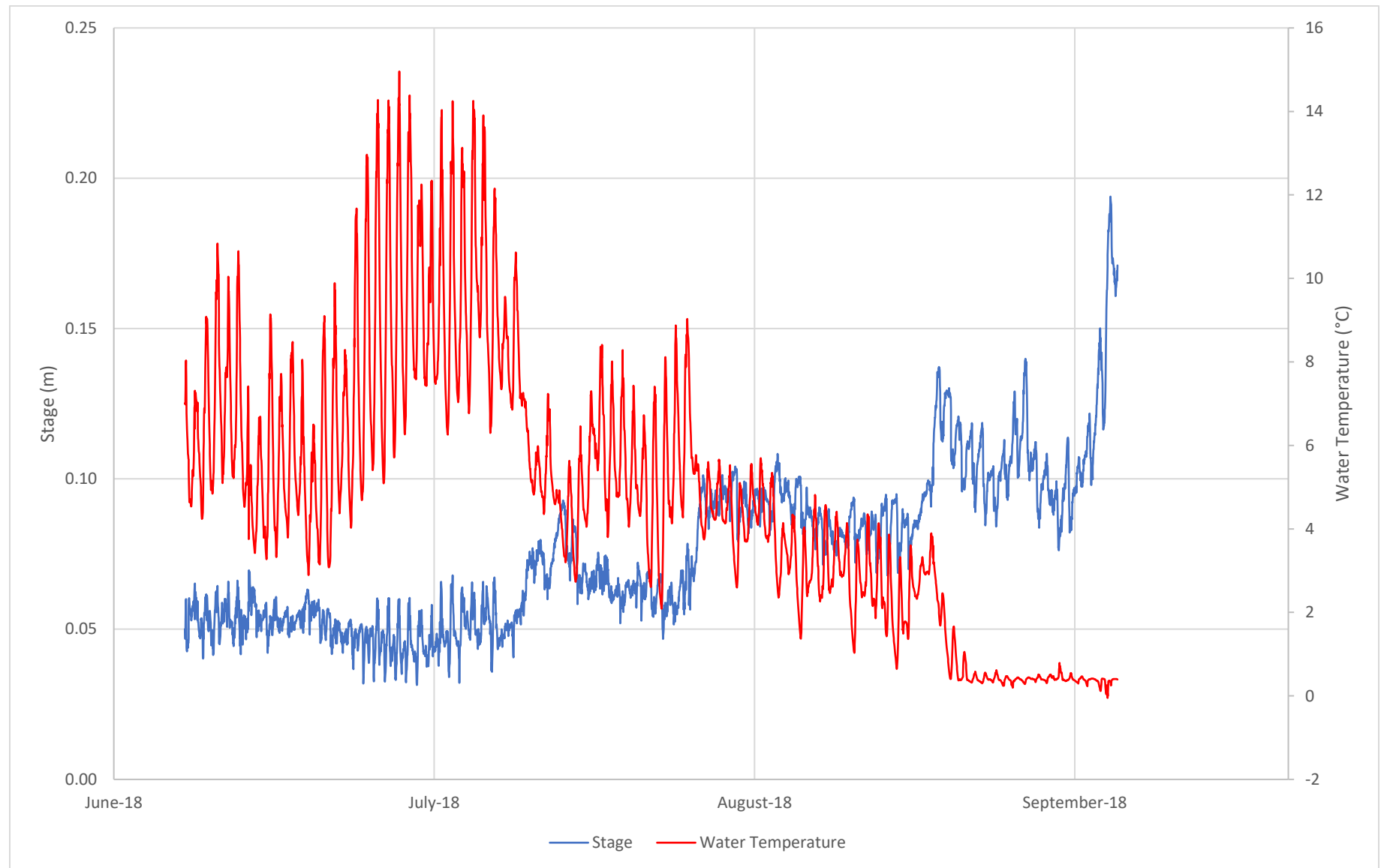


Figure 18: MN-1.5 Stage and Temperature Hydrograph

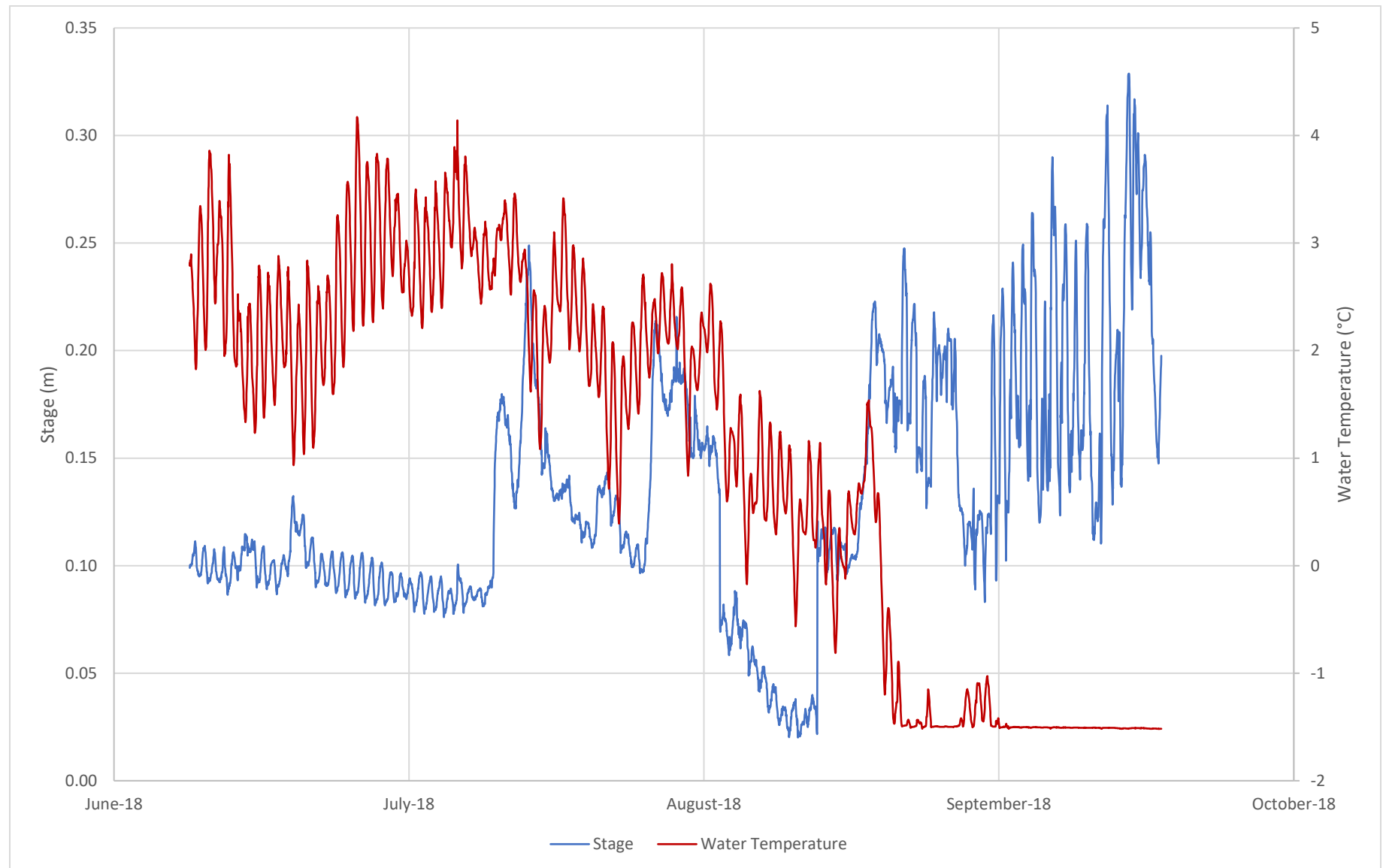


Figure 19: MN-2.5 Stage and Temperature Hydrograph

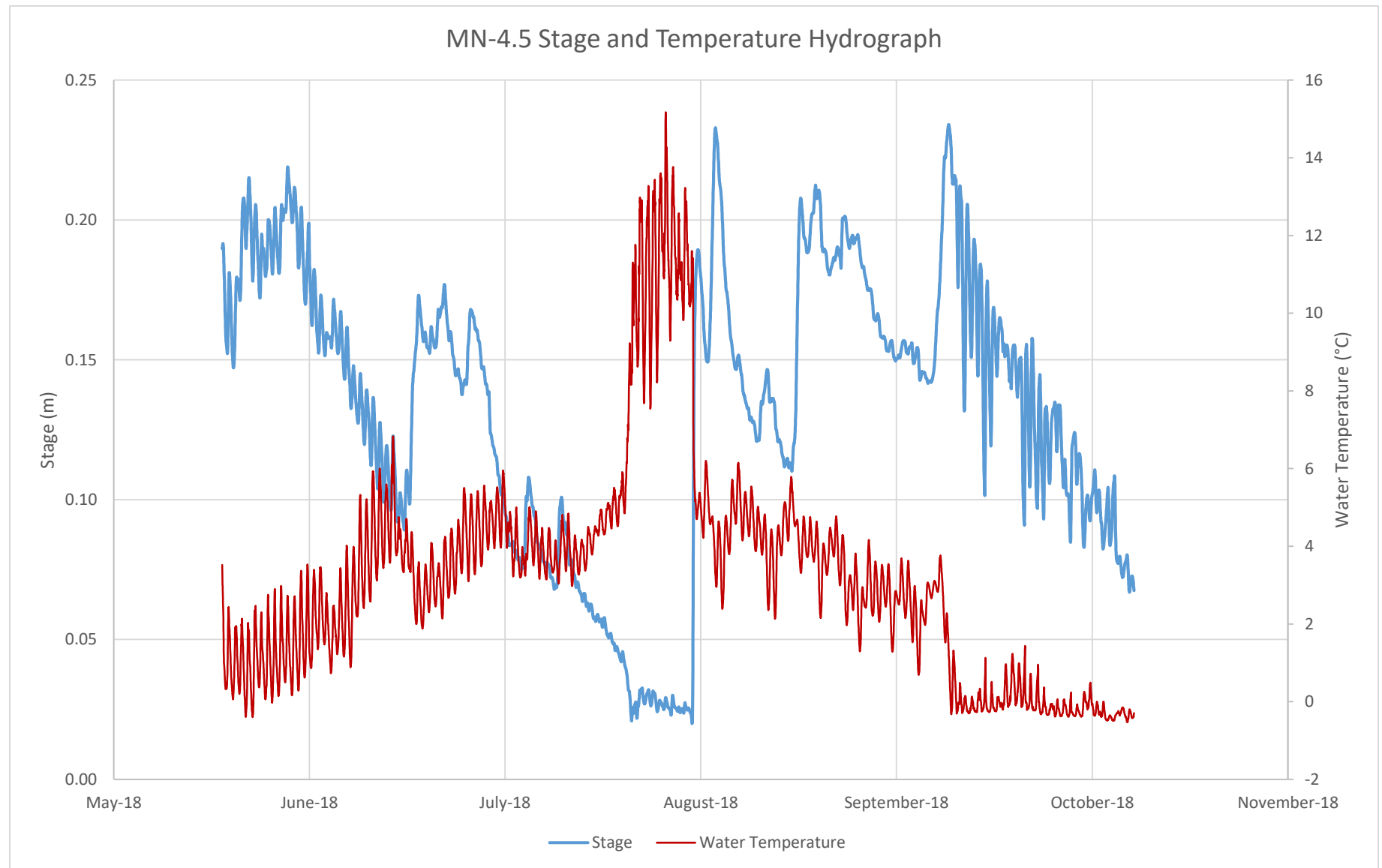


Figure 20: MN-4.5 Stage and Temperature Hydrograph

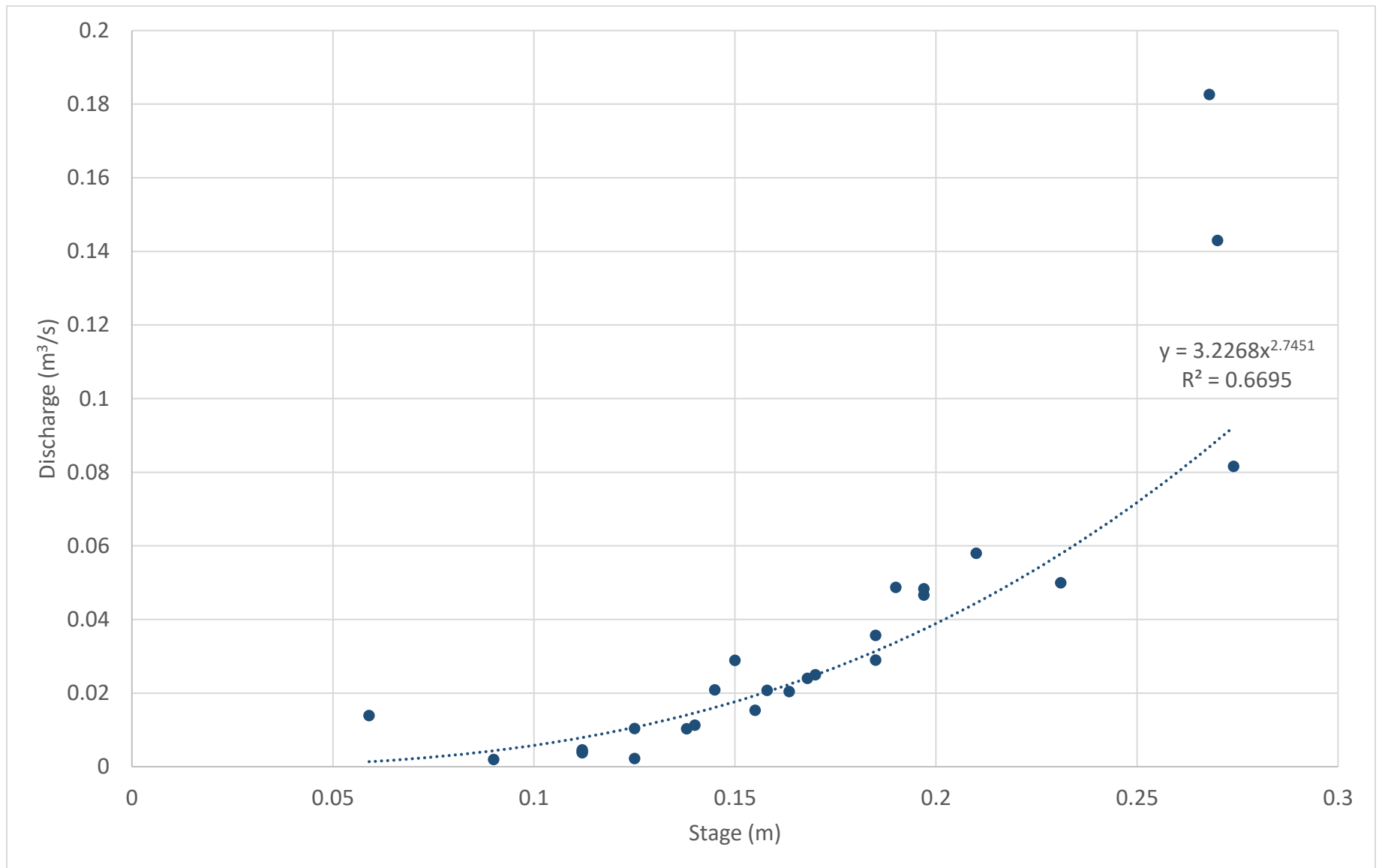


Figure 21: MN-4.5 Rating Curve

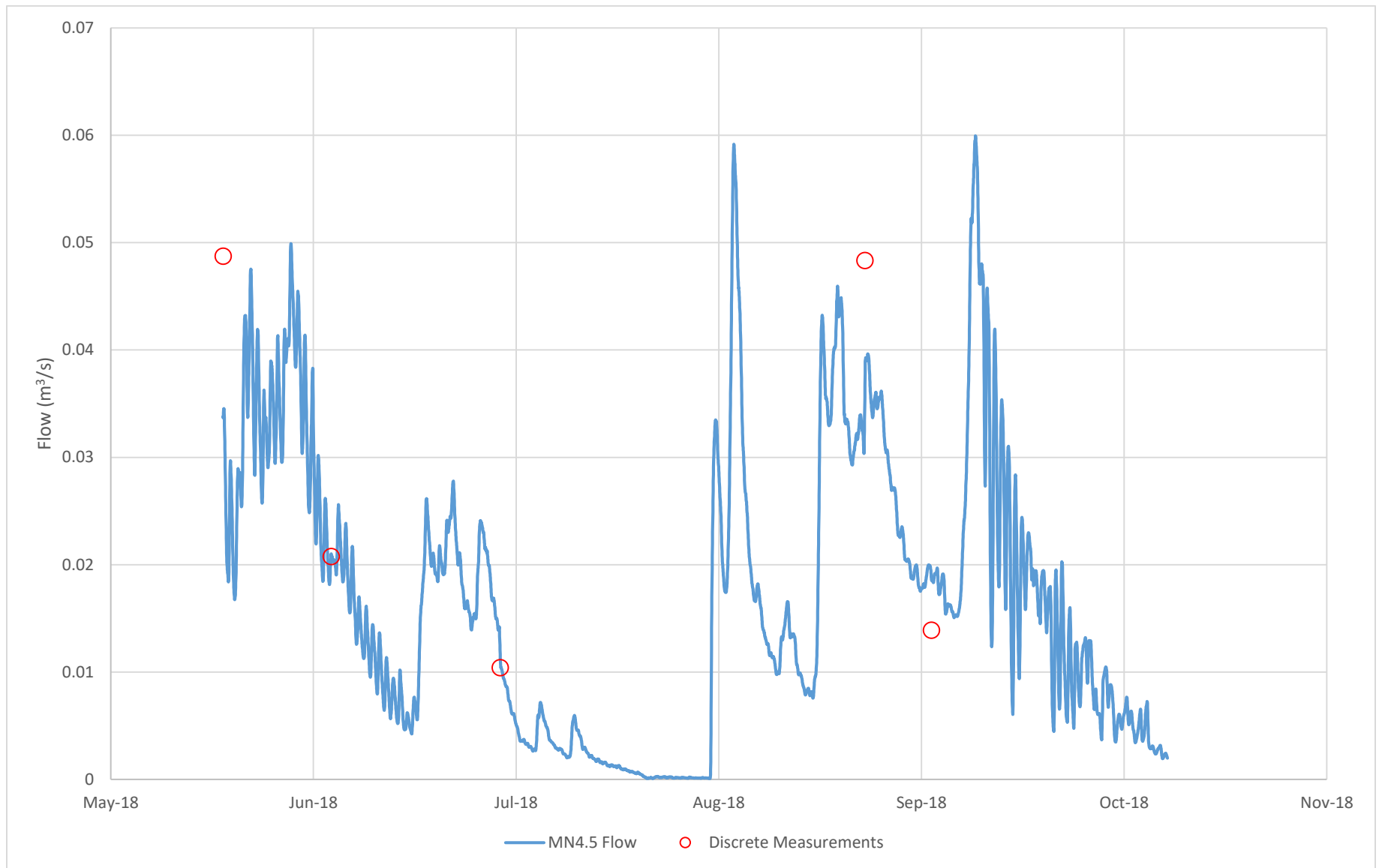


Figure 22: MN-4.5 Flow Hydrograph

Appendix G – 2019 Physical Monitoring Plan



**Revision 2018-1
Physical Monitoring Plan
Minto Mine, YT**

Prepared by:
Minto Explorations Ltd.
Minto Mine
December 2018

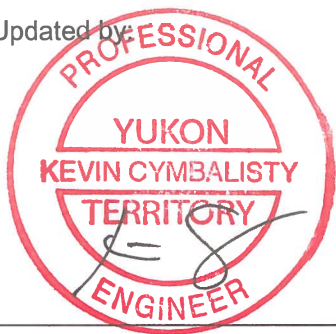
Minto Mine Physical Monitoring Plan

First Issue: June 2014

REVISION INFORMATION

Rev. Number	Issue Date	Description & Revisions Made
-	June, 2014	First issue
2015-1	November, 2015	Annual update of existing instrumentation and monitoring frequencies. Instruments Added: A215, A216, A217, A218, A2RAMP01, A2RAMP02, A2RAMP03, A2RAMP04, DSSH-26, DSSH-27, M82, M83, M84, M85, M86, M87, SWD06 Instruments Removed: DSI-14, DSI-21, DSSH-21, DSSH-22, DSSH-23, DSSH-25, WSP2
2016-1	December, 2016	Annual update of existing instrumentation and monitoring frequencies. Instruments Added: DSP-07, DSP-08, DSP-10, DSI-22, DSI-23, DSSH-28, DSSH-29, DSSH-30, DSSH-31, MV1, MV2, SWD-07, SWD-08, SWD-09 Instruments Replaced: DSSH-06, DSSH-10, DSSH-15, DSSH-18, DSSH-19, DSSH-20 Instruments Removed: A2RAMP01, A2RAMP02, A2RAMP03, A2RAMP04, SWD-02, SWD-02A, SWD-04A, SWD-05A, DSP-09
2017-1	November, 2017	Annual update of existing instrumentation and monitoring frequencies. Instruments Added: DSI-24, DSSH-32, M88, M89, M91, M92, M93, M94, SWD10, SWD11 Instruments Replaced: DSSH-17, DSSH-27, M82, M76, M86 Instruments Removed: DSI-23, DSSH-20, DSSH-29, M73, M75, M87
2018-1	December, 2018	Updated for care & maintenance. Inspection and monitoring frequencies revised. Instruments Added: DS1, DS3, DS4, MWDH1, MWDH2, MWDH3, MWDH4, MWDH5, MWDH6, M81, M95, M95, M97, M98, SWD12 Instruments Removed: M76, M85, M86, M91, SWD05A, SDI-3

Updated by:



Kevin Cymbalisty, P.Eng.

Mine Manager

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Appendix A: Instrumentation Map

Appendix B: Data Collection and Input Manuals

1 Introduction

The following document describes the instrumentation and monitoring program currently in place at Minto to monitor the stability of mining structures including waste rock, tailings, and water storage facilities. The program consists of two main components: instrumentation to measure ground conditions and deformation, and regular geotechnical inspections. The following sections summarize inspection and data collection frequencies, instrument installation details and locations, and data collection procedures.

Mining and monitoring activities at Minto included in this plan are licensed under the following:

- Type A Water Licence QZ14-031, August, 2015
- Type B Water Licence MS15-094, July 2016
- Quartz Mining Licence QML-0001, December, 2014

Existing mine structures at Minto are shown in Figure 1-1, and described in the following section. As of October, 2018 the mine has been placed in care and maintenance and no active mining is taking place.



Figure 1-1: Minto site plan (August 2017)

2 Mine Structures

Mine structures currently being monitored at Minto are listed in Table 1.

Table 1: Description of Mine Structures at Minto

Structure	Description	Instrumentation
Area 2 Pit and Area 2 Pit Tailings Management Facility (A2PTMF)	The Area 2 Pit was completed in 2015 to the extents licensed under Phase IV (Stages 1 and 2); the pit was extended to the south as part of Phase V/VI (Stage 3 and Stage 3 Expansion), completed in 2018. Tailings deposition into Area 2 Stage 2 pit (A2S2) began in March, 2015 and the pit is now maintained as a tailings management facility. Tailings deposition ceased in October 2018 when the mine was placed into care and maintenance. Dumping of NP:AP<3 waste rock (SAT) into the Stage 2 and Stage 3 pits, below the final water table at closure, took place in 2017 and 2018.	Survey hubs
Area 2 Underground	The Area 2 underground began development in 2016 and is accessed by the Minto South portal and decline south of the Area 2 and Area 118 Pits. Production mining ceased in October, 2018 and the mine is now accessed to maintain dewatering only.	None
Area 118 Pit	Mining of the Area 118 Pit was carried out in 2014. As part of Area 2 Stage 3 pit mining, overburden was dispatched to the pit, referred to as the Area 118 Backfill Dump.	None
Area 118 Backfill Dump	The Area 118 Backfill Dump is included in the Phase V/VI licence. Overburden was dispatched to the pit in 2017 as part of Area 2 pit mining.	None
Area 118 Underground	The Area 118 underground began development in 2013 and was completed in 2016. It is accessed by the Minto South portal and decline south of the Area 2 and Area 118 Pits. Production mining took place using a longhole stoping method.	None
Big Creek Bridge	Bridge on the Minto access road crossing Big Creek, located at Km 19. Licenced under Type B water licence MS15-094.	None
Barge Landings	Barge landings on the Minto access road at the Yukon river. Licensed under Type B water license MS15-094.	None
Camp	The camp consists of several connected bunkhouse buildings (Sherwood, Minto, Selkirk), a kitchen building, and several separate buildings including the gym and Site Services offices.	None
Copper Keel and Wildfire Underground	The Copper Keel and Wildfire underground are in the phase V/VI mining plan and have not commenced yet.	N/A
Dry Stack Tailings Storage Facility (DSTSF)	Construction of the DSTSF with filtered tailings placement was carried out from 2007 to November 2011. As part of progressive reclamation activities in 2012-2013, the DSTSF was covered with a layer of overburden approximately one to four meters thick. The DSTSF began showing deformation in 2009, interpreted as primarily horizontal sliding towards the north/northeast on an ice-rich layer in the underlying overburden, several meters above bedrock. The movement has continued since then but at a decreasing rate in response to construction of both the Mill Valley Fill waste rock buttress and the Mill Valley Fill Extension 2 waste rock buttress. Resloping and overburden cover	- Survey hubs - Thermistors - Inclinometers - Piezometers

Structure	Description	Instrumentation
	placement took place in 2017 and 2018 as part of progressive reclamation activities.	
Ice Rich Overburden Dump (IROD)	Originally constructed as a free-standing rockfill structure to contain ice-rich overburden. The IROD is no longer active and is now entirely surrounded by the Southwest Waste Dump rockfill. The area has been reclaimed with the Southwest Waste Dump in 2017.	None
Main Pit (Area 1 Pit) and Main Pit Tailings Management Facility (MPTMF)	Mining in the Main Pit was completed in 2011. Instability in the south wall of the pit occurred in 2009 during mining of Stage 3 of the pit, and subsequently a larger failure occurred in 2011 after completion of Stage 5. Continued sloughing and creep movement of the south wall led to the design and construction of a waste rock buttress, known as the South Wall Buttress, completed in 2013. Slurry tailings deposition into the pit began in 2012 and the pit is now maintained as a tailings management facility.	- Survey hubs - Inclinometer
Main Pit Dump	The Main Pit Dump is included in the Phase V/VI licence. Construction commenced in 2017 and ceased in 2018 when the mine placed in care and maintenance. The dump is located on the southwest side of the Main Pit.	Survey hubs
Main Waste Dump (MWD)	The Main Waste Dump stores waste rock released during the mining of the first three stages of the Main Pit. The dump is no longer active.	- Survey hubs - Inclinometer
Main Waste Dump Expansion (MWDE)	This dump is an extension of the MWD that stores waste rock released from the Minto North Pit. The dump is no longer active. Reclamation re-sloping began in 2016.	None
Main Waste Dump Wrap (MWDW)	This dump is a reclamation feature to shallow the slopes of the Main Waste Dump for reclamation purposes. The dump is no longer active.	Survey hubs
Mill Site	The mill site consists of the mill building, crusher and crusher stockpile pad.	None
Mill Valley Fill Extension (MFVE)	A waste rock buttress to the north of the DSTSF, constructed from January 2012 to March 2013 to prevent or decrease movement of the DSTSF. Resloping and overburden cover placement were carried out as part of progressive reclamation activities in 2017 and 2018.	Survey hubs
Mill Valley Fill Extension 2 (MVFE2)	An extension of the MVFE waste rock buttress to the northeast, constructed from November 2015 to August 2016 to further decrease movement of the DSTSF. Resloping and overburden cover placement were carried out as part of progressive reclamation activities in 2017 and 2018.	- Piezometers - Survey hubs - Inclinometers
Mill Valley Fill Extension 2 Collection Sump	A replacement sump for the Minto Creek Detention Structure (MCDS), constructed in 2016. It detains surface water considered impacted from upstream sub-catchment areas and directs it to the MPTMF or water treatment plant.	None
Minto Access Road	Road from the Yukon River barge crossing to the mine site. Licenced under Type B water licence MS15-094.	None
Minto East Underground	Accessed by the Minto South portal and decline south of the Area 2 and Area 118 Pits. Production was underway at the time the mine was placed in care and maintenance in October 2018.	None

Structure	Description	Instrumentation
Minto North Pit	Mining of the North Pit was completed in September 2016. The pit is currently inactive and the access is barricaded.	None
Ore Stockpiles	There are two primary ore stockpiles on site – North and South stockpile. These are located south of the crusher and east of the Area 2 pit.	None
Reclamation Overburden Dump (ROD)	Received the bulk of the overburden released as part of Phase IV and earlier mining of the Main Pit. The material in the ROD is available for use in reclamation of the mine at closure.	None
South Diversion Ditch	This structure was decommissioned in 2017 to allow for Area 2 Stage 3 Expansion mining activities.	None
South Wall Buttress (SWB)	Waste rock buttress constructed against the Main Pit south wall from 2009-2011 as a result of instability in the south wall of the pit. Now covered by the Main Pit Dump.	• Survey hubs
Southwest Waste Dump (SWD)	The Southwest Waste Dump (SWD) stores waste rock released during phase IV mining. The dump is no longer active. Resloping and overburden cover placement were carried out as part of progressive reclamation activities in 2016-2018.	• Survey hubs • Inclinometers • Thermistors • Piezometers
Tailings Diversion Ditch (TDD)	A diversion ditch located south of the DSTSF to divert unimpacted water around the tailings facility. The intake structure was extended in 2017 and 2018 to allow for the decommissioning of the South Diversion Ditch for A2S3 Expansion mining.	None
Water Storage Pond Dam (WSP)	The Water Storage Pond and Dam are located east of the mine along Minto Creek. The dam was constructed in 2006 as a clay-core water retention dam for collecting precipitation and surface water runoff at the site. Maximum depth of water at the face of the dam is approximately 15 m.	• Survey hubs • Thermistors • Piezometers

3 Design and Monitoring References

Table 2 lists the design reports for each structure and the monitoring/inspection guidance reports used to develop the inspection (Section 5) and instrumentation (Section 6) programs for each structure.

Table 2: Design Documents and Monitoring/Inspection Guidance Documents

Structure	Design Reports	Monitoring/Inspection Guidance Reports
Area 2 Pit and Area 2 Pit Tailings Management Facility (A2PTMF)	<i>Prefeasibility Geotechnical Evaluation, Phase IV, Minto Mine.</i> SRK, December 2009. <i>Review of Minto Area 2 West Wall Stability.</i> SRK, September 11, 2012. <i>Review of Minto Area 2 West Wall Stability-April 2013.</i> SRK, April 18, 2013. <i>Review of Minto Area 2 West Wall Stability-September 2013.</i> SRK, September 30, 2013. <i>Main Dam – Area 2 Pit Stability Assessment.</i> SRK Consulting Project: 1CM002.003.0701, February, 2015.	<i>Operation, Maintenance, and Surveillance Manual - Area 2 Pit Tailings Management Facility Revision 2015-2.</i> Minto, December 2015. <i>Minto Mine Operations Adaptive Management Plan Revision 2018-01.</i> Minto, 2018.
Area 2 Stage 3 Pit and Area 2 Stage 3 Expansion	<i>Pit Slope Stability Evaluation, Minto Mine, Area 2 Pit – Stage 3.</i> SRK Consulting Project: 219500.190, August 2015. <i>Geotechnical Review of Saddle Between Area 2 Stage 2 and Area 2 Stage 4 Open Pits.</i> JDS Energy & Mining Inc., August 24, 2017.	<i>Minto Mine Ground Control Plan – Open Pit Operations.</i> Minto, 2017.
Area 2 Underground	<i>Area 2 Mining Stability Assessment Summary.</i> Golder Associates, June, 2016. <i>Area 2 Mining Stability Assessment Summary.</i> Golder Associates, December, 2016.	<i>Minto Mine Ground Control Plan – Underground Operations.</i> Minto, 2017. <i>Inspection of Physical Stability of Underground Workings at Minto Mine, Yukon.</i> Golder Associates, August 2017. <i>Minto Mine Geotechnical Mapping Program Memo Review.</i> Golder Associates, September 2017. <i>Independent Review of Blasting Impacting Between Minto Surface and Underground Operations.</i> Golder Associates, September 2017. <i>Inspection of Physical Stability of Underground Workings at Minto Mine.</i> Golder Associates, August 2018.
Area 118 Pit	<i>Prefeasibility Geotechnical Evaluation, Phase IV, Minto Mine.</i> SRK, December 2009. <i>Review of Final Area 118 Pit Design.</i> SRK Consulting, Project: 219500.070. January, 2015.	-

Structure	Design Reports	Monitoring/Inspection Guidance Reports
Area 118 Backfill Dump	<i>Phase V/IV Ridgetop South and Area 118 Backfill Dumps Physical Stability Assessment.</i> SRK, October 2013.	-
Area 118 Underground	<i>Minto 118-Zone – FLAC3D Analysis of the Longhole Base Case Option.</i> Itasca, August 2014. <i>Geotechnical Characterization of Existing and Proposed Longhole Open Stope Mining Areas.</i> Golder Associates File: 1528754-002-R-Rev0-3000. July 30, 2015. <i>Longhole Open Stope Stability Addendum – Revised Mining Heights.</i> Golder Associates, File 1528754-006-TM-Rev0-3000, November 2015. <i>Area 118 Plunge Mining Stability Assessment Summary.</i> Golder Associates, File: 1528754-008-PP-Rev0-5000, December 2015	<i>Minto Mine Ground Control Plan – Underground Operations.</i> Minto, 2016. <i>Ground Control Management Plan Review.</i> Golder Associates, File 1528754-007-TM-Rev0-1000. September 2015.
Big Creek Bridge	-	-
Camp	-	-
Dry Stack Tailings Storage Facility (DSTSF)	<i>Geotechnical Design Report, Dry Stack Tailings Storage Facility, Minto Mine, Yukon.</i> EBA File: 1200173. January 2007.	<i>Operation, Maintenance, and Surveillance Manual, Dry Stack Tailings Storage Facility, Minto Mine, YT.</i> Revision 2014-1 Minto, November 2014. <i>Minto Mine Operations Adaptive Management Plan.</i> Revision 2018-01. Minto, 218.
Ice Rich Overburden Dump (IROD)	<i>Geotechnical Design Ice-Rich Overburden Dump, Minto Mine, Minto, YT.</i> EBA file: 1200173. January 2006. <i>Ice-Rich Overburden Dump Containment Berm Inspection Report, Minto Mine Site, Minto Yukon.</i> EBA File: 1200173.001. June 19, 2007.	<i>Geotechnical Design Ice-Rich Overburden Dump, Minto Mine, Minto, YT.</i> EBA file: 1200173. January 2006. EBA, 2007.
Main Pit (Area 1 Pit) and Main Pit Tailings Management Facility (MPTMF)	<i>Pit Slope Evaluation for Area 1 Open Pit.</i> SRK Consulting, Project: 2CM022.03, July 2007. <i>SAT Dump on Tailings.</i> SRK Consulting Project: 1CM002.043, March 2016.	<i>Operation, Maintenance, and Surveillance Manual - Main Pit Tailings Management Facility.</i> Revision 2015-2 Minto, December, 2015. <i>Minto Mine Operations Adaptive Management Plan</i> Revision 2018-01. Minto, 2018.

Structure	Design Reports	Monitoring/Inspection Guidance Reports
Main Pit Dump	<i>Phase V/VI Main Pit Dump Physical Stability Assessment.</i> SRK Consulting Project: 1CM002.003.0701, November, 2013. <i>Update to the Main Pit Dump Physical Stability Assessment.</i> SRK Consulting Project: 1CM002.003.0701. February, 2015. <i>Main Pit Dump (Revision 5.6) Stability Analysis.</i> SRK Consulting, Project 1CM002-053, July, 2017.	-
Main Waste Dump (MWD)	<i>Geotechnical Evaluation Proposed Main Waste Dump Minto Mine, Minto, YT.</i> EBA. April, 1998.	<i>Geotechnical Evaluation Proposed Main Waste Dump Minto Mine, Minto, YT.</i> EBA. April, 1998. <i>Minto Mine Operations Adaptive Management Plan</i> Revision 2018-01. Minto, 2018.
Main Waste Dump Expansion (MWDE)	<i>Minto Mine Phase V/VI Expansion Waste Rock and Overburden Management Plan.</i> Minto. June, 2014. <i>Phase V/VI Main Waste Dump Expansion – Physical Stability Assessment.</i> SRK Consulting Project: 1CM002.012.012, November, 2013	<i>Minto Mine Operations Adaptive Management Plan</i> Revision 2018-01. Minto, 2018.
Main Waste Dump Wrap (MWDW)	<i>Main Waste Dump Stability Analysis.</i> SRK Consulting Project: 1CM002-049, April, 2017.	-
Mill Site	-	-
Mill Valley Fill Extension (MFVE)	<i>Waste Rock and Overburden Management Plan, Phase IV Development, Minto Mine YT.</i> EBA File: W14101068.015. September 9, 2011. <i>Upstream Water Management for the Mill Valley Fill Expansion and Dry Stack Tailings Storage Facility.</i> EBA File: W14101168.013. September 14, 2011.	<i>Minto Mine Operations Adaptive Management Plan</i> Revision 2018-01. Minto, May, 2018.
Mill Valley Fill Extension 2 (MVFE2)	<i>Mill Valley Fill Extension Stage 2 Preliminary Design Report.</i> SRK Consulting Project: 1CM002.015. March, 2014 <i>Minto Mine Phase V/VI Expansion Waste Rock and Overburden Management Plan.</i> Minto. June, 2014. <i>Mill Valley Fill Extension Stage 2 Final Design Report.</i> SRK Consulting Project: 1CM002.040. September, 2015. <i>Mill Valley Fill Extension Stage 2 Record of Construction.</i> Minto. November, 2016.	<i>Minto Mine Operations Adaptive Management Plan</i> Revision 2018-01. Minto, 2018. <i>Mill Valley Fill Extension Stage 2 – Expected Performance and Evaluation Criteria.</i> SRK Consulting Project: 1CM002.050, November, 2016. <i>Mill Valley Fill Extension Stage 2 Inclinator Installation Field Report.</i> SRK Consulting Project: 1CM002.052. June 2017.

Structure	Design Reports	Monitoring/Inspection Guidance Reports
Mill Valley Fill Extension 2 Collection Sump	<i>Design for the MVFE Stage 2 Collection Sump.</i> SRK Consulting Project: 1CM002.020. June, 2015. <i>Mill Valley Fill Extension Stage 2 Collection Sump Record of Construction.</i> Minto. April, 2016.	-
Minto Access Road	-	-
Minto East Underground	<i>Geotechnical Characterization of Existing and Proposed Longhole Open Stope Mining Areas,</i> Golder Associates, Reference No. 1528754-002-R-Rev0-3000, July, 2015. <i>Minto East – Revised Longhole Open Stope Stability.</i> Golder Associates, File: 1528754-009-TM-Rev0-6000, January, 2016. <i>Minto East Raise Geotechnical Investigation and Hydrogeological Testing Program Study.</i> Golder Associates, October, 2017. <i>Minto East Stability Assessment Update - Draft.</i> Golder Associates, September 2018.	<i>Minto Mine Ground Control Plan – Underground Operations.</i> Minto, 2017. <i>Minto Mine Underground Ground Control Audit.</i> Golder Associates, January 2018. <i>Inspection of Physical Stability of Underground Workings at Minto Mine.</i> Golder Associates, August 2018.
Copper Keel, Wildfire Underground	<i>Minto Phase VI Underground Geotech Evaluation,</i> SRK Consulting Project: 2UC031.005, February, 2012. <i>Geotechnical Characterization of Existing and Proposed Longhole Open Stope Mining Areas,</i> Golder Associates, Reference No. 1528754-002-R-Rev0-3000, July, 2015. <i>Minto Mine Underground Reserve Update Geotechnical Input,</i> Golder Associates, Reference No. 1528754-003-R-Rev0-3000, July, 2015. <i>Wildfire Proposed Underground Mine Area – Geotechnical Characterization and Long Hole Open Stope Stability Assessment.</i> Golder Associates, September, 2016.	-
Minto North Pit	<i>Minto Phase VI Preliminary Feasibility Study Technical Report.</i> SRK, January 2012. <i>Review of Minto North Wall Stability.</i> SRK, May, 2016. <i>Site Visit and Review of North Pit – South Wall.</i> BGC Engineering, July, 2016. <i>Minto North South Wall Wedge Analysis.</i> SRK, August, 2016.	<i>Minto Open Pit Ground Control Plan_Rev0.</i> Minto, 2016.
Ore Stockpiles	-	-

Structure	Design Reports	Monitoring/Inspection Guidance Reports
Reclamation Overburden Dump (ROD)	<i>Geotechnical Design Proposed Reclamation Overburden Dump, Minto Mine, Yukon.</i> EBA File: W14101068.004. February 2008. <i>Reclamation Overburden Dump Expansion Geotechnical Design Report.</i> EBA File: W14101068.0040. June 29, 2010.	<i>Reclamation Overburden Dump Expansion Geotechnical Design Report.</i> EBA File: W14101068.0040. June 29, 2010. <i>Minto Mine Operations Adaptive Management Plan</i> Revision 2018-01. Minto, 2018.
Ridgetop Pit (Ridgetop North Pit, Ridgetop South Pit)	<i>Pre-Feasibility Geotechnical Evaluation Phase IV Minto Mine, SRK Consulting Project:</i> 2CM022.006, December, 2009. <i>Ridgetop North Pit TMF Stability Assessment, SRK Consulting Project:</i> 1CM002.003.710, February, 2015.	-
Ridgetop Waste Dump	<i>Phase V/VI Ridgetop Waste Dump Physical Stability Assessment.</i> SRK Consulting Project: 1CM002.012.0.12, November, 2013.	-
South Diversion Ditch (SDD)	<i>Phase 1 – Preliminary Engineering, Stormwater Diversion Ditches Minto Mine, YT,</i> EBA File: W14101068.013	-
South Wall Buttress	<i>Area 1 South Wall Buttress Design Report, Minto Mine, Yukon.</i> EBA File: W141010668.012, July 2011.	-
Southwest Waste Dump (SWD)	<i>Geotechnical Design Proposed Southwest Waste Dump, Minto Mine, Yukon.</i> EBA File: W14101068.005. September 2008.	<i>Geotechnical Design Proposed Southwest Waste Dump, Minto Mine, Yukon.</i> EBA File: W14101068.005. September 2008. <i>Minto Mine Operations Adaptive Management Plan</i> Revision 2018-01. Minto, 2018.
Tailings Diversion Ditch (TDD)	<i>Preliminary Design of the Tailings Diversion Ditch Upgrade, SRK Consulting Project:</i> 1CM002.012.006, November, 2013. <i>Area 2 Stage 3 Pit Expansion – Intake Structure and Overflow Spillway – Final Design, SRK Consulting Project:</i> 1CM002.056, May 2017.	-
Water Storage Pond Dam (WSP)	<i>Geotechnical Design Tailings/Water Dam, Minto Project, Yukon.</i> EBA File: 0201-95-11509. Dec. 1995. <i>As-built Construction Report, Water Retention Dam, Minto Mine, Minto, YT.</i> EBA File: 1200173.001. April 2008.	<i>Operation, Maintenance and Surveillance Manual, Water Retention Dam, Minto Mine, Minto, YT.</i> EBA File: W14103414-01. August 2014.

4 Roles and Responsibilities

Table 3 lists the roles and responsibilities for physical monitoring on the site. The list below has been updated to reflect the care and maintenance workforce.

Table 3: Roles and Responsibilities

Role	Responsibilities
Environmental Monitors	• Collect instrumentation data at specified frequencies • Input data into monitoring spreadsheets/databases • Internal reporting of monitoring data • Maintain equipment
Environmental Officers	• Ensure compliance with license requirements • Compile monthly and annual Water Licence reports • Visual inspections at specified frequencies • Communicate with consultants as required
External Geotechnical Consultant	• Review monthly and annual Water Licence reports • Review and update Physical Monitoring Plan • Site inspections at specified frequencies

5 Inspections

Table 4 lists the regular, required inspections.

Table 4: Inspections

Structure	Frequency	Description
Area 2 Pit and Area 2 Pit Tailings Management Facility (A2PTMF)	Quarterly	Visual inspection and review of monitoring data as per OMS Manual. Two of the inspections by a professional engineer.
Area 2 Underground	N/A	No longer accessible.
Area 118 Pit	N/A	No longer accessible.
Area 118 Backfill Dump	Semi-Annually – May/June post thaw, and September pre freeze-up	Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year.
Area 118 Underground	N/A	No longer accessible.
Big Creek Bridge	Annually	Visual inspection by a professional engineer as per MS15-094.
Camp	Semi-Annually – May/June post thaw, and September pre freeze-up	Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year.
Copper Keel, Wildfire Underground	N/A	N/A – structure does not exist yet.
Dry Stack Tailings Storage Facility (DSTS)	Quarterly	Visual inspection and review of monitoring data as per OMS Manual. Two of the inspections by a professional engineer.
Main Pit (Area 1 Pit) and Main Pit Tailings Management Facility (MPTMF)	Quarterly	Visual inspection and review of monitoring data as per OMS Manual. Two of the inspections by a professional engineer.
Main Pit Dump	Quarterly	Visual inspection and review of monitoring data. Two of the inspections by a professional engineer.
Main Waste Dump (MWD)	Semi-Annually – May/June post thaw, and September pre freeze-up	Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year.

Structure	Frequency	Description
Main Waste Dump Expansion (MWDE)	Semi-Annually – May/June post thaw, and September pre freeze-up	Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year.
Main Waste Dump Wrap (MWDW)	Semi-Annually – May/June post thaw, and September pre freeze-up	Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year.
Mill Site	Semi-Annually – May/June post thaw, and September pre freeze-up	Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year.
Mill Valley Fill Extension (MFVE)	NA	Covered by MVFE2.
Mill Valley Fill Extension 2 (MVFE2)	Quarterly	Visual inspection and review of monitoring data. Two of the inspections by a professional engineer.
Mill Valley Fill Extension 2 Collection Sump	Monthly	Visual inspection. Semi-annual inspections by a professional engineer.
Minto Access Road	Annually	Visual inspection by a professional engineer as per MS15-094.
Minto East Underground	Semi-annually	Visual inspection by a professional engineer as per Underground Ground Control Plan.
Minto North Pit	Semi-Annually – May/June post thaw, and September pre freeze-up	Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year.
Ore Stockpiles	Semi-Annually – May/June post thaw, and September pre freeze-up	Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year.
Reclamation Overburden Dump (ROD)	Semi-Annually – May/June post thaw, and September pre freeze-up	Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year.
Ridgetop Waste Dump	Semi-Annually – May/June post thaw, and September pre freeze-up	Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year.

Structure	Frequency	Description
South Wall Buttress (SWB)	NA	Covered by Main Pit Dump.
Southwest Waste Dump (SWD)	Semi-Annually – May/June post thaw, and September pre freeze-up	Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year.
Tailings Diversion Ditch (TDD)	Semi-Annually – May/June post thaw, and September pre freeze-up	Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year.
Water Storage Pond Dam (WSP)	Monthly	Visual inspection and review of monitoring data. Semi-annual inspections by a professional engineer.

6 Instrumentation

A map of site wide active instrumentation is shown in Appendix A. Installation information and data collection schedules are contained in the following sections. Instruments with a strikethrough shown were destroyed in 2018 or are no longer operational.

Inclinometers

Inclinometers are used to measure lateral, differential ground movement in a borehole. Inclinometer stations consist of grouted, slotted PVC pipe into which the inclinometer probe is lowered and deflection is measured at 0.5m intervals. The current probe used on site is an RST digital MEMS inclinometer system.

Table 5: Inclinometers

Area	ID	Northing (m)	Easting (m)	Elevation (m)	A0 Azimuth	Hole Depth (m)	Date Installed	Reading Frequency
Area 2 Pit	A2I-1	6944164.73	385298.95	822.46	302	55.5	2013-04-26	Semi-annually
Dry Stack Tailings Storage Facility and Mill Valley Fill Extension 2	DSI-22	6945229	386043.4	723.471	034	14	2016-12-12	Quarterly
Dry Stack Tailings Storage Facility and Mill Valley Fill Extension 2	DSI-24	6944971	385951.4	774.416	005	108	2017-02-01	Monthly
Main Pit (Area 1 Pit) and Main Pit Tailings Management Facility (MPTMF)	MDI -2	6945013.08	384217.20	858.67	93	50.5	2010-02-10	Quarterly
Southwest Waste Dump	SDI-3	6944591.11	383966.00	847.42	90	46.5	2010-02-11	Quarterly

Survey Hubs

Survey hubs are used to monitor surface movement of structures and are comprised of steel posts cemented into waste rock or bedrock and equipped with a threaded base to which a high precision RTK-corrected GPS instrument is attached. The GPS currently used on site is a Trimble R8.

Table 6: Survey Hubs

Area	ID	Northing (m)	Easting (m)	Elevation (m)	Date Installed	Frequency
Area 2 Pit	A210	6944268	384935	861	7/1/2011	Quarterly
Area 2 Pit	A215	6944649	385155	809	9/17/2015	Quarterly
Area 2 Pit	A216	6944749	385046	806	9/17/2015	Quarterly
Area 2 Pit	A217	6944757	384853	807	9/17/2015	Quarterly
Area 2 Pit	A218	6944707	384783	807	9/17/2015	Quarterly
Area 2 Pit	A219	6944082	385159	846	9/15/2017	Quarterly
Area 2 Pit	DS1	6944400	385310	810	1/2/2018	Monthly
Area 2 Pit	DS3	6944365	385320	811	1/2/2018	Monthly
Area 2 Pit	DS4	6944339	385323	811	1/2/2018	Monthly
Dry Stack Tailings Storage Facility	ASH05	6944281	385831	850	3/7/2011	Annually
Dry Stack Tailings Storage Facility	ASH06	6944332	385624	824	3/7/2011	Annually
Dry Stack Tailings Storage Facility	DSSH-06	6944971	385553	784	8/21/2016	Monthly
Dry Stack Tailings Storage Facility	DSSH-10	6944993	385806	769	8/21/2016	Annually
Dry Stack Tailings Storage Facility	DSSH-12	6944947	385707	778	8/16/2016	Monthly
Dry Stack Tailings Storage Facility	DSSH-14	6944920	385607	783	4/21/2012	Annually
Dry Stack Tailings Storage Facility	DSSH-15	6944944	385490	785	8/16/2016	Annually
Dry Stack Tailings Storage Facility	DSSH-18	6945071	385513	782	8/16/2016	Annually
Dry Stack Tailings Storage Facility	DSSH-19	6945110	385575	781	8/16/2016	Quarterly
Dry Stack Tailings Storage Facility	DSSH-20	6945072	385754	776	8/21/2016	Quarterly
Dry Stack Tailings Storage Facility	DSSH-24	6944758	385712	792	2/28/2014	Quarterly
Dry Stack Tailings Storage Facility	DSSH-26	6944601	385491	796	7/28/2015	Quarterly
Dry Stack Tailings Storage Facility	DSSH-27	6944757	385884	792	6/25/2017	Quarterly
Dry Stack Tailings Storage Facility	DSSH-28	6945045	385930	768	6/25/2017	Monthly
Dry Stack Tailings Storage Facility	DSSH-29	6945162	385834	766	8/21/2016	Annually
Dry Stack Tailings Storage Facility	DSSH-30	6944883	385890	789	8/21/2016	Annually
Dry Stack Tailings Storage Facility	DSSH-31	6945031	386041	776	11/1/2016	Annually

Area	ID	Northing (m)	Easting (m)	Elevation (m)	Date Installed	Frequency
Dry Stack Tailings Storage Facility	DSSH-32	6944985	385896	773	9/10/2017	Annually
Dry Stack Tailings Storage Facility	MV1	6945250	386021	728	4/4/2016	Annually
Dry Stack Tailings Storage Facility	MV2	6945217	385979	740	4/4/2016	Quarterly
Main Pit	M76	6944610	384539	836	5/23/2011	Monthly
Main Pit	M79	6944847	384209	848	9/4/2011	Annually
Main Pit	M80	6944932	384256	842	9/4/2011	Annually
Main Pit	M81	6944972	384890	807	5/8/2012	Monthly
Main Pit	M82	6944891	384526	807	4/5/2017	Quarterly
Main Pit	M83	6944948	384476	809	1/8/2015	Monthly
Main Pit	M84	6945021	384445	807	1/8/2015	Quarterly
Main Pit	M85	6944847	384316	826	7/27/2015	Monthly
Main Pit	M86	6944636	384408	839	9/12/2017	Monthly
Main Pit	M88	6944873	384377	838	9/4/2017	Monthly
Main Pit	M89	6944688	384284	843	9/4/2017	Annually
Main Pit	M91	6944830	384398	850	9/4/2017	Monthly
Main Pit	M92	6944785	384707	801	9/14/2017	Annually
Main Pit	M93	6944779	384621	801	9/14/2017	Quarterly
Main Pit	M94	6944827	384583	801	9/14/2017	Quarterly
Main Pit	M95	6944727	384535	833	5/7/2018	Quarterly
Main Pit	M96	6944505	384520	866	5/14/2018	Annually
Main Pit	M97	6944782	384380	859	5/14/2018	Quarterly
Main Pit	M98	6944887	384510	808	5/14/2018	Monthly
Main Waste Dump Wrap	MWDH01	6944932	383931	872	8/13/2018	Quarterly
Main Waste Dump Wrap	MWDH02	6944957	384113	861	8/13/2018	Quarterly
Main Waste Dump Wrap	MWDH03	6945127	384204	878	8/13/2018	Quarterly
Main Waste Dump Wrap	MWDH04	6945146	384183	881	8/13/2018	Quarterly
Main Waste Dump Wrap	MWDH05	6945044	384037	901	8/13/2018	Quarterly
Main Waste Dump Wrap	MWDH06	6945024	383937	904	8/13/2018	Quarterly
Southwest Waste Dump	SWD01	6944761	384078	859	3/7/2011	Quarterly
Southwest Waste Dump	SWD05A	6943940	383838	869	3/7/2011	Monthly

Area	ID	Northing (m)	Easting (m)	Elevation (m)	Date Installed	Frequency
Southwest Waste Dump	SWD06	6944762	384189	836	7/27/2015	Quarterly
Southwest Waste Dump	SWD07	6944743	384112	840	11/21/2016	Quarterly
Southwest Waste Dump	SWD08	6944560	383883	867	11/21/2016	Quarterly
Southwest Waste Dump	SWD09	6944163	383791	862	11/21/2016	Quarterly
Southwest Waste Dump	SWD10	6943943	383838	868	7/10/2017	Quarterly
Southwest Waste Dump	SWD11	6944512	383916	850	7/10/2017	Quarterly
Southwest Waste Dump	SWD12	6944335	383818	864	9/28/2018	Quarterly
Water Storage Pond Dam	WSP1	6945613	386481	723	6/9/2011	Monthly
Water Storage Pond Dam	WSP3	6945552	386549	720	6/9/2011	Monthly
Water Storage Pond Dam	WSP4	6945532	386555	720	6/9/2011	Monthly
Water Storage Pond Dam	WSP5	6945505	386560	721	6/9/2011	Monthly

Thermistors

Thermistor strings are used to measure ground temperature profiles in boreholes, and in particular permafrost conditions at Minto. Thermistor strings consist of multiple temperature sensor nodes distributed along a single multi-conductor cable, installed within or attached to the outside of grouted PVC pipe. EBA and RST thermistor strings have been installed on site. EBA thermistors are read using a basic ohmmeter and RST thermistors are read using a RST TH2016B readout unit.

Table 7: Thermistors

Area	ID	Northing (m)	Easting (m)	Elevation (m)	Thermistor String No.	Nodes	Hole Depth (m)	Date Installed	Reading Frequency
Area 2 Pit	A2T-1	6944162	385306	822.39	3491	16	63.4	2013-04-21	Quarterly
Dry Stack Tailings Storage Facility	DST-10	6944584	385489	797.13	3492	16	63.4	2013-04-17	Quarterly
Dry Stack Tailings Storage Facility	DST-11	6944900	385539	787.66	3494	16	86.9	2013-04-05	Quarterly
Dry Stack Tailings Storage Facility	DST-13	6945015	386271	777.01	3495	16	101.5	2013-04-02	Quarterly
Dry Stack Tailings Storage Facility	DST-14	6944769	385713	791.47	3497	16	66.5	2013-04-12	Quarterly
Dry Stack Tailings Storage Facility	DST-15	6945034	385958	764.51	3493	16	64.0	2013-03-25	Quarterly
Water Storage Pond	WDT-1	6945523	386551	720.03	2072	16	42.49	2007-11-16	Monthly
Water Storage Pond	WDT-2	6945533	386575	713.66	2073	6	44.50	2007-11-07	Monthly
Water Storage Pond	WDT-3	6945544	386544	719.78	2074	16	49.42	2007-11-11	Monthly
Water Storage Pond	WDT-4	6945535	386548	719.85	2075	16	49.42	2007-11-10	Monthly
Water Storage Pond	WDT-5	6945505	386558	721.03	2076	16	35.13	2007-11-13	Monthly
Water Storage Pond	WDT-6	6945506	386556	721.03	2077	16	33.72	2007-11-13	Monthly
Water Storage Pond	WDT-7	6945505	386556	721.08	2078	16	33.92	2007-11-13	Monthly

Water Storage Pond	WDT-8	6945533	386575	713.66	2079	16	34.14	2007-11-07	Monthly
Southwest Waste Dump	SDT-1	6944767	384779	836.36	2220	16	59.1	2010-02-04	Quarterly
Southwest Waste Dump	SDT-2	6944595	383971	847.11	2221	16	14.6	2010-01-31	Quarterly
Southwest Waste Dump	SDT-3	6944334	383825	860.17	2222	16	15.8	2010-01-28	Quarterly
Southwest Waste Dump	SDT-4	6944164	383784	860.99	2223	16	13.1	2010-01-30	Quarterly

Vibrating Wire Piezometers

Vibrating wire piezometer strings are used to measure piezometric pressure profiles in boreholes. They consist of multiple vibrating wire sensors installed on PVC pipe in grouted boreholes. RST vibrating wire piezometers are installed on site and data is collected with an RST VW2106 readout unit.

Table 8: Vibrating Wire Piezometers

Area	ID	Northing (m)	Easting (m)	Elevation (m)	Sensor	No.	Sensor Elevation (m)	Date Installed	Reading Frequency
Dry Stack Tailings Storage Facility	DSP-5	6944769	385713	791.47	DSP-5A	VW24851	765.47	2013-04-16	Quarterly
					DSP-5B	VW24853	761.47		
Dry Stack Tailings Storage Facility	DSP-6	6944900	385539	787.66	DSP-6A	VW24850	769.56	2013-04-05	Quarterly
					DSP-6B	VW24852	765.56		
Dry Stack Tailings Storage Facility	DSP-7	6944990	385390	780.404	DSP-7-1	VW34657	771.404	2015-12-09	Quarterly
					DSP-7-2	VW34658	763.404	2015-12-09	Quarterly
					DSP-7-3	VW34659	756.404	2015-12-09	Quarterly
					DSP-7-4	VW34660	753.404	2015-12-09	Quarterly
					DSP-7-5	VW34661	751.404	2015-12-09	Quarterly
					DSP-7-6	VW34662	747.404	2015-12-09	Quarterly
Dry Stack Tailings Storage Facility	DSP-8	6945058	385872	755.548	DSP-8-1	VW34663	750.548	2015-12-10	Quarterly
					DSP-8-2	VW34664	745.548	2015-12-10	Quarterly
					DSP-8-3	VW34665	740.548	2015-12-10	Quarterly
					DSP-8-4	VW34666	735.458	2015-12-10	Quarterly
					DSP-8-5	VW34667	730.458	2015-12-10	Quarterly
					DSP-8-6	VW34668	720.458	2015-12-10	Quarterly

Dry Stack Tailings Storage Facility	DSP-10	6945223	385944	724.509	DSP-10	VW34617	717.209	2015-11-27	Quarterly
Southwest Waste Dump	SDP-2	6944595.06	383971.30	843.41	SDP-2A	VW12912	843.414	2010-01-31	Quarterly
					SDP-2B	VW12911	842.714		
Southwest Waste Dump	SDP-3	6944333.87	383824.67	854.27	SDP-3A	VW12906	854.266	2010-01-28	Quarterly
					SDP-3B	VW12907	853.566		
Southwest Waste Dump	SDP-4	6944163.62	383783.54	858.49	SDP-4A	VW12908	858.494	2010-01-30	Quarterly
					SDP-4B	VW12909	857.794		
Water Storage Pond	WDP-2	6945632	386545	701.67	WDP-2	VW7212	701.67	2007-11-04	Monthly
Water Storage Pond	WDP-3A	6945618	386498	712.62	WDP-3A	VW7557	712.62	2007-11-28	Monthly
Water Storage Pond	WDP-3	6945609	386500	712.60	WDP-3	VW7202	712.60	2007-11-12	Monthly
Water Storage Pond	WDP-4	6945609	386500	702.60	WD -4	VW7210	702.60	2007-11-14	Monthly
Water Storage Pond	WDP-5	6945605	386526	712.35	WDP-5	VW7204	712.35	2007-11-20	Monthly
Water Storage Pond	WDP-6	6945605	386526	701.50	WDP-6	VW7214	701.50	2007-11-20	Monthly
Water Storage Pond	WDP-7	6945605	386526	689.20	WDP-7	VW7208	689.20	2007-11-20	Monthly
Water Storage Pond	WDP-8	6945554	386542	693.10	WDP-8	VW7200	693.10	2007-11-18	Monthly
Water Storage Pond	WDP-9	6945554	386542	687.93	WDP-9	VW7206	687.93	2007-11-18	Monthly
Water Storage Pond	WDP-10	6945554	386542	676.17	WDP-10	VW7211	676.17	2007-11-18	Monthly
Water Storage Pond	WDP-11	6945523	386551	712.96	WDP-11	VW7201	712.96	2007-11-16	Monthly
Water Storage Pond	WDP-12	6945523	386551	694.64	WDP-12	VW7209	694.64	2007-11-16	Monthly
Water Storage Pond	WDP-13	6945533	386578	684.55	WDP-13	VW7205	684.55	2007-11-07	Monthly

7 Instrumentation Procedures and Documentation

Data collection manuals for all monitoring devices are included in Appendix B.

After collection, data is input into a series of spreadsheets and databases used for storing, tracking and interpreting instrumentation data. Instructions for data input are contained in the instrumentation manuals in Appendix B.

8 Quality Assurance/Quality Control

Planned job observations (PJO's) are routinely performed and documented on Environmental Monitors to verify data collection is consistent with the designed procedures.

Data collection equipment is returned to the manufacturers as per their recommended calibration schedules.

All data is reviewed and summarized by a Geotechnical Engineer monthly as part of the Water Licence reporting.

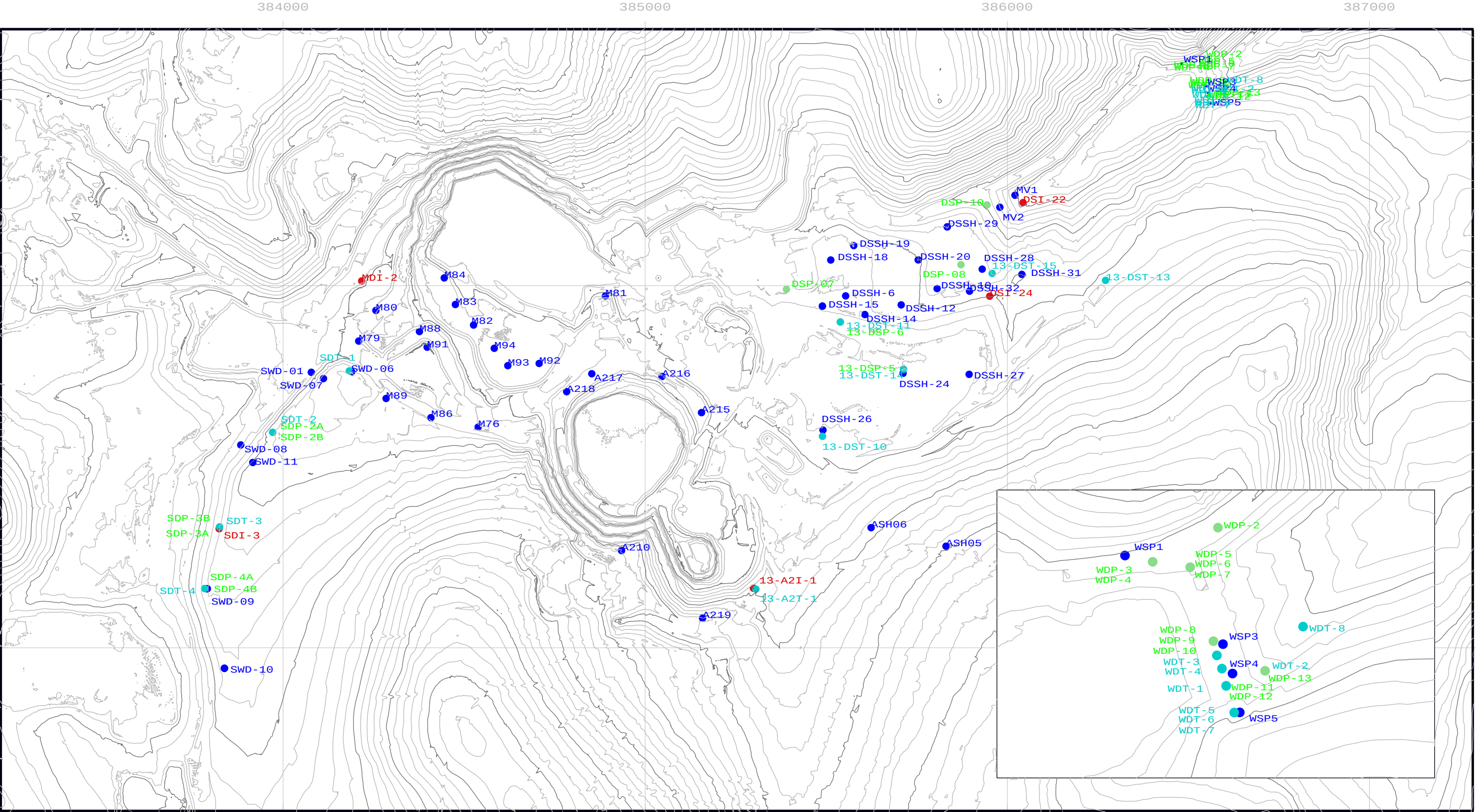
9 Reporting

Regular processing and review of monitoring data is completed and presented in the following documents.

Table 9: Reporting

Report	Frequency	Submission
Minto Mine Type A Water Licence QZ14-031 Monthly Report (Clause 4.4)	Monthly	Submitted to Yukon Water Board maximum 30 days following each month
DSTSF Inspection Reports	Quarterly	Filed internally within one week of the inspection
Water Storage Pond Dam Inspection Reports	Monthly	Filed internally within one week of the inspection
Area 2 and Main Pit Tailings Storage Facility Inspection Reports	Quarterly	Filed internally within one month of the inspection
Semi-Annual Site-wide Geotechnical Inspection Report	After spring melt (May/June) and before freeze-up (September)	Submitted to Yukon Water Board within 60 days of inspection.
Minto Mine Type A Water Licence QZ14-031 Annual Report (Clause 4.5)	Annually	Submitted to Yukon Water Board by March 31 each year
Minto Mine Type B Water Licence MS15-094 Annual Inspection Report (Clause 34)	Annually	Submitted to Yukon Water Board with the Annual Report

Appendix A: Instrumentation Map



DESIGNED BY: DH	DATE PLOTTED: 15-Nov-2017	Monitoring Instrumentation 2017 Comments: _____
CHECKED BY:	SCALE:	

LEGEND	
● SURVEY HUBS	● THERMISTORS
● PIEZOMETERS	● INCLINOMETERS



Appendix B: Data Collection and Input Manuals

Inclinometer Measurements

Please refer to RST MEMS Digital Inclinometer System Instruction Manual for complete instruction.

System Overview:



Figure 1 – System Overview

1. Soft Shell Case
2. Digital Inclinometer Probe (w/ protective end cap)
3. Reel Battery Charger
4. 70mm/2.75" OD Cable Grip
5. 85mm/3.34" OD Cable Grip
6. Ultra-Rugged Field PC
7. 12V DC car adapter for Reel Battery Charger or Ultra-Rugged Field PC
8. Spare Reel Battery
9. Silicone Lubricant (for use on connectors)
10. USB Cable for Ultra-Rugged Field PC
11. AC Adapter (110-240V) for Reel Battery Charger
12. AC Adapter (110-240V) for Ultra-Rugged Field PC
13. Cable Reel with Wireless Communication System and protective end cap
14. Reel Carrying Case

1. Make sure the battery for the reel and the Field PC are charged.
2. Lift up protective box with two hands and put it on side as a work bench.



3. Remove cap from inclinometer casing and look for A_0 marking (black mark).



4. Remove excess water inside the probe and the cable connector.
Probe is very sensitive and susceptible to vibration. **DO NOT BANG THE PROBE.** Use a paper towel to wipe it.
5. Apply silicon lubricant to probe and cable connector when needed.



6. Connect the inclinometer cable to the probe by aligning the keyways and threading the connector onto the probe. Turn the threaded ring, but not the cable.



7. Turn on the power of the reel. A green light indicates that the power is on. This energizes the accelerometers and makes them less susceptible to shock.



8. Check the depth of the hole. Turn on Field PC and select the hole you are going to measure.



9. Always start with **UPPER** Wheel in the A_0 direction.



10. Lower the probe gently and carefully. When it gets close to the bottom lower it very gently to avoid bouncing the probe off the bottom of the hole. The cable has aluminum sleeve marks which are spaced at 0.5m and it has a red measure mark with label every 5m.



11. Lower the probe gently to ensure the bottom of the hole is encountered. (Slightly passed the designated depth). Double check your correct depth by pulling out reel to the next 5m mark and counting back each 0.5m for each increment.
12. Place the cable grip on top of the casing and hang the cable by the aluminum crimps.



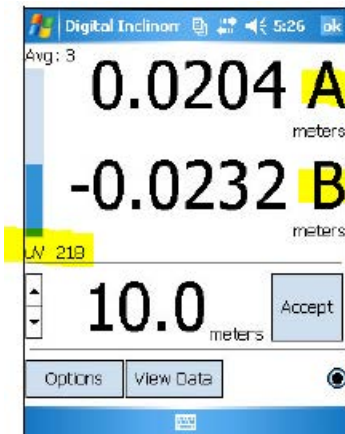
13. Connect the Field PC to the reel. Use the pen attached to the field PC and press “Connections”.



14. Once connected, hit “Readings”.



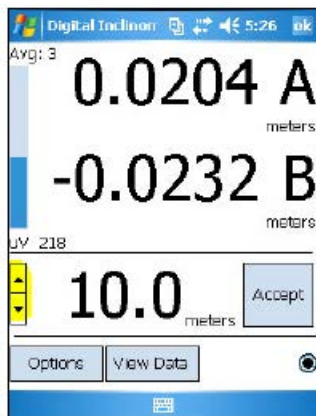
15. At each depth allow the A and B readings as well as the noise level become stabilized before you accept the readings. Ideally noise level should be at or below 30 μV .



16. Wear gloves as the Envirobond inside the inclinometer casing can be sticky and irritable. Pull up gently to the next marker and let the aluminum crimp to sit on the metal grip. Wait for the readings and noise level to stabilize and then hit “Accept”.



17. If you accidentally pull the probe too far (more than an inch), lower the probe back down to the previous bead then pull up to the bead you want to measure. This will ensure that the readings remain consistent.
18. At each 5m mark, check that you are at the right location. If you miss or overpass a reading, go back to the previous 5m depth. For examples, if something goes wrong at 41.5m, go back to 45m and drop the cable to 45.5m. Then gently pull up to 45m and hit "Accept" again. There are arrow keys on the Field PC which allow you to adjust your depth.



19. Once the last reading (0.5m) is taken, gently take out the probe and turn it 180° so that the **Lower** wheel



is now in the A₀ direction.

20. Go back gently to the bottom of hole and take the second set of readings.

21. During the measurement of the second set of readings, checksum data will appear in a smaller font below the current readings. Checksum should be reasonably small and consistent. Ideally it should be somewhere between -0.0035m to +0.0045m.
22. If the checksum is large ($> 0.01\text{m}$) and inconsistent, check the following:
 - Is the probe at the right depth?
 - Is the probe in the correct direction?
 - Lower the probe to the previous depth and retake the reading again.

It is possible that checksum is high due to differential pressure in the ground. In that case continue measurement and keep monitoring checksum.

23. Once readings are completed, take out the probe and wipe away the Envirobind gently. Put the caps back onto the probe and connector.



Data Input

Note: Windows Mobile Device Center must be installed on the computer in order to collect the readout unit to the computer.



1. Connect the USB cable from the readout unit to the computer and turn the power on.
2. Open DMM for Windows



3. *File – Open – Project Database*

The database for all inclinometer data is stored here:

<X:\Mine Technical\03 - Monitoring\! Inclinometers\Master Database>

4. *File – Import – Import RPP file*

Navigate to the mobile device and select the .rpp file for the appropriate monitoring station and date. The data will then import and save in the database automatically.

Thermistor Readings

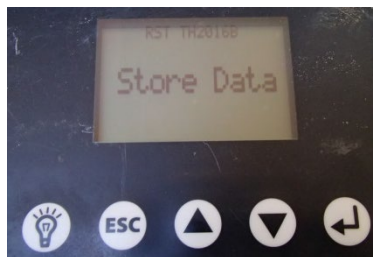
Two different types of thermistors are currently installed on site – RST and EBA thermistors.

To read RST thermistors:

1. Connect adapter cord to the TH2016B Readout Box.
2. Record the resistivity (Ohms) for each thermistor node on paper or store the data in the readout box with the following steps:
 - a. Scroll with the Up/Down arrows to the **Memory** screen and press enter (arrow key)



- b. Scroll with the Up/Down arrows to the **Store Data** screen and press enter



- c. Scroll with the Up/Down arrows to the station being monitored and press enter to store the reading



- d. The data is now stored and the readbox can be turned off by pressing the escape button (ESC) three times to get back to the main menu and scrolling to Power Off.



To read EBA thermistors:

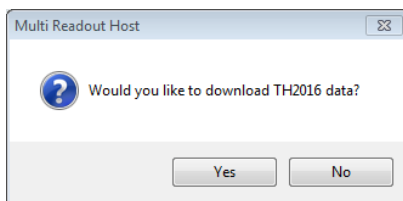
1. Connect the EBA 16 Point Ground Temperature Dial into the thermistor cable.
2. Connect the multi-meter to the EBA 16 Point Ground Temperature Dial.
3. Record on paper the resistance in Ohm's (Ω) for each point.

Data Downloading

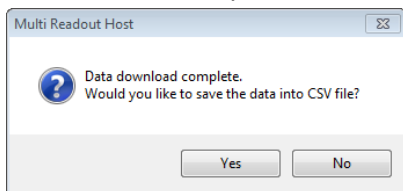
1. Connect USB cord from computer to the readout box.
2. Open the software Multi Readout Host.



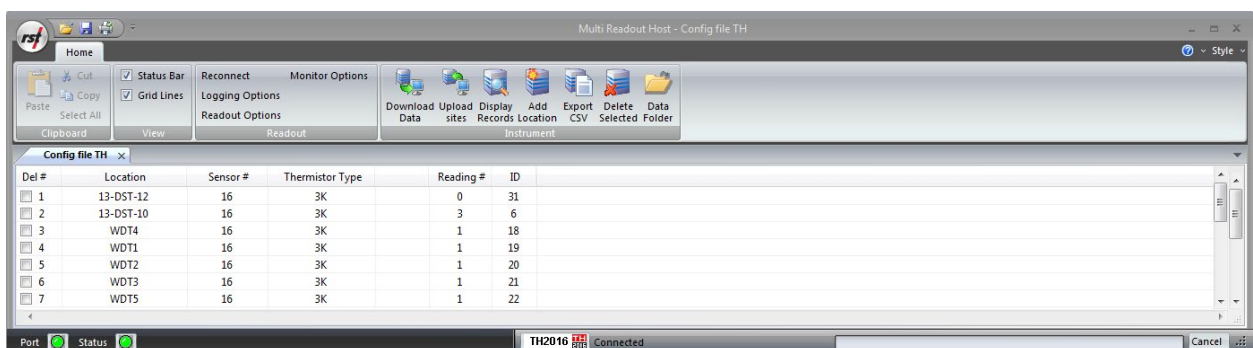
3. Turn on the power on the readout box.
4. The software will recognize the readout unit and prompt to download data. Choose "Yes" to download the data from the readout unit.



5. Once data is downloaded you will have the option to save all data as .csv file. Choose "Yes" and the data will be stored in My Documents in a folder named "TH2016data".



6. The software can be used to setup new locations or view data but no further steps are required.

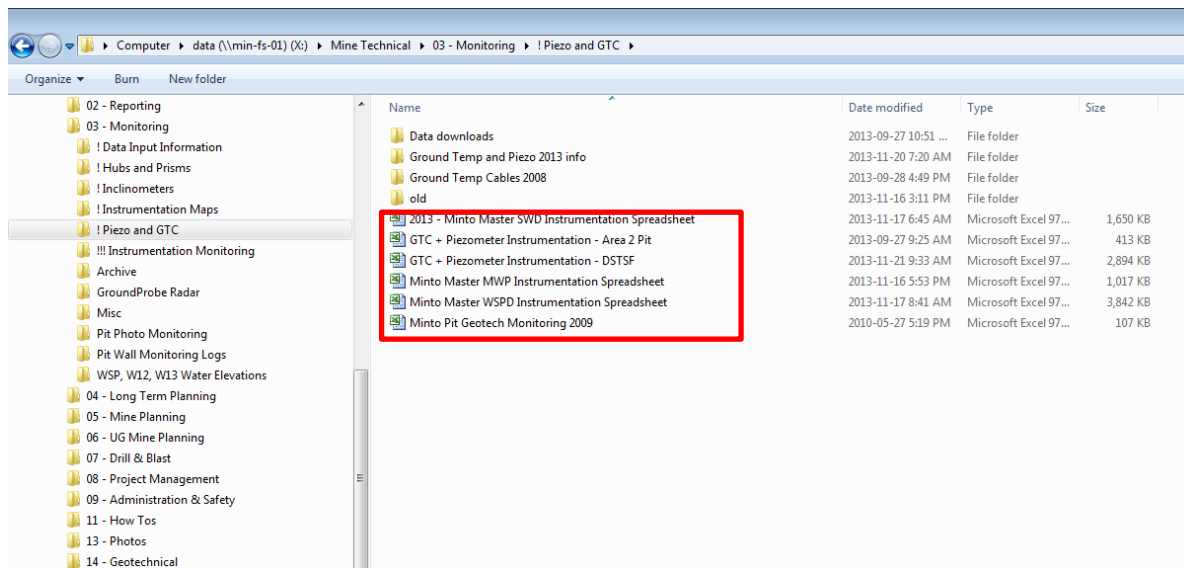


Data Input

Spreadsheets for piezometer data input and tracking are stored here:

X:\Mine Technical\03 - Monitoring\! Piezo and GTC

1. Open the spreadsheet for the area monitored



2. Open the tab "GTC Readings"



- [illegible]

Vibrating Wire Piezometer Readings

1. Connect adapter cord to the VW2106 Readout Box.
2. Connect the coloured wires to the correct wire clips on the extension cable. Make sure the wires do not touch each other.
3. Record the **DATE** and **TIME** as barometric pressure will be needed to calibrate the water level.
4. Record the measurement (between 7000B to 9000B) and the temperature (°C) for each piezometer. The piezometer ID should be labeled on the wire (eg. P5a and P5b).



5. Alternatively the data can be stored in the readout box:
 - a. Scroll with the Up/Down arrows to the **Memory** screen and press enter (arrow key)



- b. Scroll with the Up/Down arrows to the **Store Data** screen and press enter



- c. Scroll with the Up/Down arrows to the station being monitored and press enter to store the reading



- d. The data is now stored and the readout box can be turned off by pressing the escape button (ESC) three times to get back to the main menu and scrolling to Power Off.

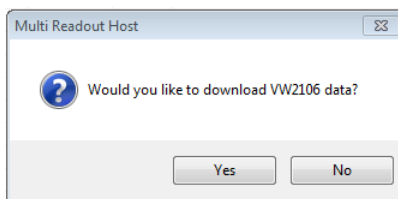


Data Downloading

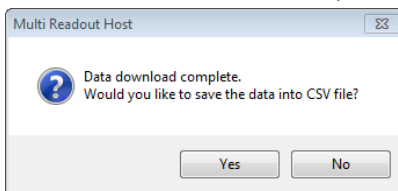
7. Connect USB cord from computer to the readout box.
8. Open the software Multi Readout Host.



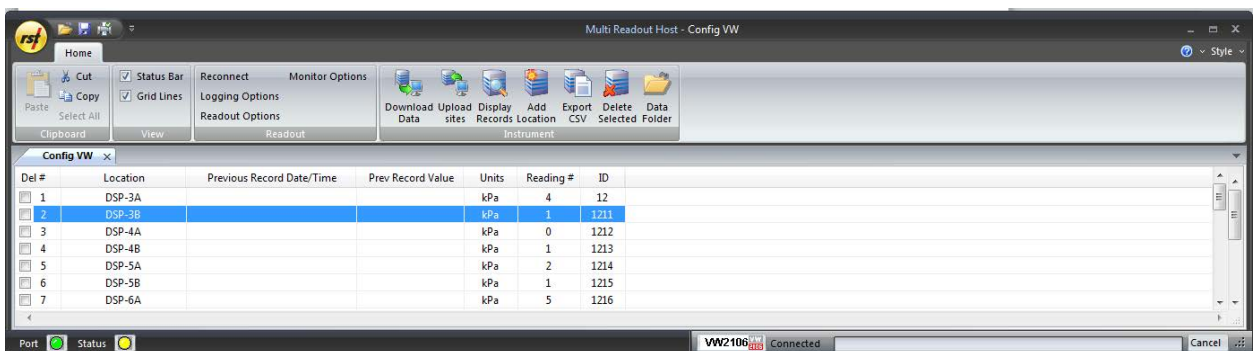
9. Turn on the power on the readout box.
10. The software will recognize the readout unit and prompt to download data. Choose "Yes" to download the data from the readout unit.



11. Once data is downloaded you will have the option to save all data as .csv file. Choose "Yes" and the data will be stored in My Documents in a folder named "VW2016data".



12. The software can be used to setup new locations or view data but no further steps are required.

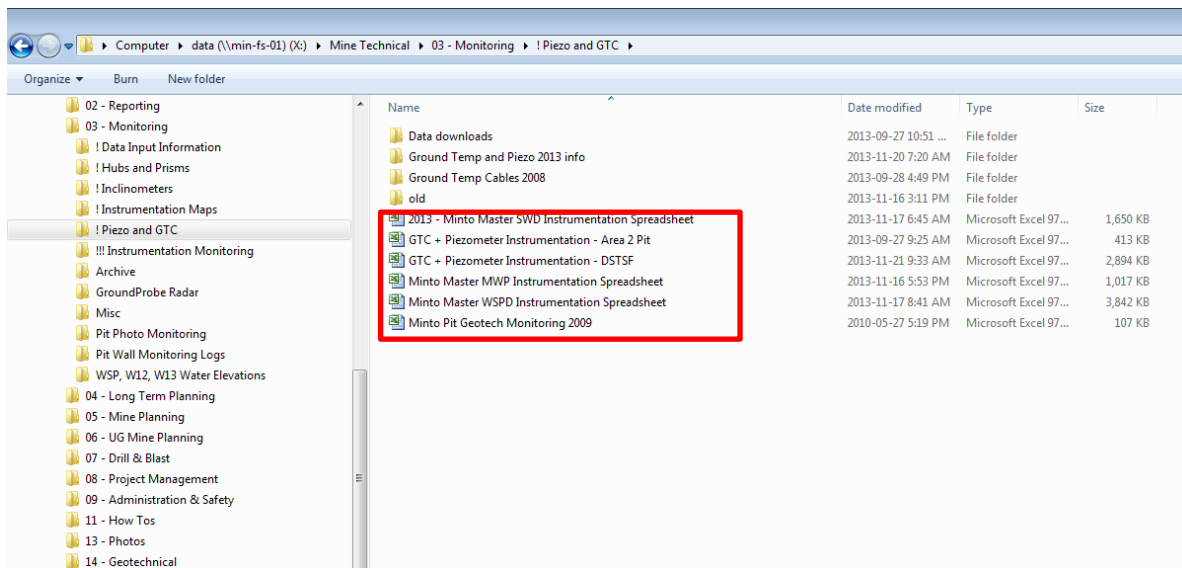


Data Input

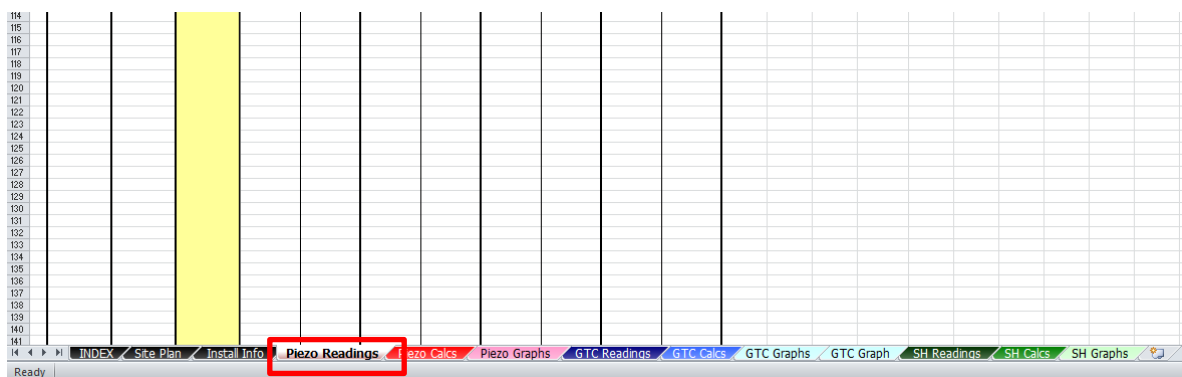
Spreadsheets for piezometer data input and tracking are stored here:

X:\Mine Technical\03 - Monitoring\! Piezo and GTC

4. Open the spreadsheet for the area monitored



5. Open the tab "Piezo Readings"



- In a new row, input the date, time, barometric pressure, B-unit and temperature readings for each instrument.

Y144

MINTO MINE: DRY STACK TAILINGS STORAGE FACILITY

Tab Use Instructions:
1. Enter Date
2. Enter Time
3. Enter Reading (B) and Temp Reading (C) to corresponding piezo.
4. Enter Barometer Reading

Note:
Barometer readings obtained from VW Piezometer readings obtained
RED indicates assumed values (re
Grey row highlight indicates begin
#N/A indicates a missing reading

	DATE	TIME	BAROMETER READING (kPa)	DSP-5A Reading (B) Temp. Reading (C)	DSP-5B Reading (B) Temp. Reading (C)	DSP-6A Reading (B) Temp. Reading (C)	DSP-6B Reading (B) Temp. Reading (C)
77	2013-Apr-08	21:30	89.00				
78	2013-Apr-16	6:15	89.00	8137.6	-0.7	7709.1	-0.1
79	2013-Apr-26	17:00	87.80	8333.9	-0.8	7569.1	-0.3
80	2013-Apr-27	13:30	89.20			8938	-0.8
81	2013-Apr-28	10:00	89.10	8334.9	-0.9	75815	-0.4
82	2013-Apr-30	10:30	89.50	8355.2	-0.9	7597	-0.4
83	2013-May-16	12:00	89.50	8388.2	-0.9	7585.5	-0.5
84	2013-Jun-17	12:00	89.50			8917.1	-0.3
85	2013-Jun-18	12:00	89.50	8410.8	-0.9	7576.7	-0.5
86	2013-Jul-10	12:00	89.50			8921.9	-0.2
87							

Barometric pressure can be obtained from the site's weather monitoring stations. Data is stored here:

X:\Environmental\Environmental Monitoring Program\1_MASTER LOGS\Meteorology Station Data\Met
Station 1 and 2 Data Summary.xlsx

Appendix H – 2018 AMP McGinty Creek Selenium Memo (Minnow)

June 28, 2018

Mr. Ryan Herbert
Environmental Manager
Minto Mine
PO Box 11
Whitehorse Central PO
Whitehorse, Yukon
Y1A 2V3

Dear Mr. Herbert,

Re: Evaluation of a Dissolved Selenium AMP Threshold Exceedance in McGinty Creek

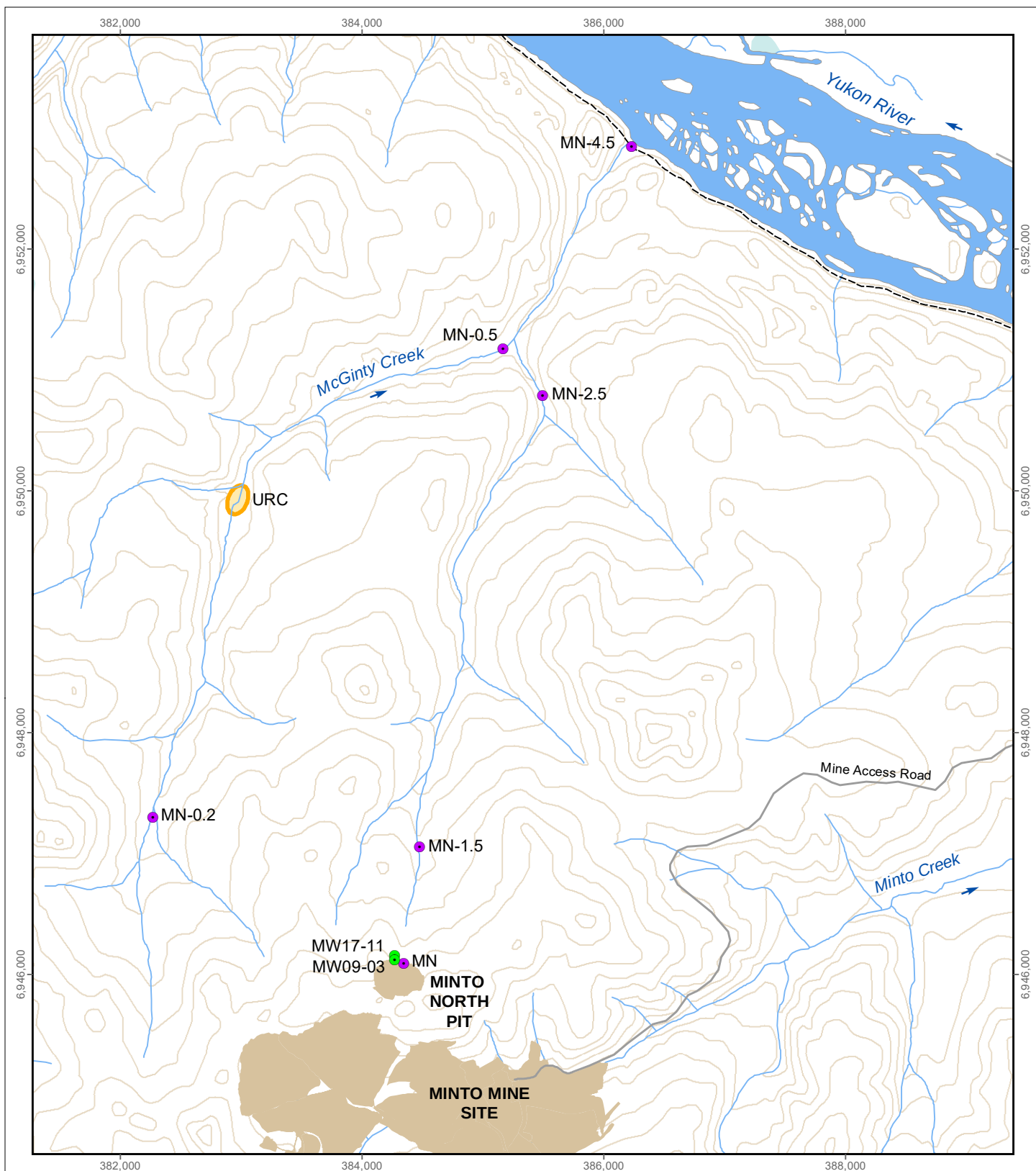
The Minto Mine (Minto) engaged Minnow Environmental Inc. (Minnow) as a Qualified Professional (QP) to evaluate the concentration of dissolved selenium that exceeded thresholds identified in the Minto Mine's Operations Adaptive Management Plan (AMP; Minto 2017). The exceedance occurred on May 26, 2018 at McGinty Creek Station MN-4.5 (Figure 1). As required under the AMP, this brief letter report determines if the exceedance was mine-related and whether the exceedance was likely to have affected aquatic resources.

Background

Exploration drilling within the McGinty Creek watershed began in 2009 around a single continuous zone of high-grade ore (Minto North Pit; Figure 1) located northeast of the mine's Main Waste Dump. Pit-stripping and road construction began in August 2015 following approval under the Minto Mine's Water Use Licence (WUL; QZ14-031). The Minto North Pit is located within the catchment of McGinty Creek's east arm, which travels 9.5 km to the Yukon River (Figure 1). There is no direct release of effluent from the Minto North Pit to McGinty Creek. Operations in the Minto North Pit continued until October 1, 2016.

Yukon Government Energy, Mines, and Resources (EMR) approved Minto Mine's AMP 2017-01 under the current Quartz Mining License (QML-0001). The Yukon Water Board approved the updated AMP (AMP 2017-02) under the current Water Use Licence (QZ41-031). This assessment is relative to the AMP 2017-02 specific thresholds.

As described in an evaluation of exceedances that occurred in November 2017 (Minnow 2018a), the AMP includes three Specific Thresholds (ST) and three Specific Performance Thresholds (SPT) for surface waters (Figure 2). Analytes that exceed a ST objective at MN-4.5 trigger a SPT. Each SPT is associated with response steps, including notification, review, evaluation, and actions. Two consecutive samples exceeding the ST-1 objective triggers SPT-1. Analytes exceeding ST-2 and/or ST-3 objectives will trigger SPT-2 (Figure 2) and two consecutive samples exceeding either ST-2 or ST-3 objectives will trigger SPT-3 (only if the first exceedance was confirmed to have been due to mine loading).



LEGEND

- Groundwater Station
- Water Quality Monitoring Station
- URC Minnow Monitoring Area
- Mine Footprint

Water Quality Monitoring on McGinty Creek

0 0.75 1.5 3 km

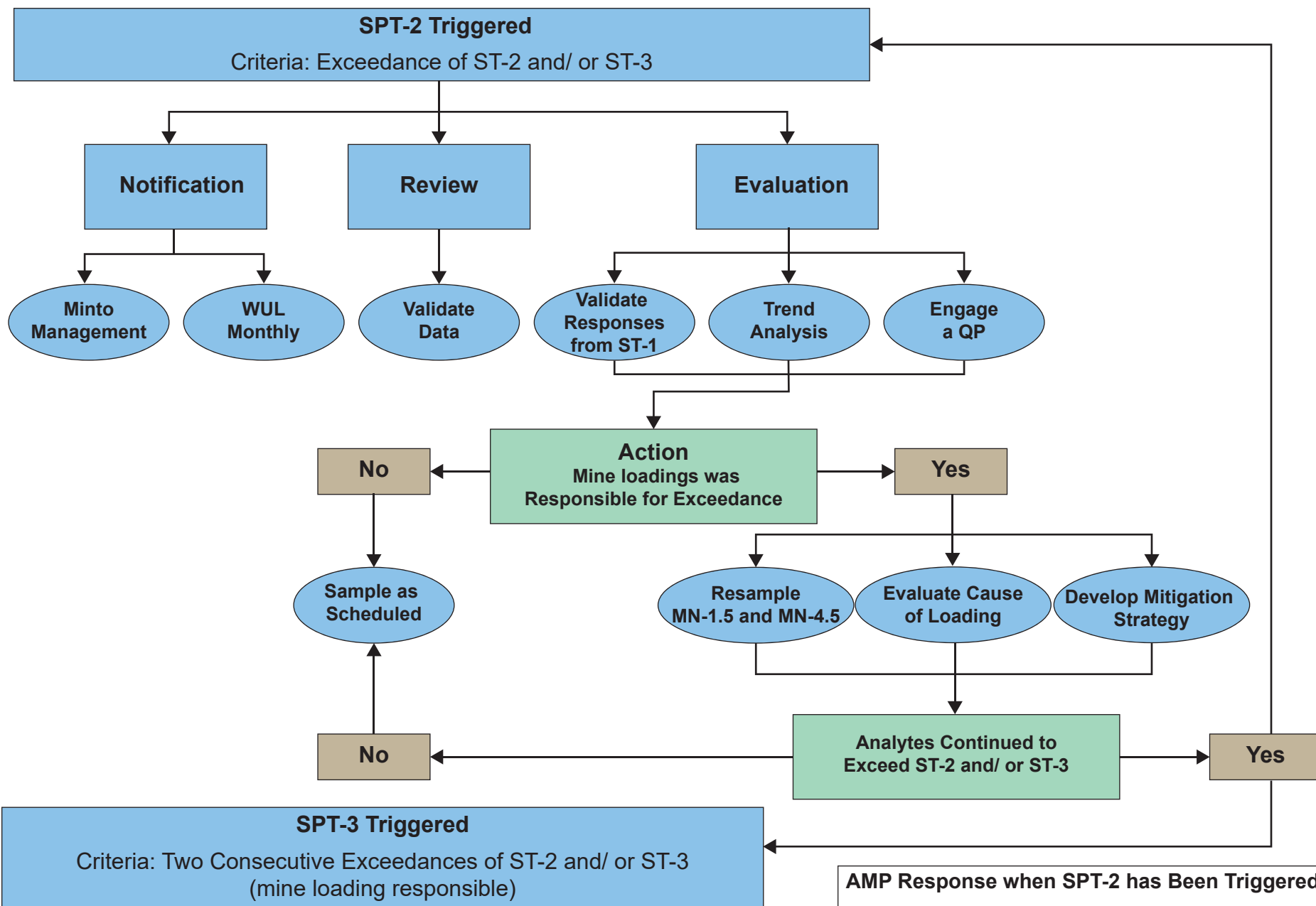
Projection: North American Datum 1983 UTM Zone 8V
 Reproduced under licence from Her Majesty the Queen in Right of Canada,
 Department of Natural Resources Canada. All rights reserved.



Date April 2018
 Project 177202.0047



Figure 1



Notes:

SPT - Specific Performance Threshold
ST - Specific Threshold

QP - Qualified Professional
WUL - Water Use Licence

AMP Response when SPT-2 has Been Triggered

Date: April 2018
Project 177202.0047



Figure 2

Nitrate and dissolved selenium had previously exceeded ST-2 and ST-3 objectives at MN-4.5 on November 10, 2018 (Minnow 2018a). Exceedances of both analytes were unrelated to the mine as concentrations were higher than ST-2 objectives prior to the operation of the mine at MN-4.5 and at other upstream locations (dissolved selenium; Minnow 2018a). Concentrations of nitrate and dissolved selenium were well below applicable guidelines for the protection of aquatic life and effects to aquatic life were not expected.

Methods

Water quality monitoring stations are located on the west and east arms of McGinty Creek (considered as “reference” and “exposed” arms, respectively) and near the mouth as it flows into the Yukon River (Figure 1). Review of historical and current conditions (2009 to 2018) included data from these stations as well as those from an additional monitoring area associated with the annual sediment, periphyton, and benthic invertebrate community monitoring that has been implemented annually since 2011 (URC; Figure 1; Minnow 2012, 2013, 2014, 2015, 2016, 2017, 2018b).

The 12-month rolling averages for dissolved selenium were calculated and compared to the ST-3 objective (0.00016 mg/L; Table 1). Averages were calculated by taking the average of the current sample and the previous 364 days of samples beginning in 2016. Individual grab samples for dissolved selenium were compared to the ST-2 objective (0.00020 mg/L; Table 1) and to the British Columbia Water Quality Guideline (BCWQG) of 0.0020 mg/L as has been adopted under the WUL (BCMOE 2014).

Results

Dissolved selenium exceeded the ST-3 objective at MN-4.5 on May 26, 2018 (0.00020 mg/L; Table 2, Figure 3), triggering SPT-2, and prompting an evaluation under the AMP. The calculated 12-month rolling average for dissolved selenium at MN-4.5 exceeded the ST-3 objective at the beginning of 2016, throughout most of 2017, and into 2018 (0.00015 to 0.00020 mg/L; Table 2, Figure 3). Concentrations of dissolved selenium at MN-4.5 were usually lower than at MN-0.5, which exceeded the ST-3 objectives throughout 2016 to 2018 (0.00015 to 0.00021 mg/L; Table 2, Figure 3). Station MN-0.2 (west arm; reference) and all stations on the east arm (MN-1.5 and MN-2.5; exposed) were below ST-3 objectives (Table 2, Figure 3).

Dissolved selenium did not exceed the ST-2 objective on May 26, 2018 (Table 3, Figure 4). Review of previous data indicates that dissolved selenium only exceeded the ST-2 objective at MN-4.5 twice in 2015 (once prior to Minto North Pit operations) and once each in 2016 and 2017. Station MN-0.5 on the west arm (reference) had multiple exceedances before, during, and after Minto North Pit operations (Table 3, Figure 4). This also occurred at URC, the area monitored annually by Minnow since 2011 and located upstream of MN-0.5 (0.00020 to 0.00086 mg/L; Table 4, Figure 1).

Historical concentrations suggest that the source of the dissolved selenium on the west arm was unrelated to the mine. Concentrations of dissolved selenium in the east arm (reference) were below the ST-2 objectives except for once in 2010 at MN-2.5 (0.00038 mg/L; Table 3, Figure 4). Any potential mine-related dissolved selenium would be more likely to occur on the east arm of McGinty Creek, as this area is downgradient of the Minto North Pit. Lastly, all concentrations of dissolved selenium were well below the BCWQG of 0.0020 mg/L, thus no effect on the aquatic resources at MN-4.5 would be expected (Tables 3 and 4).



Table 1: Specific Thresholds for McGinty Creek, Station MN-4.5

Analytes	Units	Specific Threshold 1 (85 th percentile)	Water Quality Objectives	
			Specific Threshold 2 Individual Data Point Evaluator (95 th percentile)	Specific Threshold 3 Central Tendency Evaluator (95 th percentile of annual medians)
Total Suspended Solids	mg/L	52	269	32
Ammonia	mg/L	0.040	0.12	0.046
Nitrite	mg/L	0.0060	0.050	0.0050
Nitrate	mg/L	0.20	0.23	0.083
Dissolved Aluminum	µg/L	49	135	47
Dissolved Arsenic	µg/L	0.55	0.61	0.54
Dissolved Cadmium	µg/L	0.026	0.041	0.015
Dissolved Chromium	µg/L	1.0	1.0	1.0
Dissolved Copper	µg/L	2.9	3.5	2.8
Dissolved Iron	µg/L	334	403	358
Dissolved Lead	µg/L	0.20	0.20	0.20
Dissolved Molybdenum	µg/L	1.0	1.0	1.0
Dissolved Nickel	µg/L	1.6	1.8	1.6
Dissolved Selenium	µg/L	0.17	0.20	0.16
Dissolved Silver	µg/L	0.020	0.020	0.020
Dissolved Zinc	µg/L	5.0	5.2	5.0

Note: Reproduced from Table 2-4 in the Operational AMP (Minto 2017).

Table 2: Twelve Month Rolling Average of Dissolved Selenium (mg/L) for Water Quality Stations on McGinty Creek, Minto Mine, 2016 to 2018

Year	Date	Station				
		MN-0.2	MN-0.5	MN-1.5	MN-2.5	MN-4.5
2016	29-Apr-16	0.000067	0.00017	0.000050	0.000068	0.00016
	30-Apr-16	0.000069	0.00017	0.000058	0.000068	0.00016
	30-Apr-16	0.000070	0.00017	0.000064	0.000068	0.00016
	26-May-16	0.000071	0.00015	0.000064	0.000070	0.00015
	28-May-16	0.000071	0.00016	0.000064	0.000072	0.00015
	29-May-16	0.000071	0.00016	0.000065	0.000072	0.00015
	20-Jun-16	0.000076	0.00016	0.000067	0.000072	0.00015
	21-Jun-16	0.000076	0.00016	0.000066	0.000073	0.00015
	21-Jun-16	0.000076	0.00016	0.000066	0.000073	0.00015
	04-Jul-16	0.000079	0.00016	0.000069	0.000077	0.00015
	04-Jul-16	0.000079	0.00016	0.000070	0.000077	0.00015
	30-Jul-16	0.000083	0.00016	0.000072	0.000080	0.00015
	04-Aug-16	0.000083	0.00016	0.000072	0.000079	0.00015
	04-Aug-16	0.000083	0.00016	0.000072	0.000079	0.00015
	07-Aug-16	0.000083	0.00016	0.000074	0.000079	0.00015
	15-Aug-16	0.000084	0.00016	0.000074	0.000079	0.00015
	03-Sep-16	0.000080	0.00017	0.000084	0.000085	0.00016
	03-Sep-16	0.000080	0.00017	0.000084	0.000085	0.00016
	05-Sep-16	0.000083	0.00017	0.000084	0.000085	0.00016
	07-Oct-16	0.000085	0.00017	0.000088	0.000089	0.00015
	10-Oct-16	0.000085	0.00017	0.000088	0.000089	0.00015
	10-Nov-16	0.000084	0.00018	0.000093	0.000093	0.00016
	12-Nov-16	0.000084	0.00018	0.000093	0.000089	0.00016
	02-Dec-16	0.000084	0.00020	0.000093	0.000078	0.00016
	02-Dec-16	0.000084	0.00021	0.000093	0.000078	0.00016
2017	26-May-17	0.000092	0.00020	0.000092	0.000083	0.00016
	27-May-17	0.000092	0.00020	0.000092	0.000083	0.00016
	24-Jun-17	0.000091	0.00019	0.000097	0.000084	0.00017
	24-Jun-17	0.000091	0.00020	0.000097	0.000084	0.00017
	25-Jun-17	0.000092	0.00020	0.000097	0.000084	0.00017
	06-Jul-17	0.000092	0.00020	0.000106	0.000087	0.00017
	07-Jul-17	0.000092	0.00020	0.000100	0.000086	0.00017
	07-Jul-17	0.000092	0.00020	0.000096	0.000086	0.00017
	16-Aug-17	0.000090	0.00020	0.000096	0.000088	0.00018
	19-Aug-17	0.000090	0.00020	0.000089	0.000088	0.00018
	19-Aug-17	0.000090	0.00020	0.000084	0.000088	0.00018
	21-Aug-17	0.000090	0.00020	0.000084	0.000085	0.00017
	16-Sep-17	0.000087	0.00020	0.000075	0.000078	0.00017
	18-Sep-17	0.000083	0.00020	0.000075	0.000078	0.00017
	18-Sep-17	0.000081	0.00020	0.000075	0.000078	0.00017
	21-Oct-17	0.000082	0.00020	0.000072	0.000069	0.00017
	22-Oct-17	0.000074	0.00020	0.000072	0.000069	0.00017
	22-Oct-17	0.000072	0.00020	0.000072	0.000069	0.00017
	10-Nov-17	0.000072	0.00020	0.000072	0.000070	0.00019
	10-Nov-17	0.000072	0.00020	0.000072	0.000071	0.00019
2018	26-May-18	0.000070	0.00019	0.000068	0.000070	0.00020

Note: Values are a rolling average of the previous 12 months of data, see Table 4 for actual sample days for each station.



Shading indicates that the value exceeded the Specific Threshold (ST-3) for dissolved selenium (0.00016 mg/L).



Shading indicates that the value exceeded the British Columbia Water Quality Guideline for selenium (0.002 mg/L; BCMOE 2014).

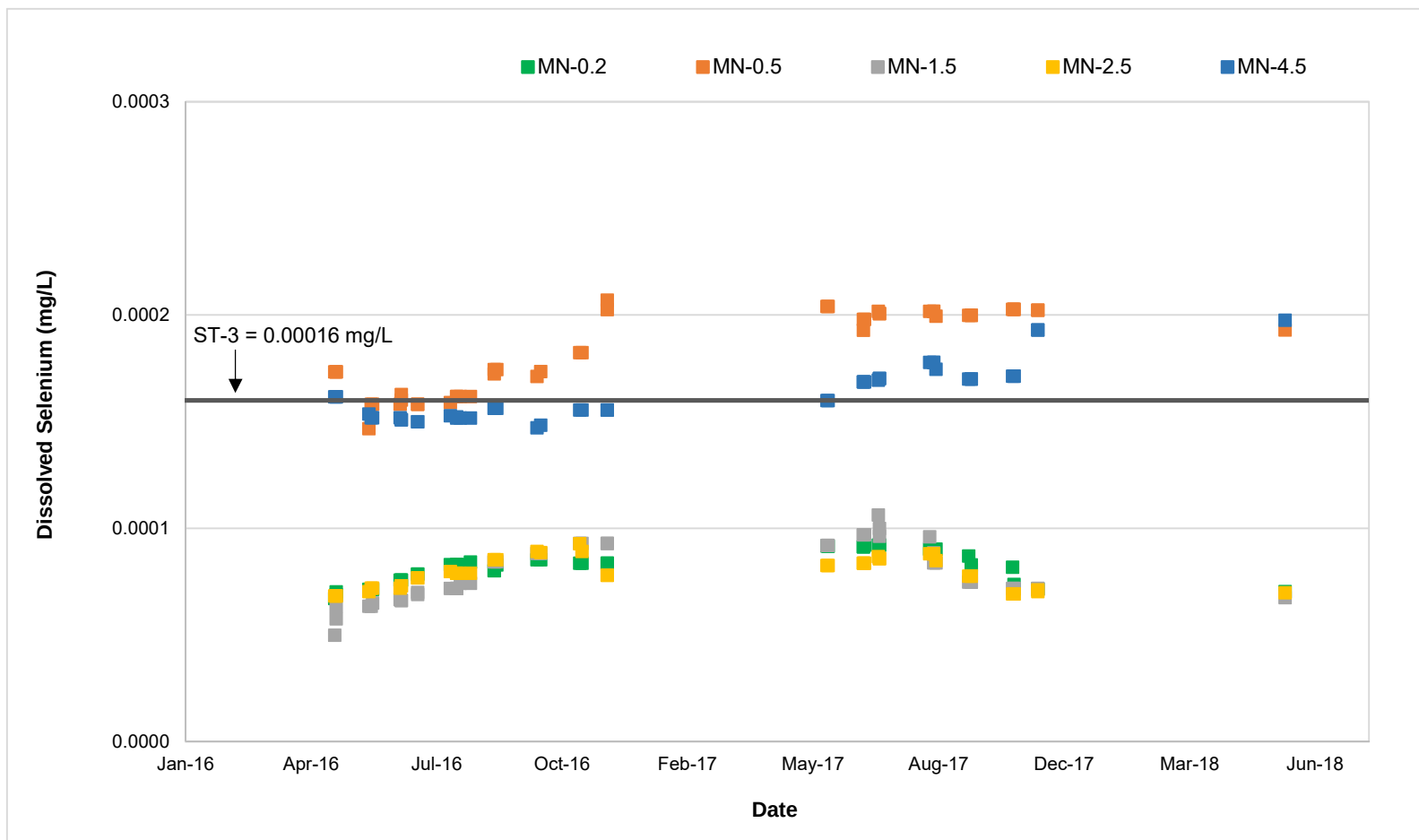


Figure 3: Twelve Month Rolling Average Dissolved Selenium (mg/L) Water Quality Samples on McGinty Creek, Minto Mine, 2016 to 2018

Note: See Table 4 for actual sampling days.

Table 3: Dissolved Selenium (mg/L) Grab Samples at Water Quality Stations on McGinty Creek, Minto Mine, 2009 to 2018

Year	Date	Station				
		MN-0.2	MN-0.5	MN-1.5	MN-2.5	MN-4.5
2009	3-May-09	-	0.000090	0.000060	0.000070	-
	6-May-09	-	0.000050	0.000020	0.000040	0.000060
	13-May-09	0.000050	0.00010	0.000060	0.000080	0.00010
	21-May-09	-	0.00014	0.000040	0.000080	0.00012
	28-May-09	0.000070	0.00013	0.000070	0.000070	0.00013
	25-Jun-09	0.000060	0.00019	0.000080	0.000080	0.00015
	28-Jul-09	-	0.00021	0.000070	0.000060	0.00016
	29-Aug-09	-	0.00018	0.000080	0.000080	0.00013
	29-Sep-09	-	0.00017	0.000070	0.000060	0.00013
	23-Oct-09	-	0.00023	0.000070	0.000080	0.00017
	27-Nov-09	-	0.00024	0.000060	0.000070	0.00020
	15-Dec-09	-	0.00023	0.000050	0.000060	-
2010	25-Jan-10	-	0.00040	0.00015	0.00038	-
	23-Feb-10	-	-	-	-	-
	22-Mar-10	-	-	-	-	-
	21-Apr-10	-	-	0.000070	-	-
	22-Apr-10	-	0.000090	-	0.000070	0.000090
	28-May-10	-	0.00021	0.000070	0.000070	0.00017
	28-Jun-10	-	0.00016	0.000070	0.000070	0.00014
	21-Jul-10	-	-	0.000080	0.000070	0.00015
	18-Aug-10	-	0.00018	0.000090	0.00010	0.00013
	15-Sep-10	-	0.00020	0.000090	0.00010	0.00013
	21-Oct-10	-	0.00018	0.000070	0.000070	0.00017
2011	11-Jan-11	-	-	-	0.000060	-
	29-Apr-11	0.000040	0.000090	0.000060	0.000060	0.000090
	19-May-11	0.000050	0.00010	0.000060	0.000080	0.00010
	28-Jun-11	0.000070	0.00017	0.000090	0.00011	0.00014
	15-Jul-11	0.000090	0.00014	0.000080	0.000090	0.00013
	10-Aug-11	0.000050	0.00014	0.000080	0.000080	0.00011
	28-Oct-11	0.000050	0.00022	0.000080	0.000090	0.00017
2012	19-Apr-12	0.000020	0.000099	0.000050	0.000060	0.000096
	24-May-12	0.000050	0.00017	0.00010	0.00013	0.00013
	14-Jun-12	0.000069	0.00013	0.000092	0.000094	0.00014
	12-Jul-12	0.000066	0.00020	0.000093	0.00010	0.00015
	6-Aug-12	0.000062	0.00022	0.000078	0.00013	0.00018
	7-Sep-12	0.000050	0.00024	0.000050	0.000050	0.00016
	1-Oct-12	0.000050	0.00017	0.000050	0.000050	0.00017
2013	27-May-13	0.000050	0.00013	0.000050	0.000050	0.000050
	17-Jun-13	0.000050	0.00016	0.000050	0.000050	0.00017
	15-Jul-13	0.000050	0.00021	0.000050	0.000050	-
	28-Aug-13	0.000066	0.00019	0.00013	0.000099	0.00013
	11-Sep-13	0.000050	0.00023	0.00012	0.00010	0.00016
	16-Oct-13	0.000050	0.00019	0.000050	0.000050	0.00013
2014	16-May-14	0.000050	0.00023	0.000050	0.00012	0.00017
	3-Jun-14	0.000050	0.00020	0.00011	0.000050	0.00020
	26-Jul-14	0.000050	0.00016	0.000050	0.000050	0.00014
	17-Aug-14	-	0.00018	0.000050	0.000050	0.00015
	18-Aug-14	-	-	-	-	-
	20-Sep-14	0.000050	0.00017	0.000050	0.000050	0.00012
	10-Oct-14	-	0.00017	-	-	0.00015
	11-Oct-14	0.000050	-	0.000050	0.000050	-
	4-Dec-14	-	-	-	-	-
	4-Dec-14	-	-	-	0.000050	-
	7-Dec-14	-	-	-	-	-
2015	02-Mar-15	-	0.00063	-	-	-
	02-Mar-15	-	0.00063	-	-	-
	26-May-15	-	0.00028	-	0.000050	0.00021
	26-May-15	-	0.00028	-	-	-
	30-May-15	0.000050	-	0.000050	-	-
	23-Jun-15	-	0.00021	-	0.000050	0.00017
	23-Jun-15	-	-	-	0.000050	-
	30-Jun-15	0.000050	-	0.000050	-	-
	13-Jul-15	0.000050	0.00015	0.000050	0.000050	0.00013
	29-Aug-15	-	-	0.000050	-	-
	29-Aug-15	-	-	0.000050	-	-
	30-Aug-15	-	0.000050	-	0.000050	0.00012
	31-Aug-15	0.00012	-	-	-	-
	20-Sep-15	-	0.00021	0.000050	0.000050	0.00023
	21-Sep-15	0.000050	-	-	-	-
	18-Oct-15	-	0.00017	-	0.000050	0.00015
	18-Oct-15	-	0.00015	-	-	-
	19-Oct-15	0.00010	-	0.000050	-	-
	26-Nov-15	-	0.000050	-	0.00019	-
	06-Dec-15	0.000050	-	-	-	-
	19-Dec-15	-	-	-	0.000050	-

Table 3: Dissolved Selenium (mg/L) Grab Samples at Water Quality Stations on McGinty Creek, Minto Mine, 2009 to 2018

Year	Date	Station				
		MN-0.2	MN-0.5	MN-1.5	MN-2.5	MN-4.5
2016	29-Apr-16	-	0.00018	-	0.000093	0.00012
	30-Apr-16	0.000081	-	0.00011	-	-
	30-Apr-16	0.000081	-	0.00011	-	-
	26-May-16	0.000082	-	-	-	-
	28-May-16	-	0.00025	-	0.000087	0.00014
	29-May-16	-	-	0.000078	-	-
	20-Jun-16	0.000093	-	-	-	-
	21-Jun-16	-	0.00018	0.000062	0.000083	0.00014
	21-Jun-16	-	0.00019	-	-	-
	04-Jul-16	-	0.00016	0.000078	0.000065	0.00016
	04-Jul-16	-	-	0.000079	-	-
	30-Jul-16	0.000090	-	-	-	-
	04-Aug-16	-	0.00019	-	0.000072	0.00015
	04-Aug-16	-	-	-	-	0.00015
	07-Aug-16	-	-	0.000098	-	-
	15-Aug-16	0.000095	-	-	-	-
	03-Sep-16	-	0.00017	0.00013	0.00011	0.00016
	03-Sep-16	-	0.00020	-	-	-
	05-Sep-16	0.00011	-	-	-	-
	07-Oct-16	0.000074	-	-	-	-
	10-Oct-16	-	0.00020	-	0.000083	0.00016
	10-Nov-16	-	0.00024	-	-	0.00021
	12-Nov-16	-	-	-	0.000056	-
	02-Dec-16	-	0.00027	-	-	-
	02-Dec-16	-	0.00026	-	-	-
2017	26-May-17	-	0.00015	0.00012	0.00010	0.00016
	27-May-17	0.000091	-	-	-	-
	24-Jun-17	-	0.000097	0.000078	0.000095	0.00020
	24-Jun-17	-	0.00025	-	-	-
	25-Jun-17	0.000096	-	-	-	-
	06-Jul-17	0.000092	-	-	-	-
	07-Jul-17	-	0.00019	0.000075	0.000080	0.00018
	07-Jul-17	-	-	0.000078	-	-
	16-Aug-17	0.000082	-	-	-	-
	19-Aug-17	-	-	0.000051	-	-
	19-Aug-17	-	-	0.000056	-	-
	21-Aug-17	-	0.00018	-	0.000065	0.00016
	16-Sep-17	-	0.00017	0.000064	0.000062	0.00013
	18-Sep-17	0.000062	-	-	-	-
	18-Sep-17	0.000068	-	-	-	-
	21-Oct-17	-	0.00023	0.000051	0.000025	0.00017
	22-Oct-17	0.000025	-	-	-	-
	22-Oct-17	0.000057	-	-	-	-
	10-Nov-17	-	0.00024	-	0.000078	0.00037
	10-Nov-17	-	-	-	0.000078	-
2018	26-May-18	0.000060	0.00020	0.000087	0.000076	0.00019

Note: Bolded values are less than the laboratory reporting limit (LRL) and presented as 1/2x LRL.

Shading indicates that the value exceeded the Specific Threshold (ST-2) for dissolved selenium (0.00020 mg/L).

Shading indicates that the value exceeded the British Columbia Water Quality Guideline for selenium (0.002 mg/L; BCMOE 2014).

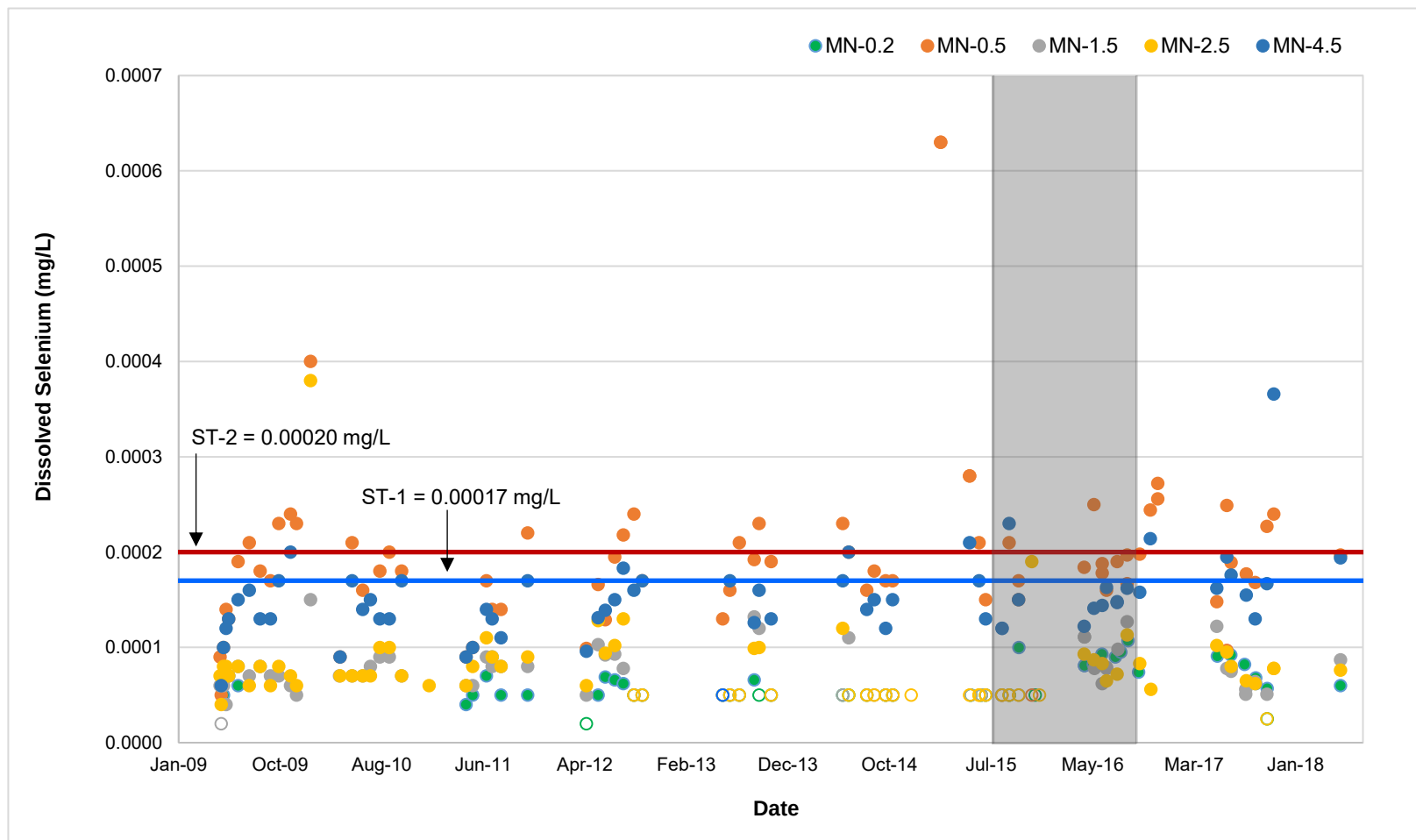


Figure 4: Dissolved Selenium (mg/L) Water Quality Grab Samples on McGinty Creek, Minto Mine, 2009 to 2018

Notes:

Unfilled circles are less than the laboratory reporting limit (LRL) and presented as 1/2x LRL.

Shaded area represents time period Minto North Pit was operational.

Table 4: Dissolved Selenium (mg/L) Minnow Monitoring Samples on McGinty Creek, Minto Mine, 2011 to 2017 ^a

Date	Dissolved Selenium
2011	0.00020
2012	0.00029
2013	0.00025
2014	0.00028
2015	0.00022
2016	0.00030
2017	0.00086

Note: Bolded values are less than the laboratory reporting limit (LRL) and presented as 1/2x LRL.

 Shading indicates that the value exceeded the Specific Threshold (ST-2) for dissolved selenium (0.00020 mg/L).

 Shading indicates that the value exceeded the British Columbia Water Quality Guideline for selenium (0.002 mg/L; BCMOE 2014).

^a Samples were collected during the Sediment, Periphyton, and Benthic Invertebrate Community Monitoring Programs, 2011 to 2017.

Conclusions and Recommendations

Dissolved selenium exceeded the ST-3 objective at MN-4.5, but the source was unrelated to the Minto Mine and consistent with reference concentrations further upstream on the west arm of McGinty Creek. Dissolved selenium was well below applicable guidelines for the protection of aquatic life, so effects to aquatic life would not be expected.

It is recommended that sampling continue as scheduled since the exceedance of dissolved selenium was unrelated to the mine. Increased frequency is not required at this time. Two investigations show that exceedances of dissolved selenium are unrelated to the mine, and it is recommended that a reevaluation of the Specific Thresholds (which are lower than reference) be conducted.

Sincerely,

Minnow Environmental Inc.



Lisa Bowron, M.Sc., R.P.Bio.

Aquatic Toxicologist

cc: Pierre Stecko, M.Sc., R.P.Bio., EP
Senior Aquatic Scientist / Principal Consultant

References

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- Minnow. 2018b. Minto Creek Sediment, Periphyton, and Benthic Invertebrate Community Assessment – 2017. Prepared for Minto Explorations Ltd, March 2018.
- Minto (Minto Explorations Ltd.). 2017. Minto Mine Operations Adaptive Management Plan 2017-01. Prepared on January 2017.



Appendix I – 2018 AMP Groundwater SRK Memo

Memo

To:	Deborah Flemming, Minto Explorations Ltd.	Client:	Minto Explorations Ltd.
From:	Dan Mackie, PGeo Laura Volden, MSc, GIT	Project No:	1CM002.057
Cc:		Date:	March 20, 2019
Subject:	Minto Mine – Summary of 2018 Groundwater OAMP SPT Exceedances		

1 Purpose

Groundwater monitoring at the Minto Mine, Yukon, is conducted and reviewed through the Minto Mine Groundwater Monitoring Plan (Minto, 2016) and the Operational Adaptive Management Plan (OAMP; Minto, 2017). The purpose of this memo is to summarize groundwater quality (and locations) at Minto that have exceeded a specific performance threshold (SPT) of the OAMP in 2018.

2 Background

The groundwater monitoring network at Minto includes 10 active multi-level monitoring wells that have been installed between 2009 and 2017. The monitoring wells are located across the site, both outside of the current mining footprint and topographically (and hydraulically) down gradient of mining activities. Monitoring locations are shown on Figure 1. All of these monitoring wells were installed after the start of mining (except MW09-03, which was installed after the main Minto operations began, but before mining at the adjacent Minto North Pit started). Details of groundwater monitoring locations can be found in SRK (2018).

Groundwater monitoring is conducted as required by the Groundwater Monitoring Plan. Review of groundwater monitoring results is carried out as part of the OAMP. In the OAMP, performance thresholds have been defined to establish changes in concentration and concentration values for specific constituents of concern (CoCs) at which actions may need to be taken by Minto to avoid potential impacts to the environment. Specifically, the OAMP states:

Specific Performance Thresholds (SPTs) are defined for each of the Effluent Quality Standards (EQS) parameters identified in Clause 9 (a), Table 1 of Water Use Licence QZ14-031, with the exception of pH, oil and grease, iron and nitrite.

There are three SPT levels for groundwater quality defined in the OAMP for the Minto Creek Catchment, and two for the McGinty Creek Catchment. Of the 10 multi-port monitoring wells active in the monitoring network, only three are compared to the SPT in the AMP. They are MW12-05 and MW12-06 (Minto Creek Catchment), and MW09-03 (McGinty Creek Catchment). All three of these monitoring wells are located hydraulically or topographically down gradient of certain mine components:

- MW09-03 – topographically down gradient of the Minto North Pit in the McGinty Creek catchment;
- MW12-06 – hydraulically and/or topographically down gradient of the Main and Area 2 open pits, DSTSF and MVFE, in the Minto Creek catchment;
- MW12-05 – hydraulically and topographically down gradient of all mine activities in the Minto Creek catchment.

Attachment 1 provides table of SPT threshold concentrations. SPTs for each catchment are summarized below:

Minto Creek Catchment

1. SPT-1 corresponds to a trend-based assessment designed to flag potential rapidly-increasing groundwater concentrations that have not yet exceeded concentration-based thresholds.
2. SPT-2 generally corresponds to the EQS concentrations defined in the OAMP (with four exceptions: Cr-D, Cu-D, Ni-D and sulphate).
3. SPT-3 generally corresponds to the estimated concentrations in groundwater that would be necessary to cause exceedance of the Water Quality Objectives in lower Minto Creek under long term steady state conditions.

McGinty Creek Catchment

1. SPT-1 is triggered when there are three consecutive exceedances of the 75th percentile background level in a single monitoring port.
2. SPT-2 is triggered when there are three consecutive exceedances of the 95th percentile background level in a single monitoring port.

Groundwater monitoring results are reviewed monthly and, if a SPT is reached or exceeded, data are reviewed, interpretations are made, the risk narrative is assessed (in terms of the receiving environment), and management actions are defined. If an OAMP SPT has not been reached for any parameter at any location, no further action is taken on the assumption that there has been no change of significance from defined baseline conditions. Monthly OAMP reports are provided to the Yukon Government as per the OAMP.

3 Groundwater AMP SPT Events

Table 1 and Table 2 summarize groundwater locations and parameters for which OAMP SPTs have been reached for the 2018 monitoring year. CoCs at any groundwater monitoring location that are not identified in this table are assumed to not have changed by a significant amount relative to established baseline conditions. Baseline groundwater conditions are defined in the OAMP based on data from MW09-03 prior to 2015 (start of Minto North mining).

Groundwater monitoring data for all CoCs are included in Attachment 2.

Table 1 Minto Creek Catchment threshold exceedances

Monitoring Well Zone	Parameter	SPT	Context
MW12-05-01	Al	1	1 of 4 samples exceeded threshold concentration
	Se	1	1 of 4 samples exceeded threshold concentration
	SO ₄ ²⁻	2	4 of 4 samples exceeded threshold concentration
MW12-05-02	SO ₄ ²⁻	2	4 of 4 samples exceeded threshold concentration
MW12-05-03	SO ₄ ²⁻	1	1 of 4 samples exceeded threshold concentration
MW12-05-04	As	1	1 of 4 samples exceeded threshold concentration
MW12-05-05	Zn	1	1 of 4 samples exceeded threshold concentration
MW12-05-06	Al	1	1 of 4 samples exceeded threshold concentration
	Cu	1	1 of 4 samples exceeded threshold concentration
MW12-06-01	As	1	2 of 4 samples exceeded threshold concentration
	Cr	3	4 of 4 samples exceeded threshold concentration
	Zn	1	1 of 4 samples exceeded threshold concentration
MW12-06-02	As	1	1 of 4 samples exceeded threshold concentration

Table 2 McGinty Creek Catchment threshold exceedances

Monitoring Well Zone	Parameter	SPT	Context
MW09-03-01	Ag	1	1 of 9 samples exceeded threshold concentration
	Al	1	1 of 9 samples exceeded threshold concentration
		2	3 of 9 samples exceeded threshold concentration
	As	1	3 of 9 samples exceeded threshold concentration
		2	6 of 9 samples exceeded threshold concentration
	Cd	1	3 of 9 samples exceeded threshold concentration
	Cr	2	1 of 9 samples exceeded threshold concentration
	Cu	1	5 of 9 samples exceeded threshold concentration
	Mo	1	3 of 9 samples exceeded threshold concentration
	Se	1	5 of 9 samples exceeded threshold concentration
	Zn	1	2 of 9 samples exceeded threshold concentration
		2	4 of 9 samples exceeded threshold concentration

Monitoring Well Zone	Parameter	SPT	Context
MW09-03-02	Ag	2	1 of 9 samples exceeded threshold concentration
	Al	1	2 of 9 samples exceeded threshold concentration
		2	2 of 9 samples exceeded threshold concentration
	Cd	1	7 of 9 samples exceeded threshold concentration
	Cr	1	1 of 9 samples exceeded threshold concentration
	Cu	1	5 of 9 samples exceeded threshold concentration
	Se	1	2 of 9 samples exceeded threshold concentration
	Zn	2	9 of 9 samples exceeded threshold concentration
	SO ₄ ²⁻	1	6 of 9 samples exceeded threshold concentration
	NO ₃ ⁻	1	3 of 9 samples exceeded threshold concentration
		2	6 of 9 samples exceeded threshold concentration

4 Discussion

Monitoring results for CoCs are routinely reviewed to provide context on potential impacts of mining activities to groundwater. Groundwater SPT exceedances (events) have occurred for a limited number of parameters and do not necessarily correlate with distance from mining activities (i.e., events have not necessarily all occurred at monitoring wells in relatively close proximity to mining activities). Some of these events may reflect elevated background concentrations that were not identified prior to start of mining because monitoring wells were not in place at that time.

Ongoing events are addressed specifically as follows:

- Sulphate SPT events in MW12-05 have been restricted to the deeper zones (MW12-05-01, MW12-05-02, and MW12-05-03) which monitor depths greater than 85 meters below ground surface (m bgs). Recently, the MW12-05-03 sulphate trend appears to have stabilised at a concentration below that of Minto Creek catchment SPT-2. The sulphate trend at MW12-05-01 and MW12-05-02 continues to increase, but at a slower rate than previously. This may suggest that Zone 1 may be approaching equilibrium with groundwater. Zones shallower than Zone 3 all record stable and far lower sulphate concentrations (<100 mg/L). Surface water stations in the Minto Creek catchment downstream of the mine footprint (e.g. MC1) display stable trends in sulphate at similar concentrations to those observed in the shallow zones at MW12-05 (SRK, 2018).
- Sulphate at MW09-03-02 exceeded thresholds in the first half of 2018 but has been decreasing consistently since. Both MW09-03-02 and MN-4.5, a surface water monitoring station downstream in McGinty Creek, demonstrate a seasonal trend, with the highest concentrations in groundwater occurring in Q2, and the highest concentrations in surface water occurring in Q4. While groundwater concentrations have been decreasing, values at MN-4.5 remain stable in the range of baseline monitoring.

- Nitrate at MW09-03-02 has been increasing since the beginning of 2017 and has consistently exceeded the McGinty Creek SPT-2. The nitrate concentration of the deeper zone, MW09-03-01, remains stable and below both SPTs. Presently, the Minto North Pit acts as a hydraulic sink, capturing (locally) groundwater topographically downgradient (including MW09-03). Therefore, migration of pit water is not the cause of the nitrate increase observed at MW09-03-02. The likely explanation for the observed water quality at MW09-03 is flushing of blasting residuals from the rock used to construct the mine haul road on the topographically downgradient side of the Minto North Pit, and immediately adjacent to the monitoring well. This effect is expected to be relatively short-lived, as blasting residuals will flush out over time. Data from the nearest McGinty Creek surface water monitoring station (MN-1.5) indicate nitrate concentrations remain within the range observed during baseline monitoring (SRK, 2018).
- As with nitrate, since the Minto North Pit is acting as a hydraulic sink, the other SPT events at MW09-03 (Ag, Al, As, Cd, Cr, Cu, Mo, Se, Zn) are not likely caused by migration of the pit water. Threshold exceedances of Ag, Cr and Mo were isolated occurrences and could be due to surface contamination during sampling, laboratory error or temporary site activities. Concentrations of the remaining elements had higher annual averages in 2018 than in the past but demonstrate a high degree of variability and could potentially be caused by flushing of blasting residuals in the rock used to construct the mine haul road. The concentration of these parameters at MN-1.5 are within pre-mining conditions, indicating no identifiable impact from SPT events.
- Chromium concentrations at MW12-06-01 have been increasing since monitoring began in 2016 and have consistently exceeded SPT 3 with seasonality that shows peak values occurring late in the year. W8A, a surface water monitoring station that collects water from sumps under the tailings facility shows similar seasonality, but with peak concentrations decreasing each year. As high chromium concentrations are only observed in the deepest zone, it is likely caused by an isolated zone of chromium rich minerals in the rock.
- Arsenic concentrations at MW12-05-04 and multiple depths at MW12-06 exceeded thresholds during the last monitoring event of 2018. These exceedances were isolated, except for MW12-06-01, and appear almost systematic, suggesting they were caused by temporary site activities, field contamination during sampling or laboratory error. Surface water concentrations remain in the range of baseline and show no response to the sudden increases.
- Events occurring in MW12-05 and MW12-06 other than sulphate (Al, As, Cu, Se, Zn) were generally isolated in 2018 and are likely reflective of field contamination during sampling, temporary site activities or laboratory error. Surface water concentrations in Minto Creek remain in the range of baseline conditions and show no response to the heightened groundwater events.

5 Conclusions

Groundwater exceedances of the OAMP SPTs in 2018 have been limited. Consistent SPT exceedance is not widespread; most wells (~66%) did not exceed more than one OAMP SPT in 2018.

Where regular exceedances have been identified (Al, As, Cd, Cu, Mo, Se and Zn at MW09-03-01; Cd, Cu, Zn, nitrate, and sulphate at MW09-03-02; sulphate at MW12-05-01 and MW12-05-02; Cr at MW12-06-01), the likely cause is either a lack of characterization or the range of pre-mining groundwater concentrations (MW12-05-01 and MW12-06-01), or local, temporary mine-related sources of CoCs (i.e., apparent influence of the haul road rock on groundwater in the MW09-03 zones). While the source of high sulphate in MW12-05-01 and MW12-05-02 is yet to be determined, it is thought to be naturally occurring in the deeper groundwaters and efforts to identify the source continue.

Overall, the groundwater CoC exceedances of the OAMP SPTs have not required mitigation as surface water bodies have not been impacted by elevated groundwater concentrations. Groundwater monitoring should continue as per the Minto Mine Groundwater Monitoring Plan, and results should continue to be evaluated against the Operational Adaptive Management Plan SPTs and compared with other studies assessing natural background conditions.

Regards,
SRK Consulting (Canada) Inc.

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Consultant

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Dan Mackie, PGeo
Principal Consultant

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The opinions expressed in this report have been based on the information available to SRK at the time of preparation. SRK has exercised all due care in reviewing information supplied by others for use on this project. Whilst SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information, except to the extent that SRK was hired to verify the data.

6 References

Minto Explorations Ltd., 2016. Minto Mine Groundwater Monitoring Plan, Version 2016-01. Report prepared by Minto Explorations Limited, with contributions from SRK Consulting. July 2016.

Minto Explorations Ltd., 2017. Minto Mine Operations Adaptive Management Plan 2017-02. April 2017.

SRK Consulting (Canada) Inc., 2018. Minto Groundwater Characterization and Hydrogeologic Conceptual Model Update Report. Report submitted to Minto Explorations Ltd. SRK project number 1CM002.057. January 2018. 35 pages.

Attachment 1

Minto Creek SPTs

	Ag-D	Al-D	As-D	Cd-D	Cr-D	Cu-D	Pb-D	Mo-D	Ni-D	Se-D	Zn-D	N-NO3	Ammonia	Sulphate
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
SPT-2	0.00030	0.30	0.015	0.003	0.0020	0.030	0.012	0.22	0.165	0.0060	0.090	27	0.75	1000
SPT-3	0.00046	0.48	0.025	0.006	0.0030	0.060	0.020	0.34	0.34	0.0093	0.13	45	1.0	4951

McGinty Creek SPTs

		Ag-D	Al-D	As-D	Cd-D	Cr-D	Cu-D	Pb-D	Mo-D	Ni-D	Se-D	Zn-D	N-NO3	Ammonia	Sulphate
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
MW09-03-01	SPT-1	0.000010	0.0065	0.00011	0.000075	0.000500	0.00155	0.0001	0.005	0.0021	0.0001	0.013	0.13	0.067	24
	SPT-2	0.000016	0.0101	0.00081	0.000272	0.000575	0.00625	0.0003	0.026	0.0060	0.0015	0.022	0.28	0.133	38
MW09-03-02	SPT-1	0.000018	0.0073	0.00074	0.000031	0.000500	0.00263	0.0001	0.018	0.0009	0.0005	0.010	0.03	0.230	7
	SPT-2	0.000034	0.0095	0.00092	0.000272	0.000796	0.01080	0.0002	0.062	0.0026	0.0040	0.015	0.07	0.282	67
MW09-03-03	SPT-1	0.000010	0.0047	0.00005	0.000023	0.000500	0.00247	0.0001	0.006	0.0005	0.0004	0.008	0.50	0.020	12
	SPT-2	0.000010	0.0075	0.00014	0.000069	0.000500	0.00500	0.0003	0.018	0.0011	0.0004	0.011	0.54	0.058	13

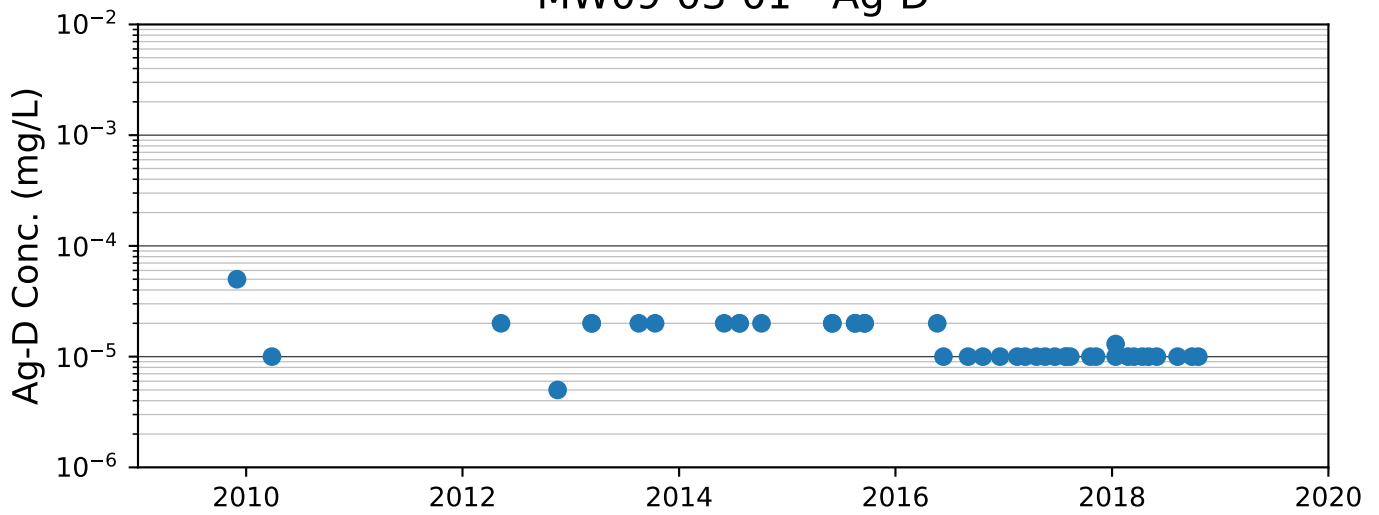
Source: Minto 2017-02 OAMP, pages 21 and 25 (Minto, 2017)

Attachment 1: SPT Threshold Concentrations

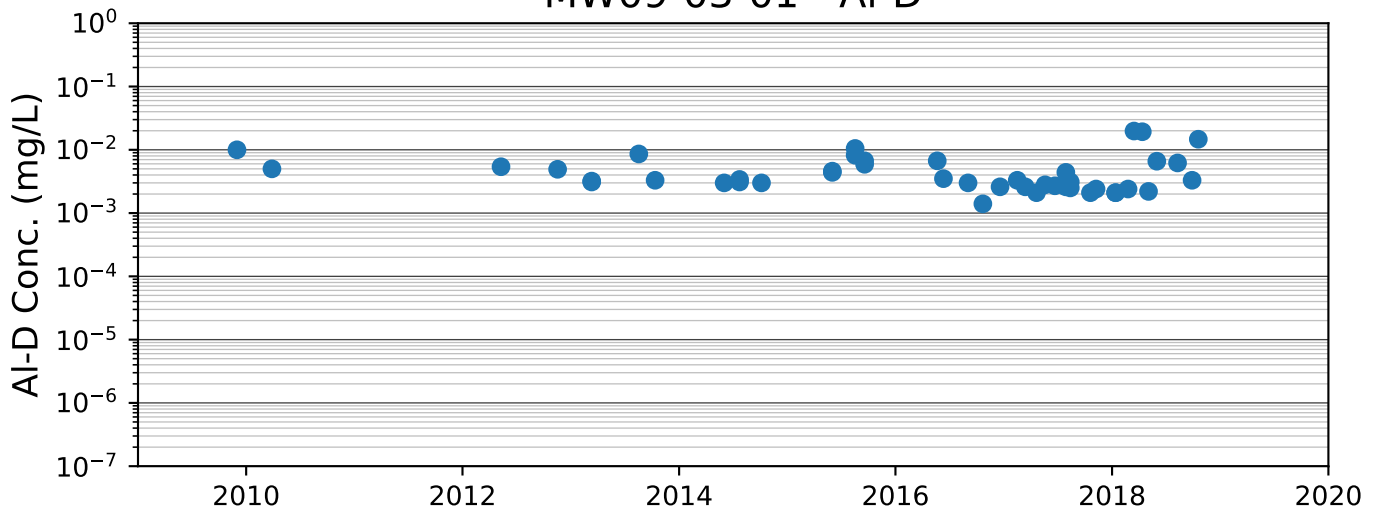
Attachment 2: Groundwater Monitoring Data for All CoCs

Attachment 2: Groundwater Monitoring Data for All CoCs

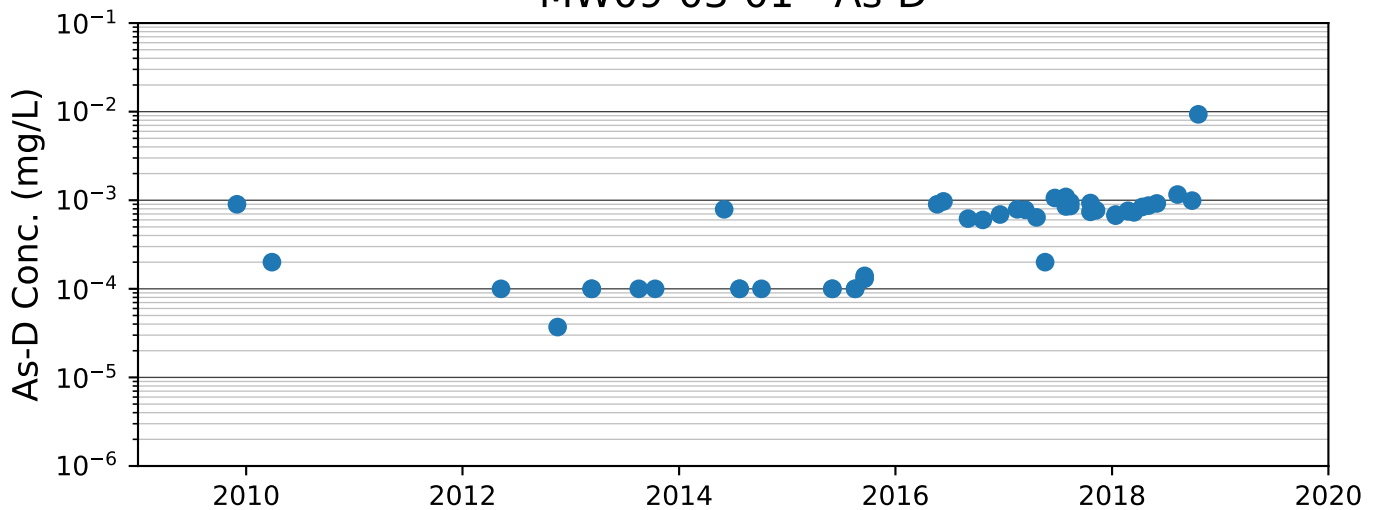
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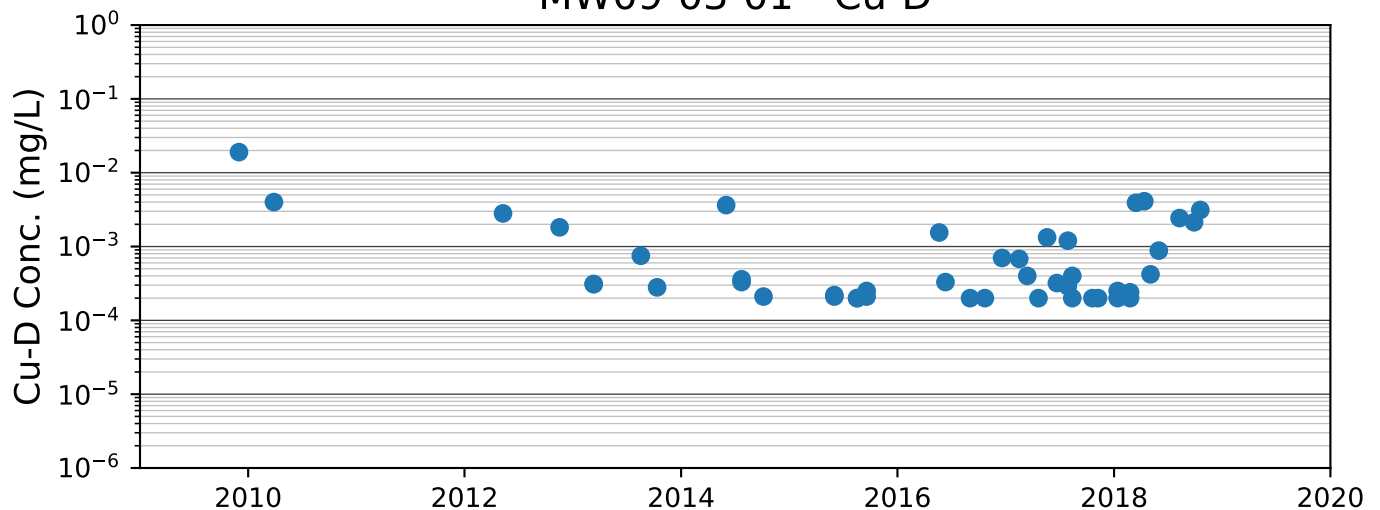
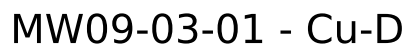
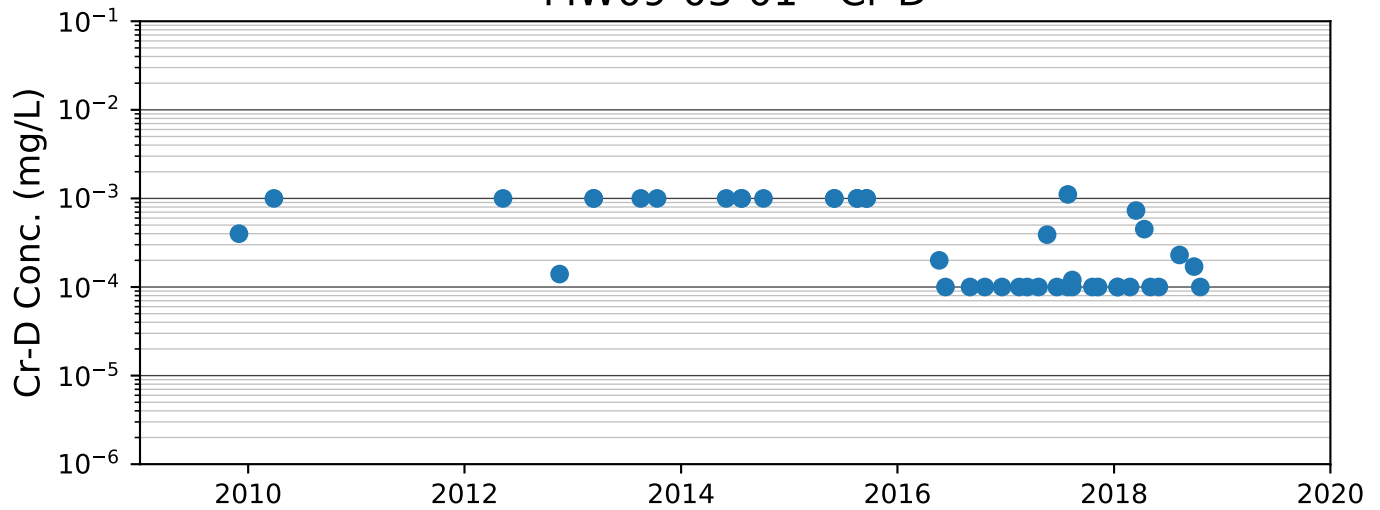
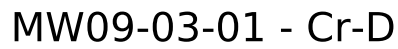
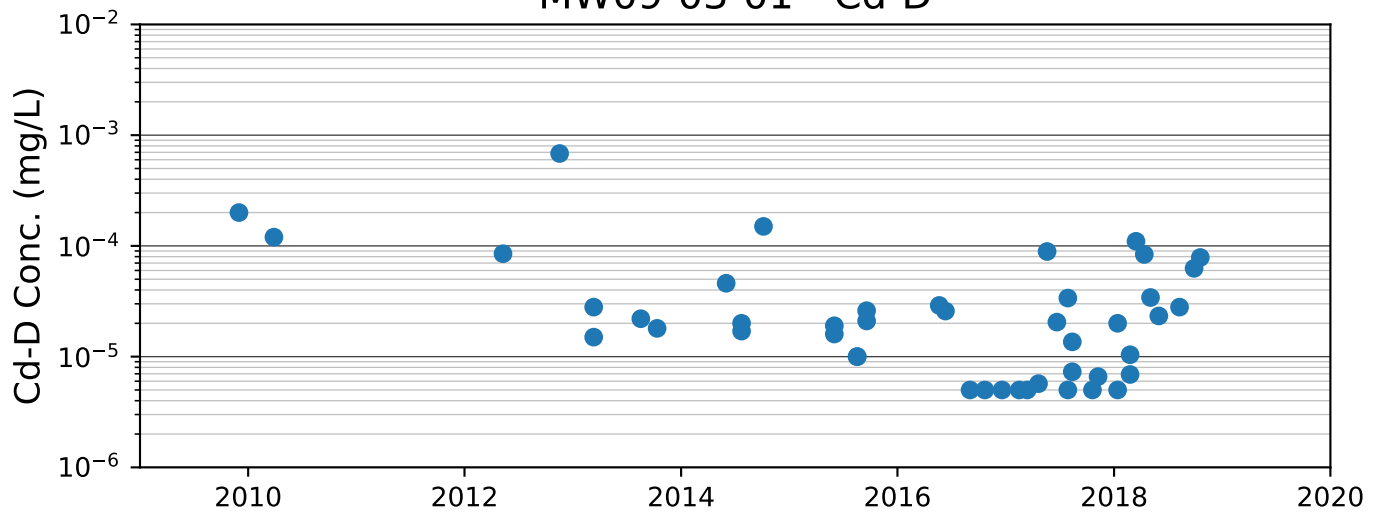
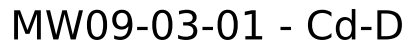
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MW09-03-01 - As-D

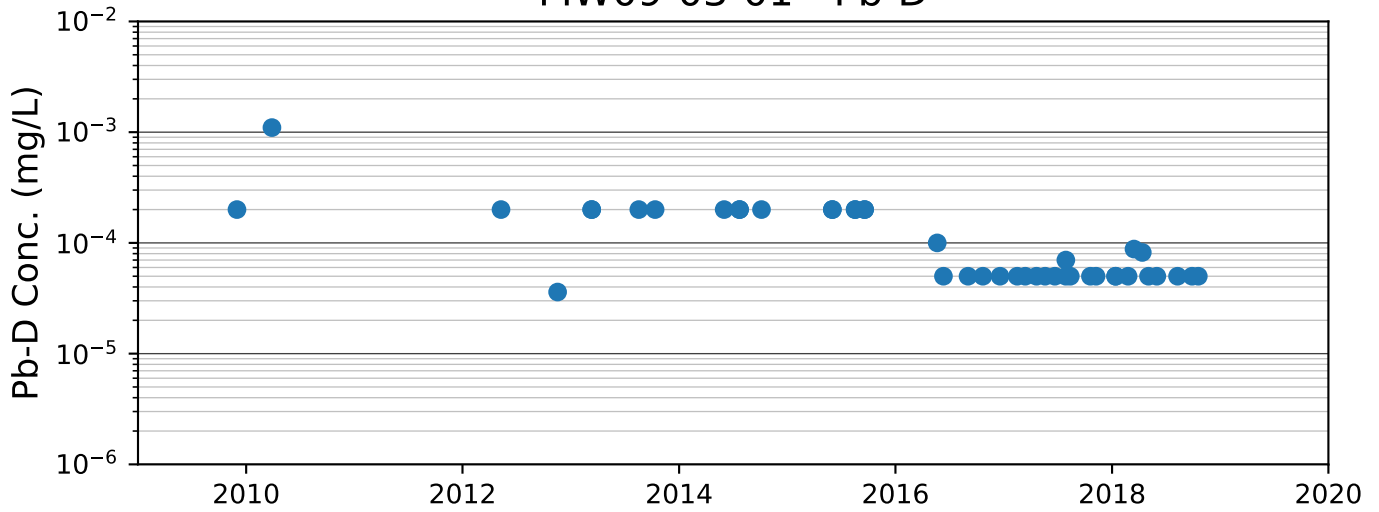


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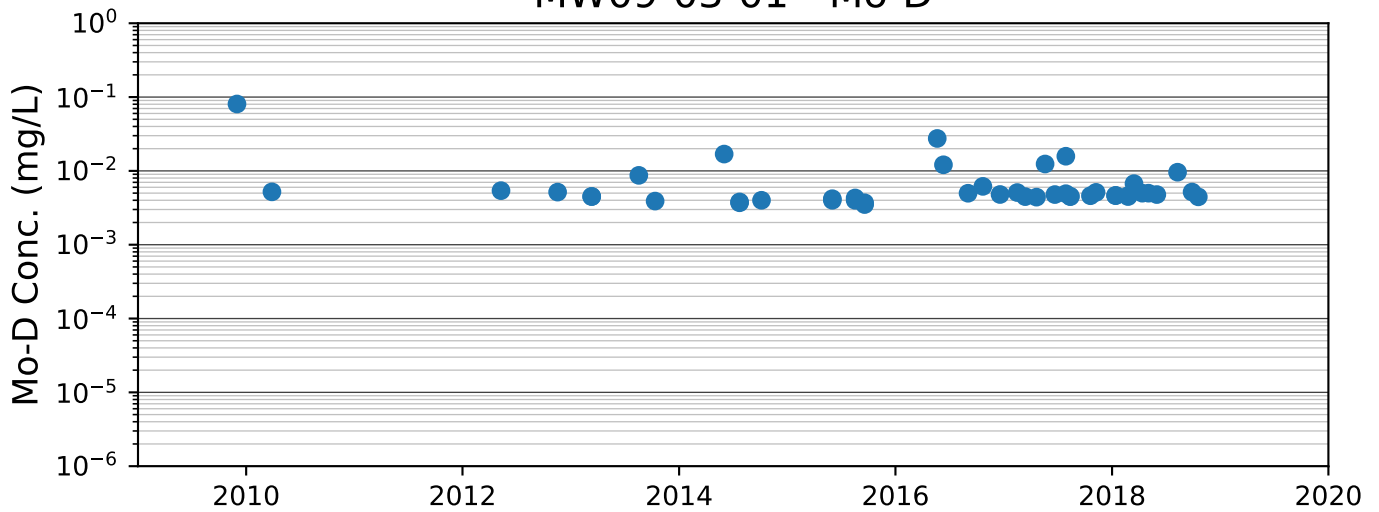


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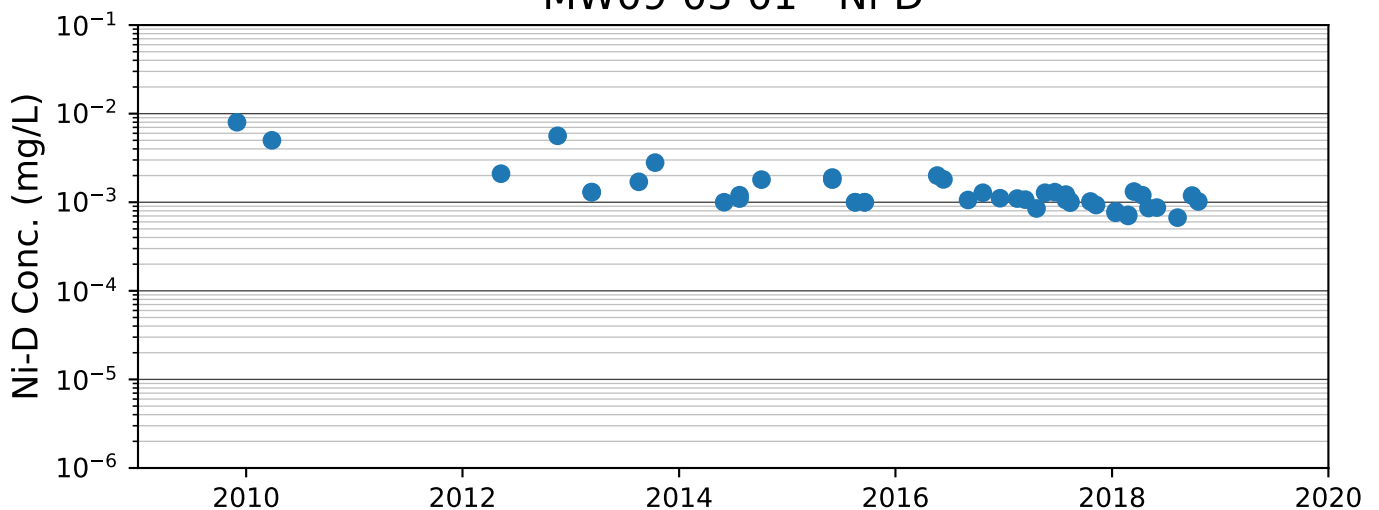
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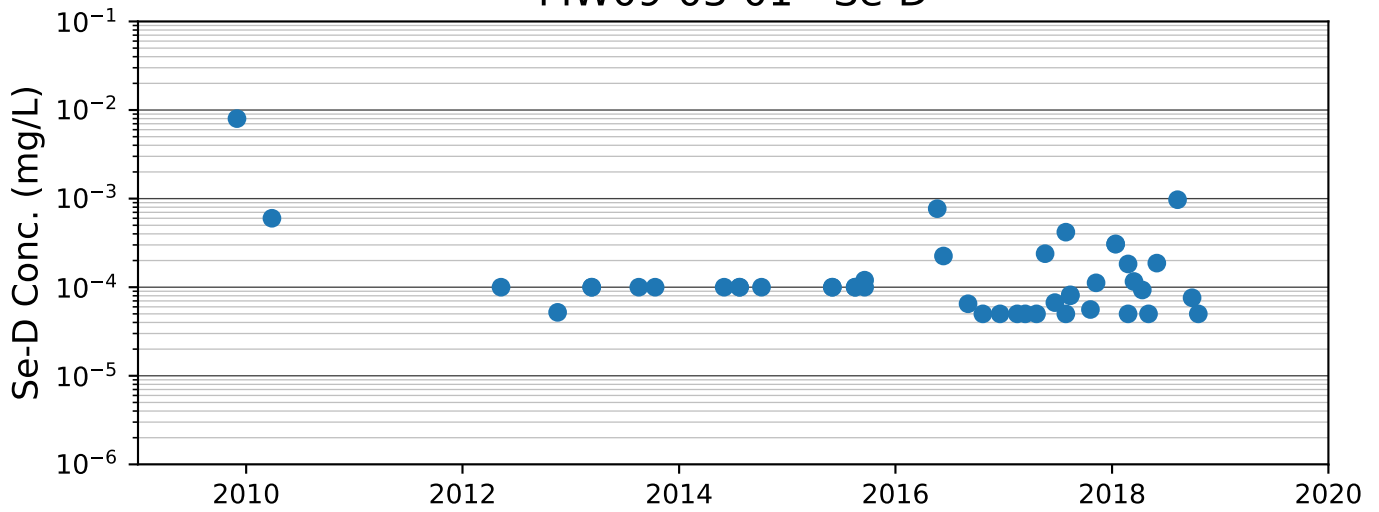
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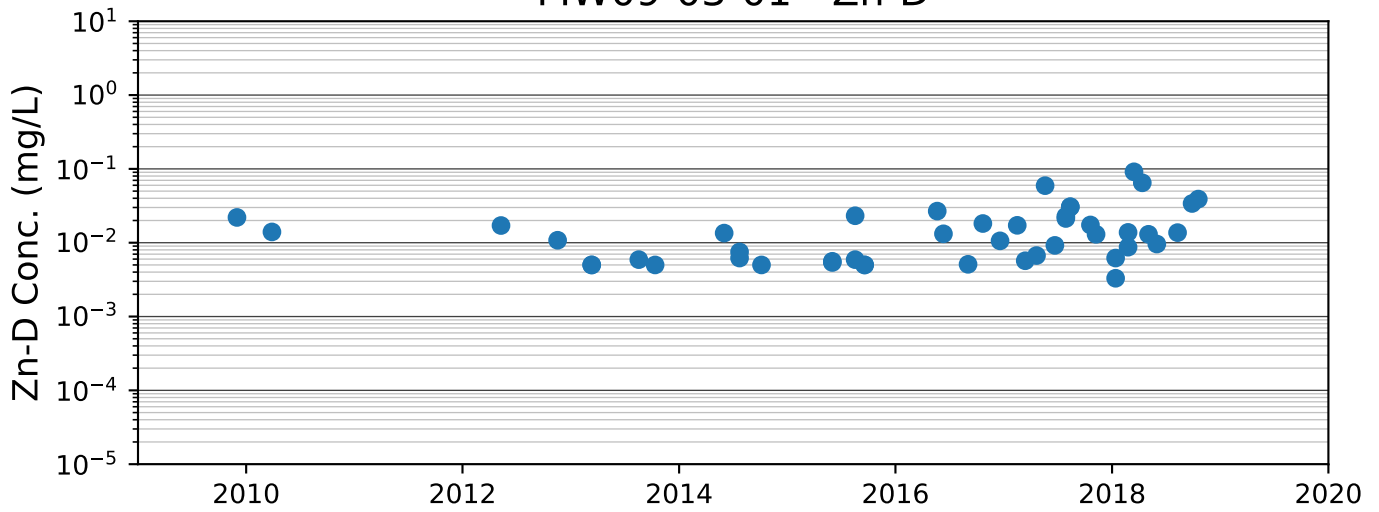
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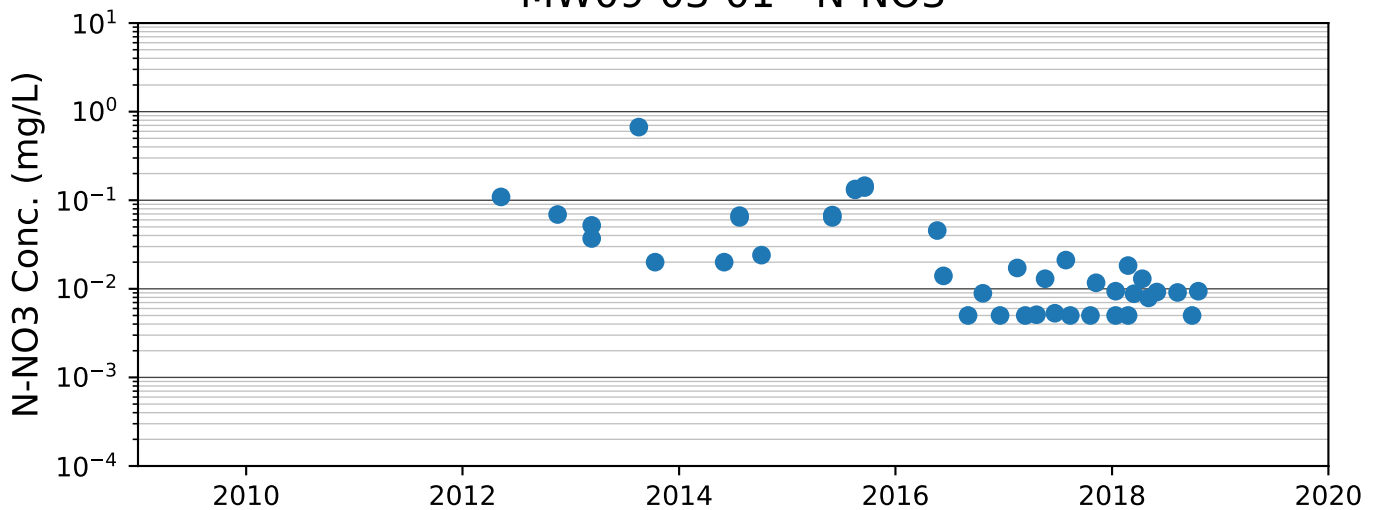
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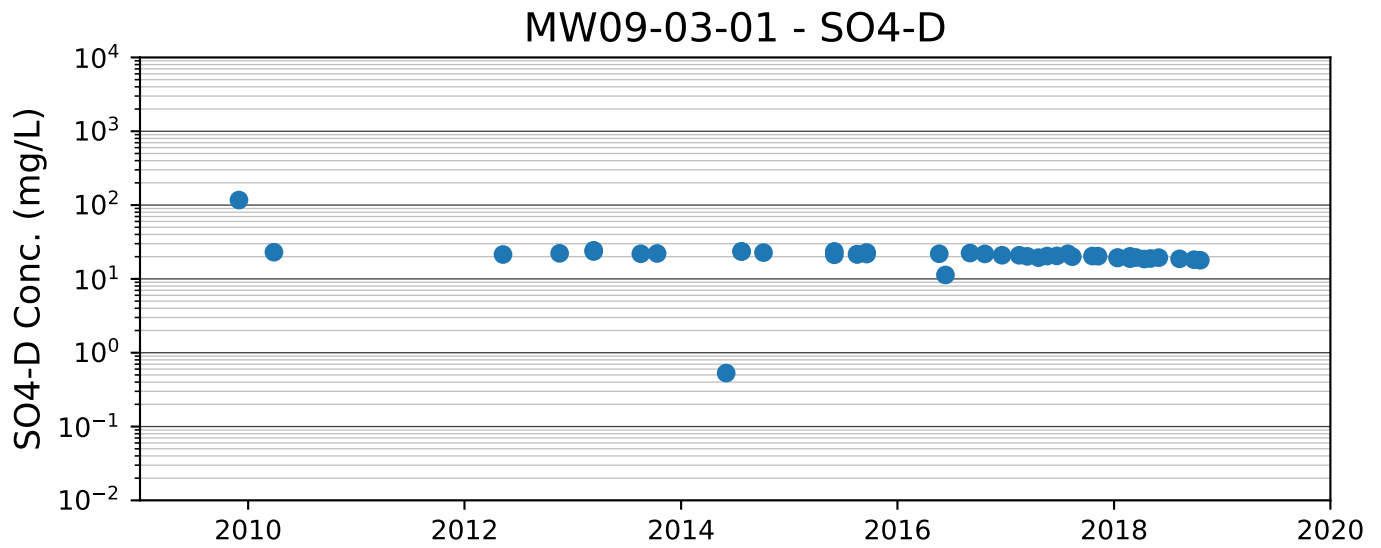


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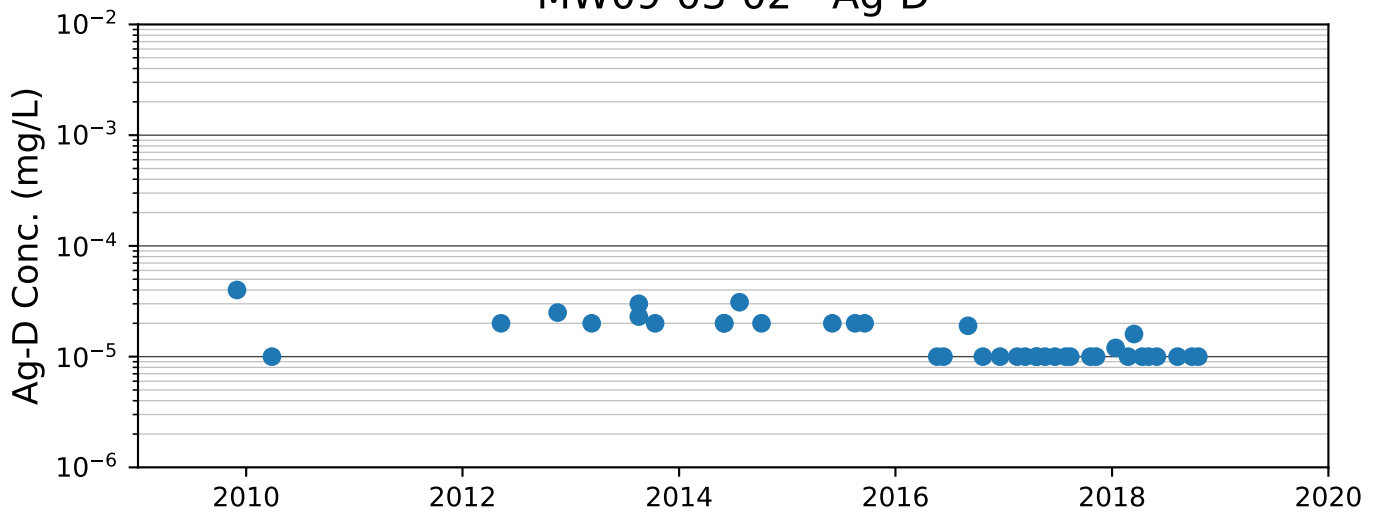
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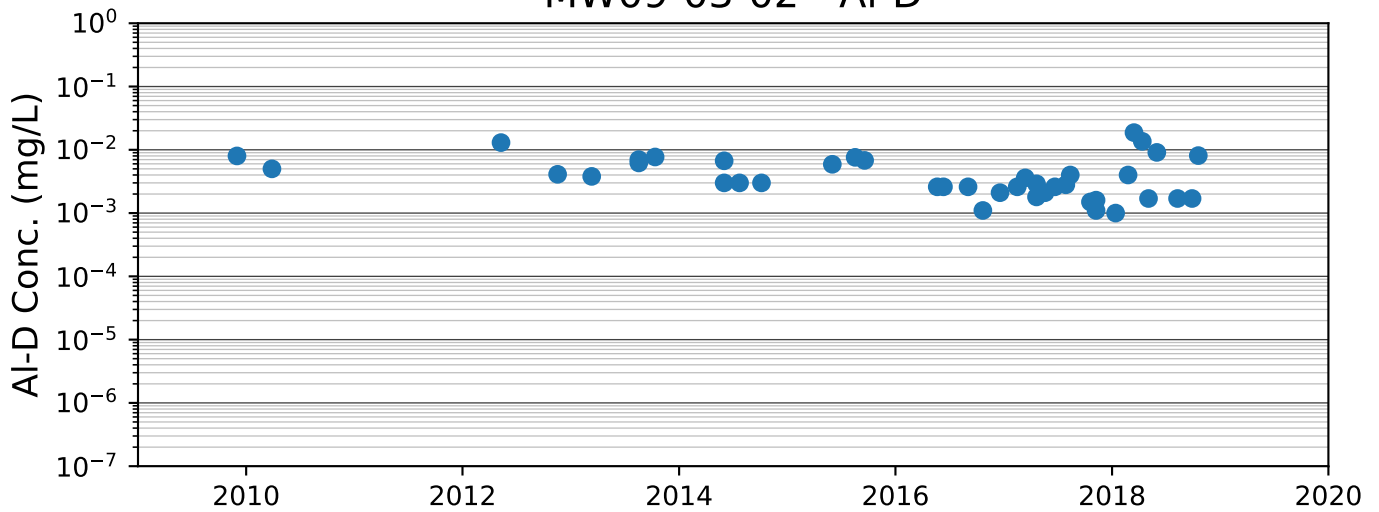


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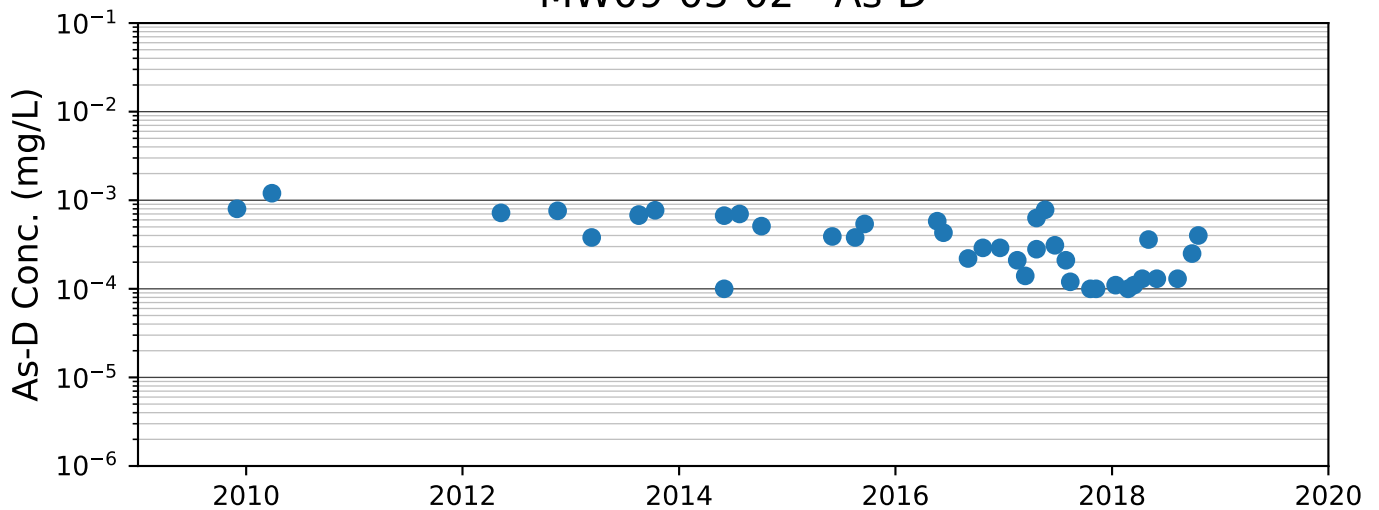
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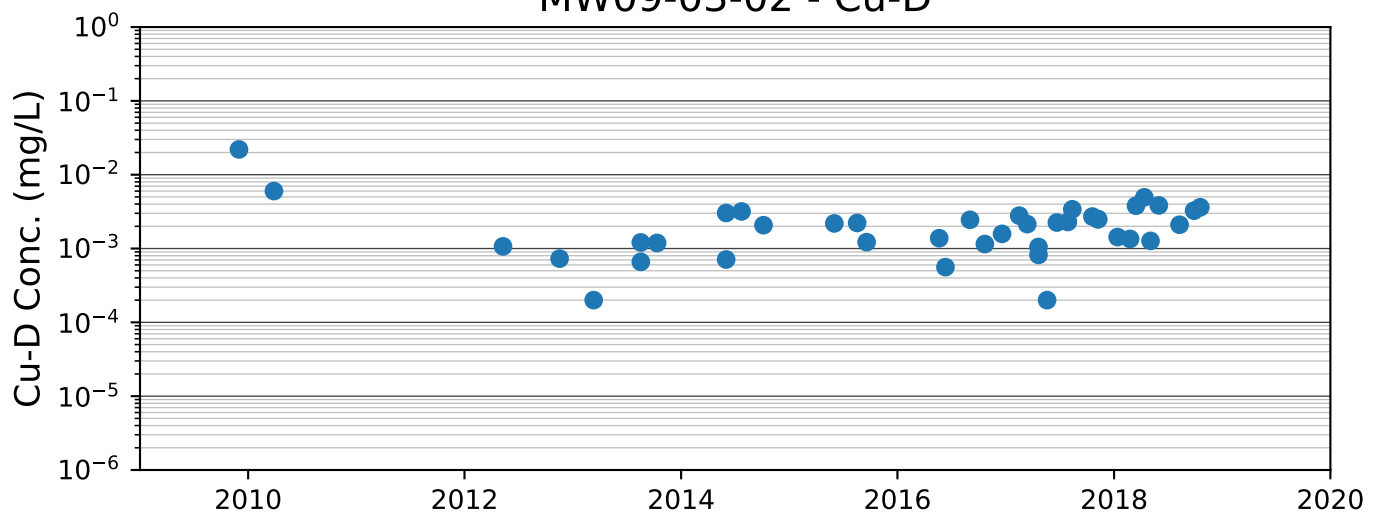
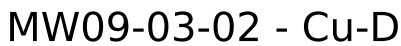
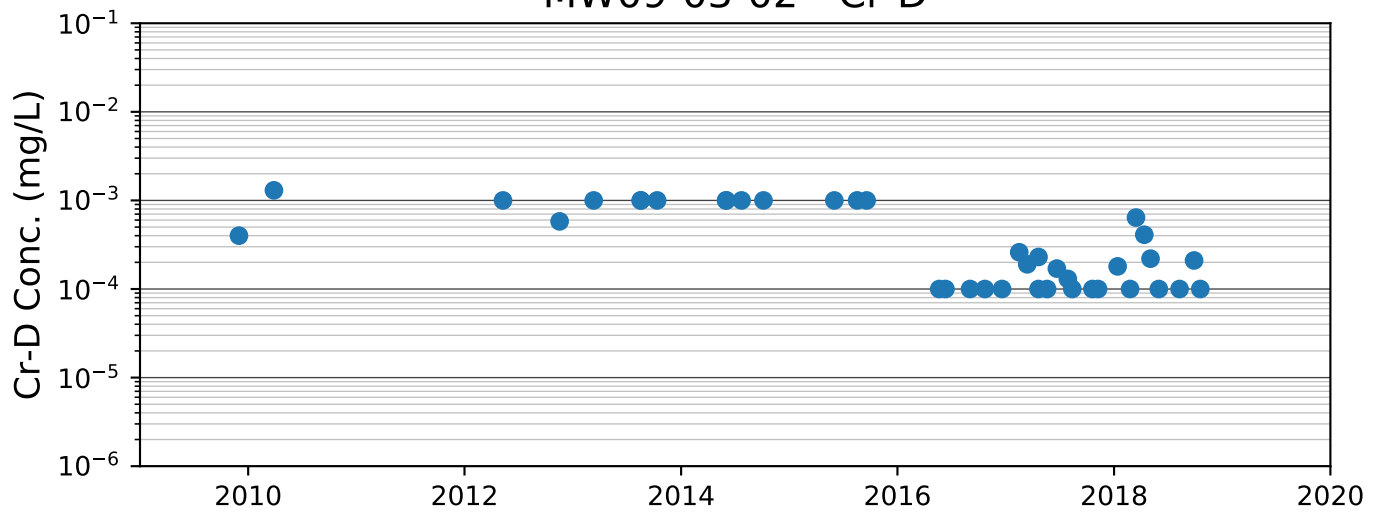
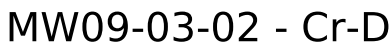
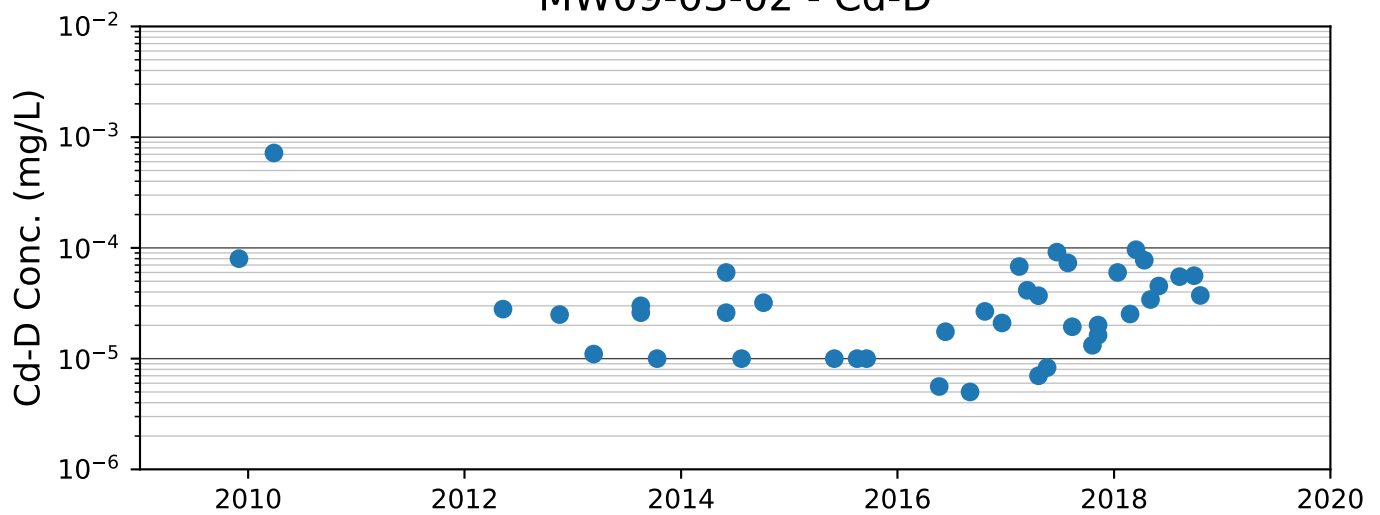
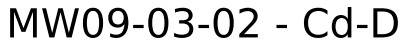
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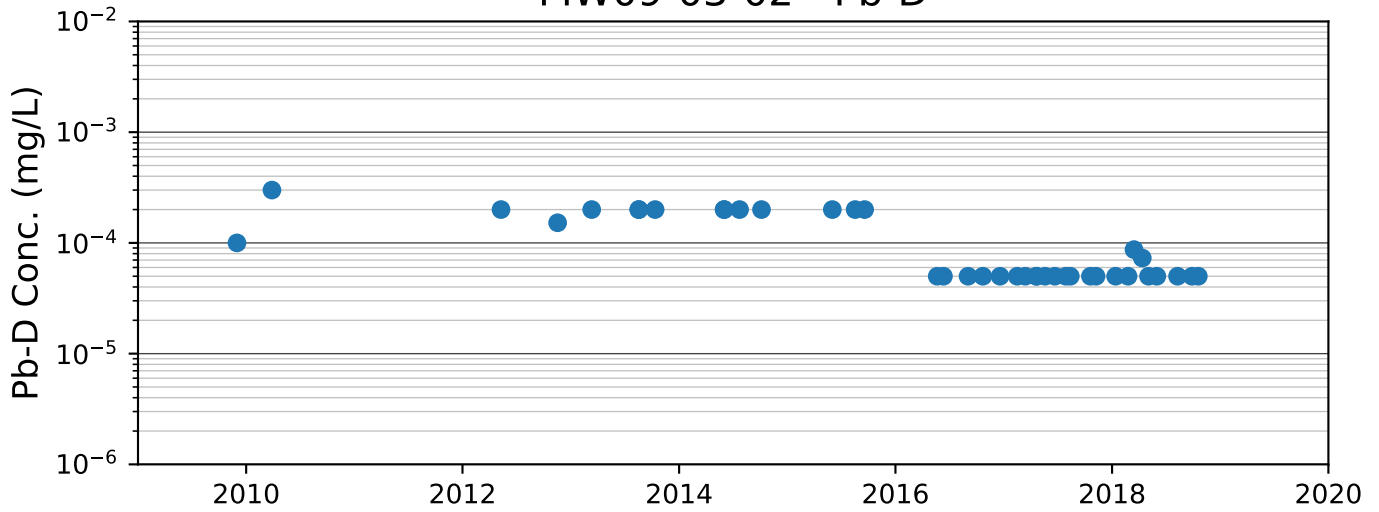


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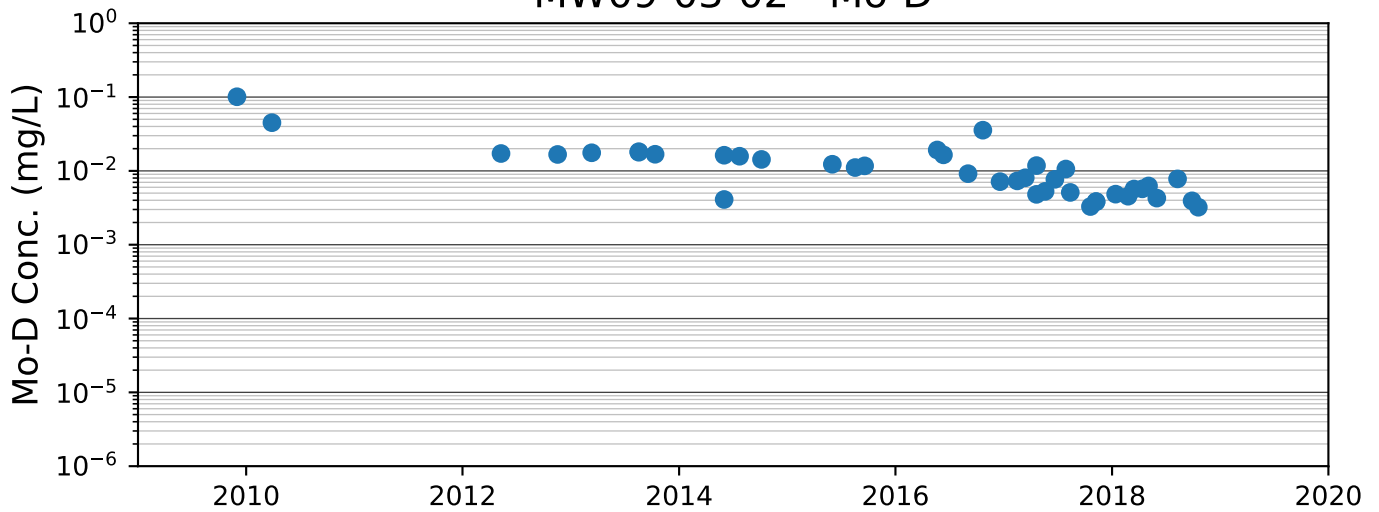


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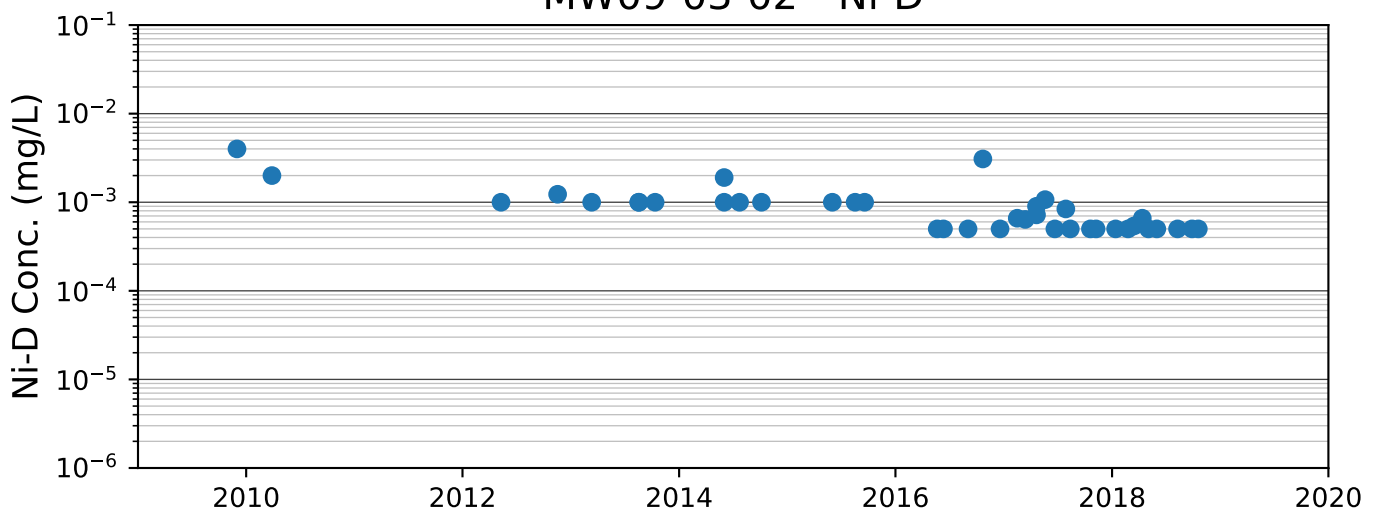
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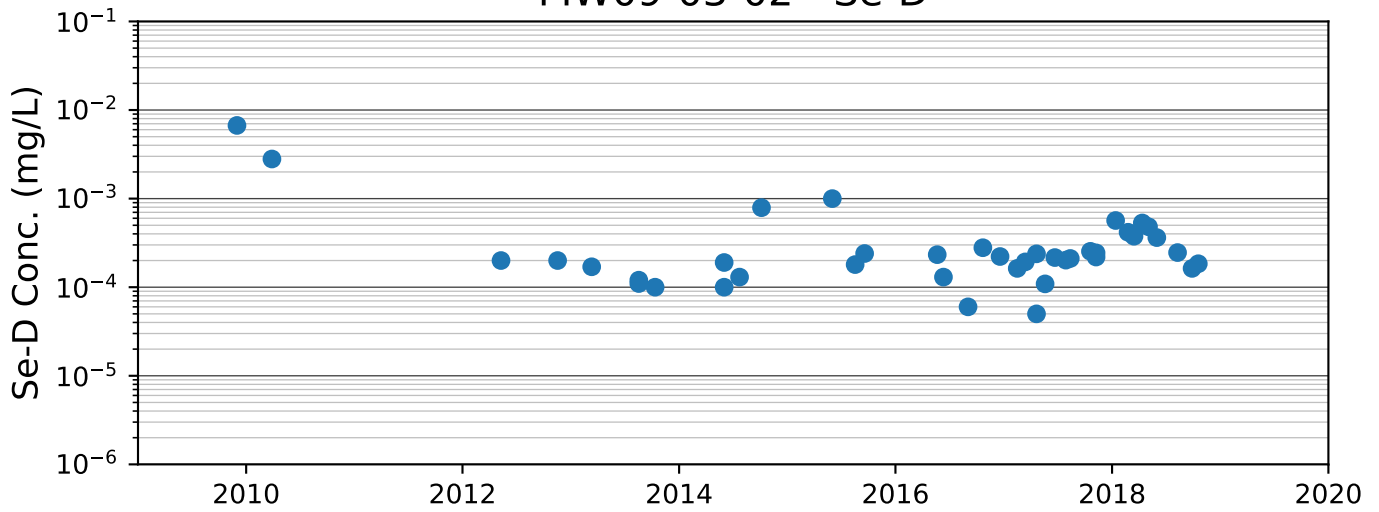


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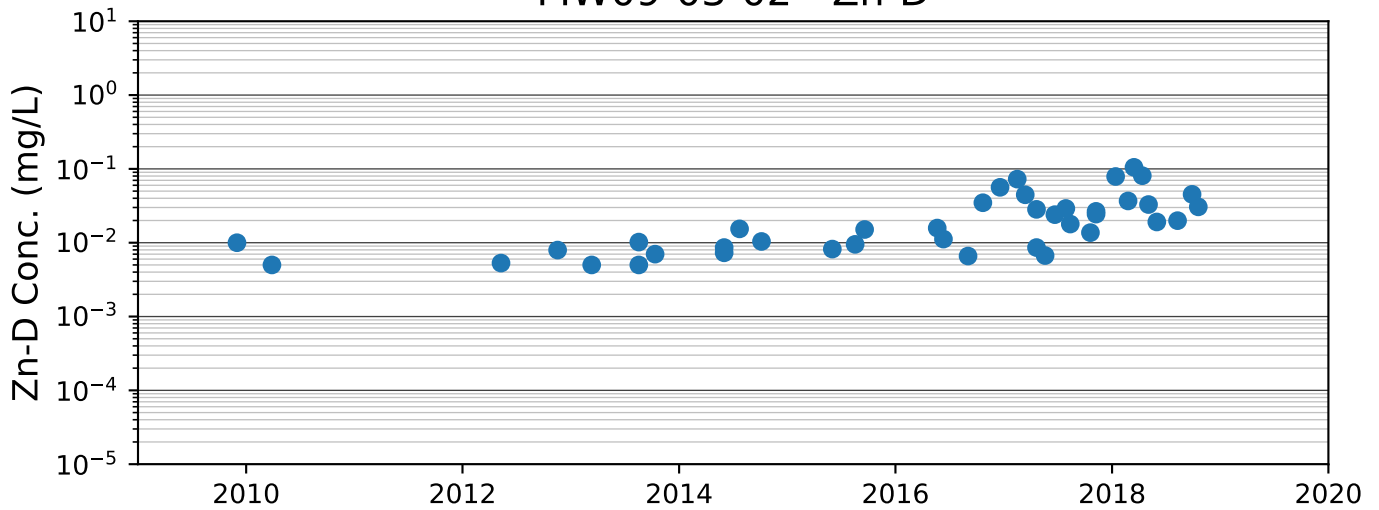


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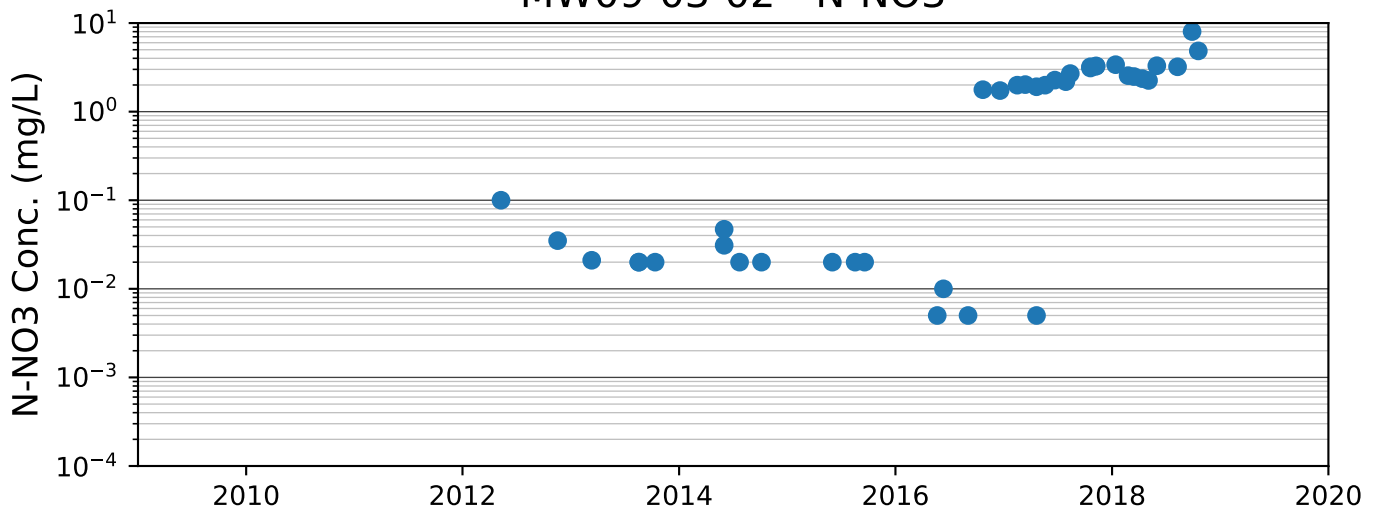
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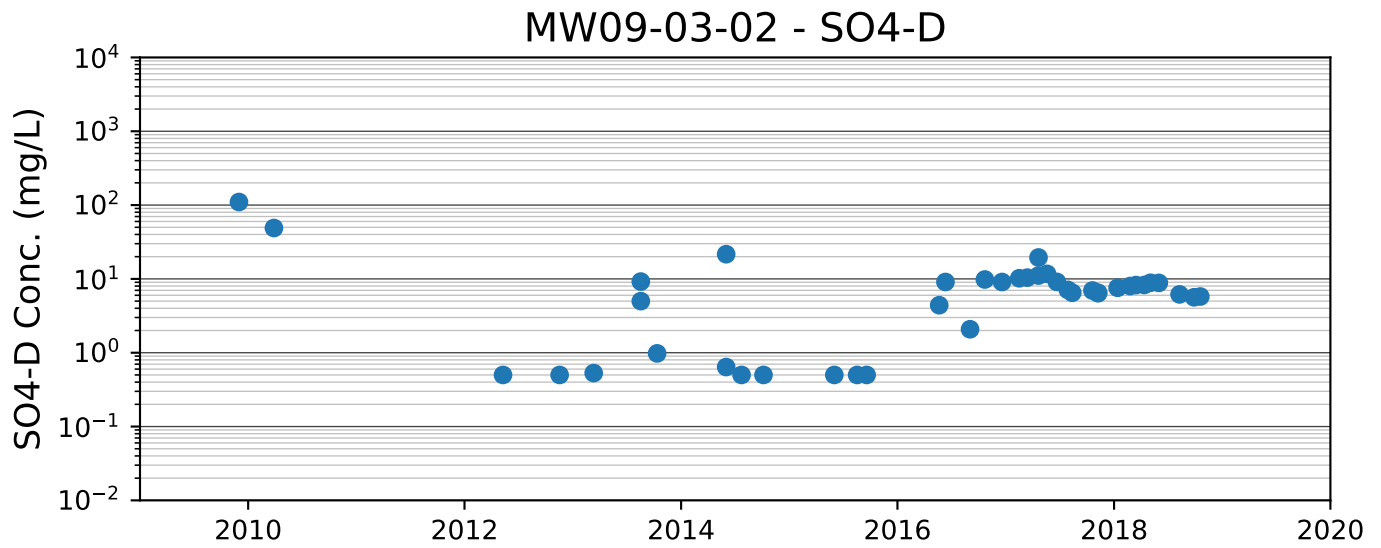


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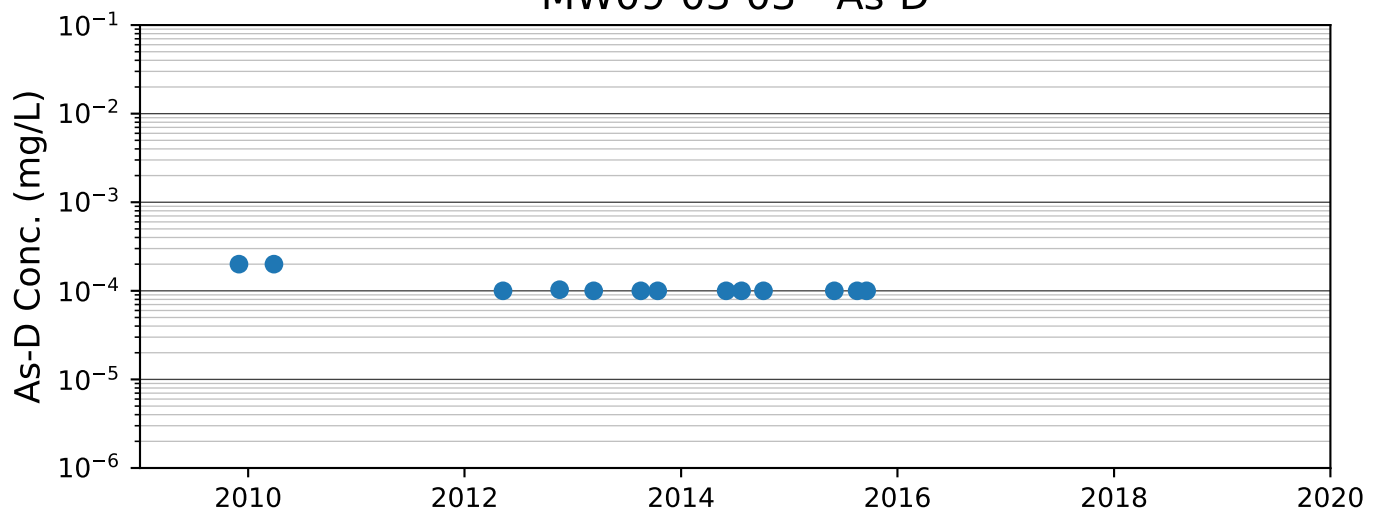
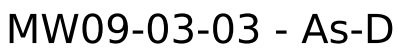
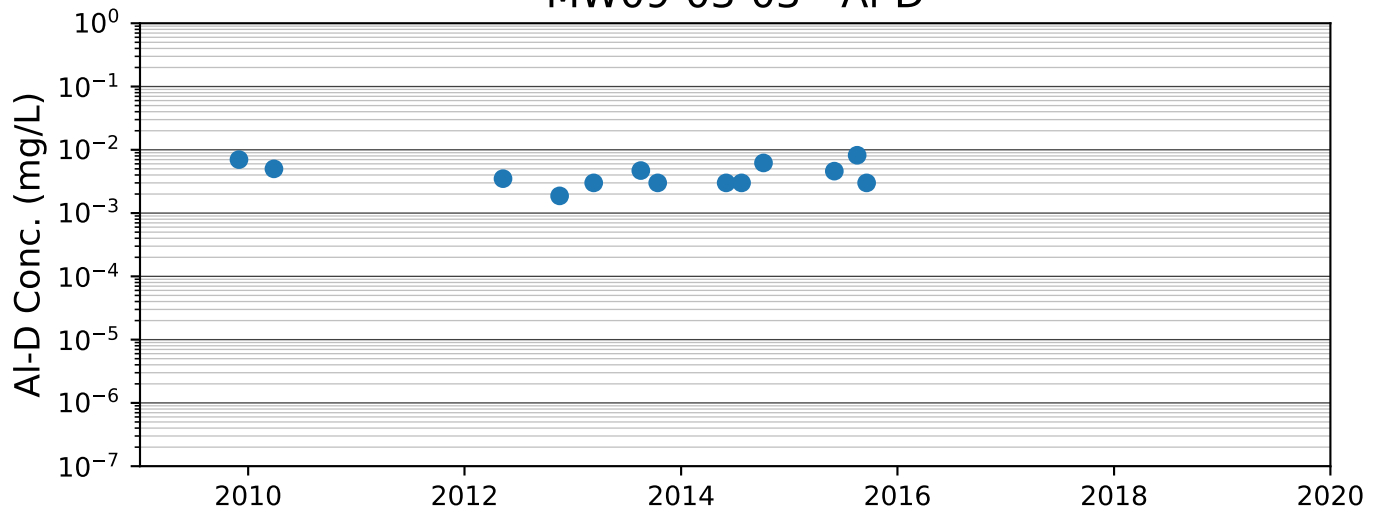
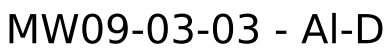
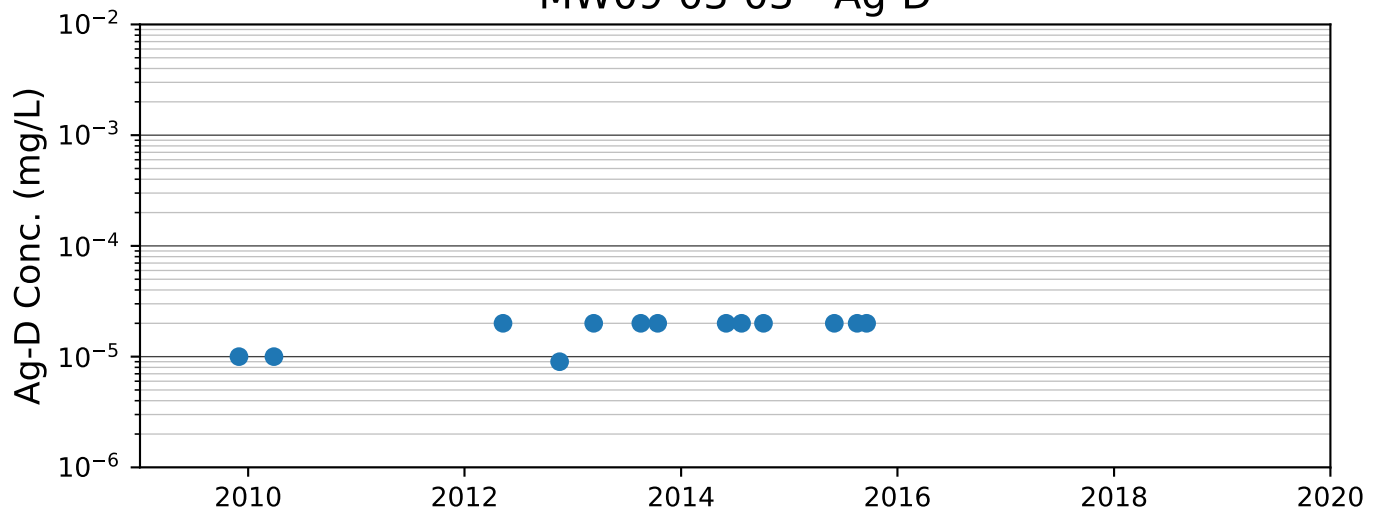
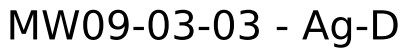


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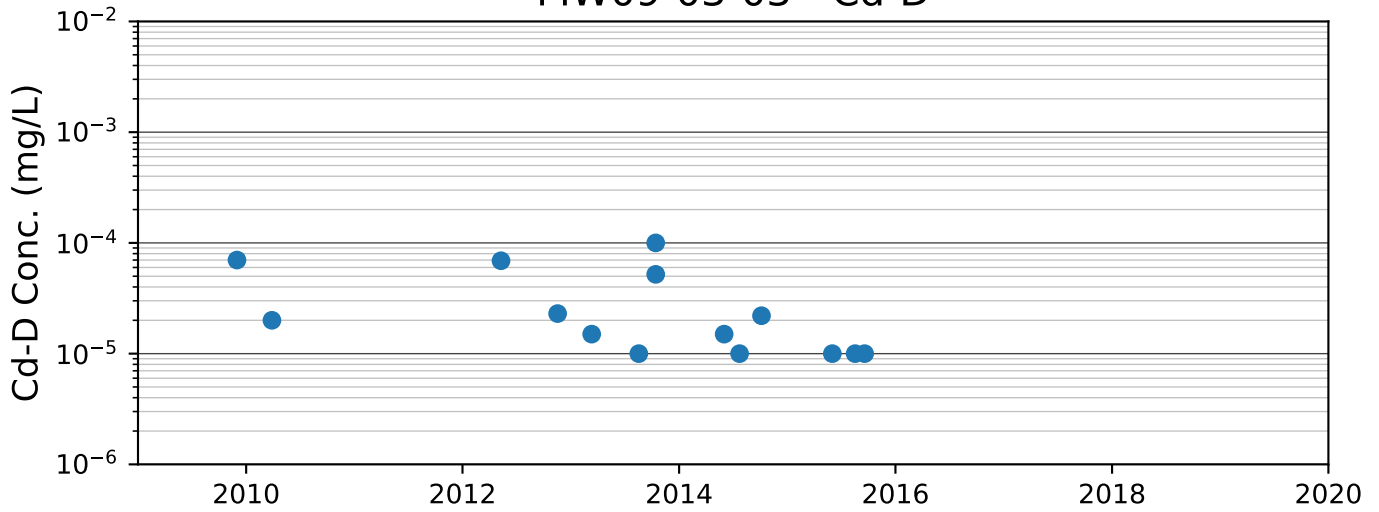




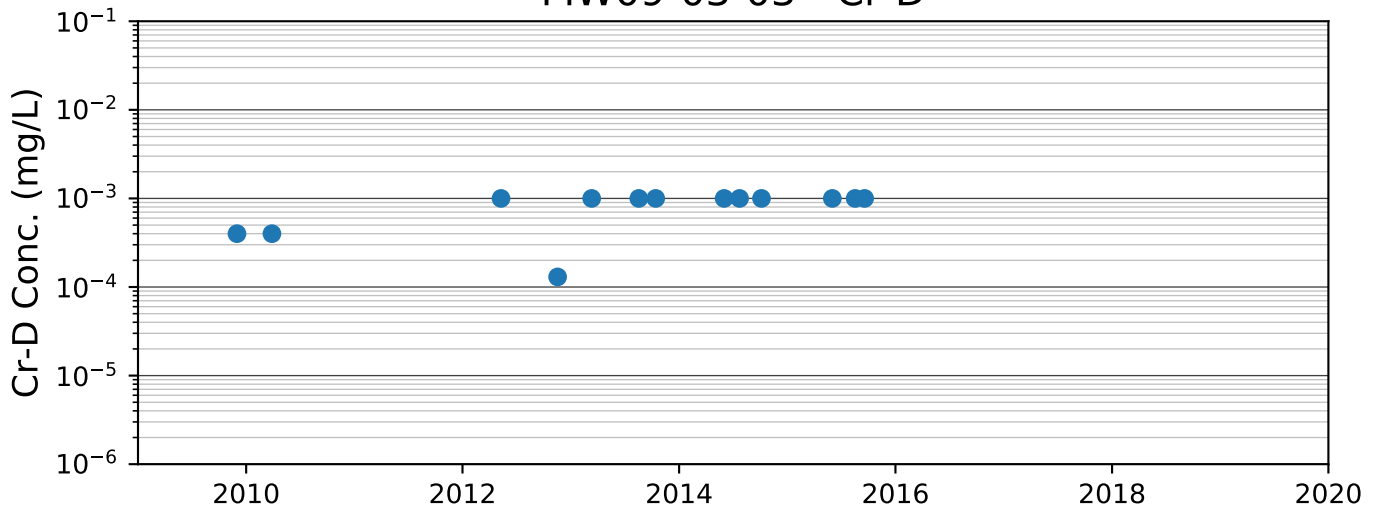
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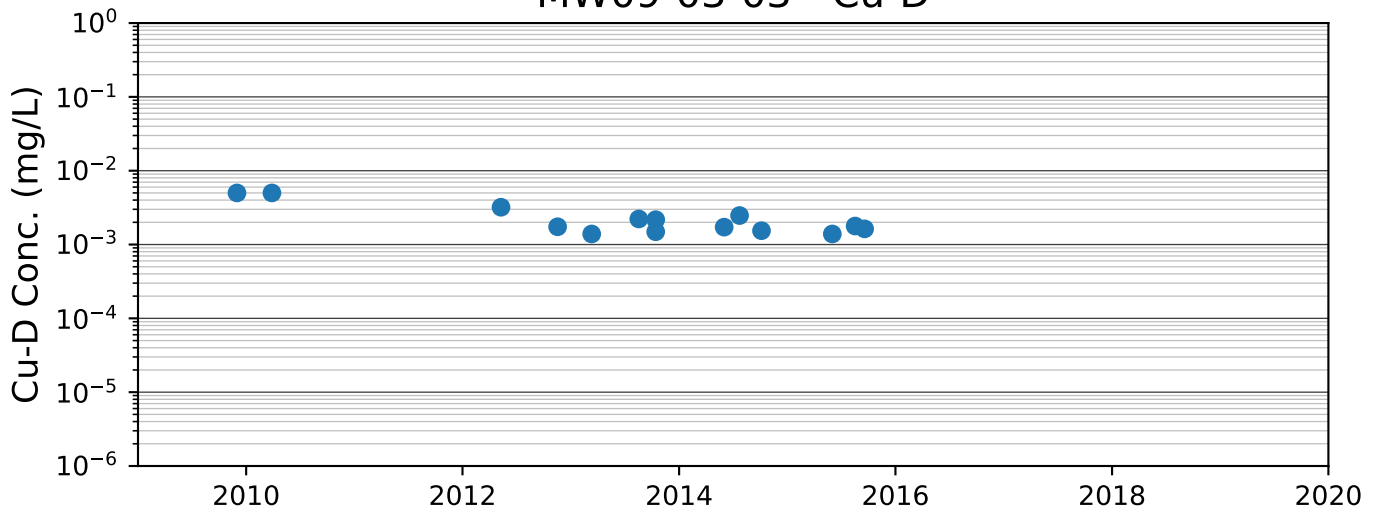
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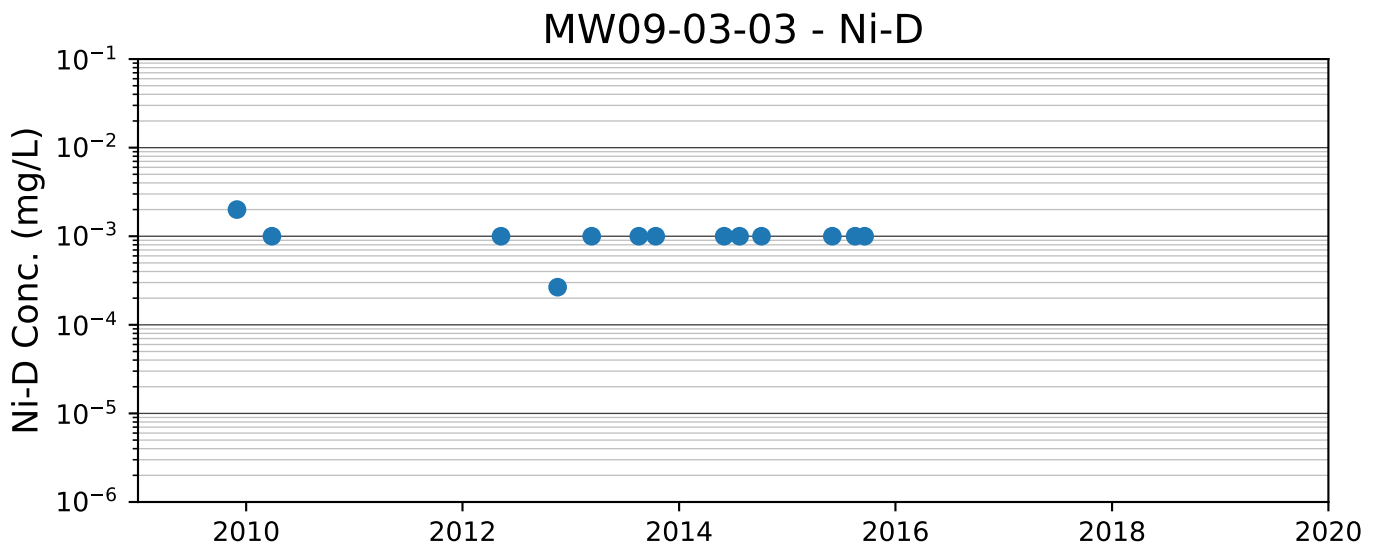
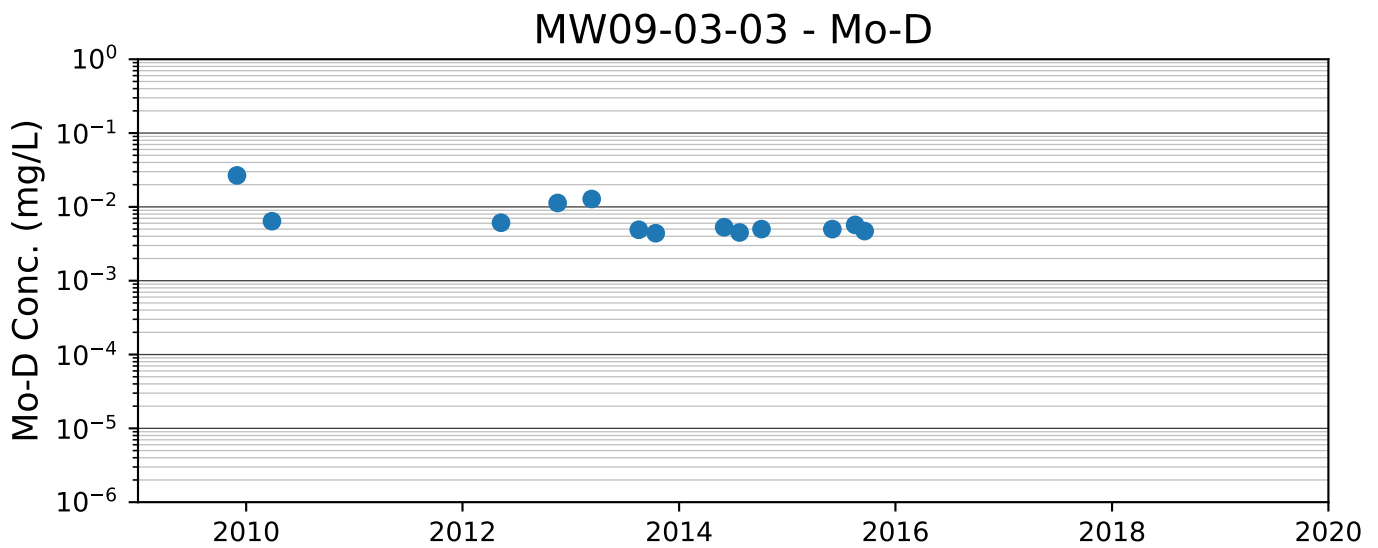
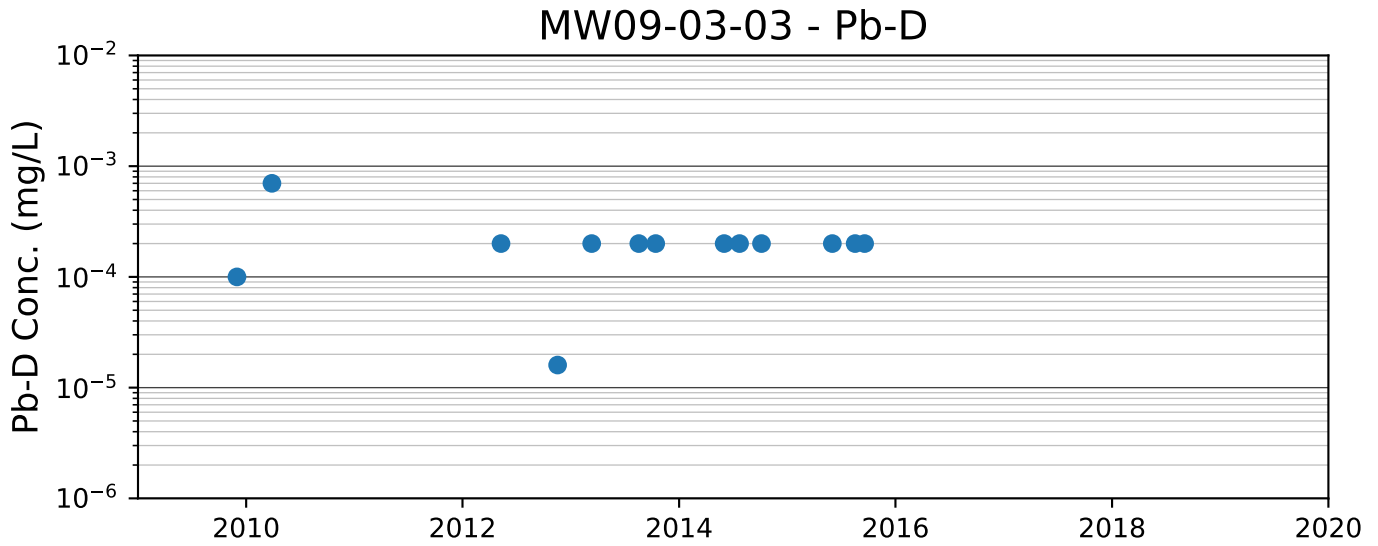
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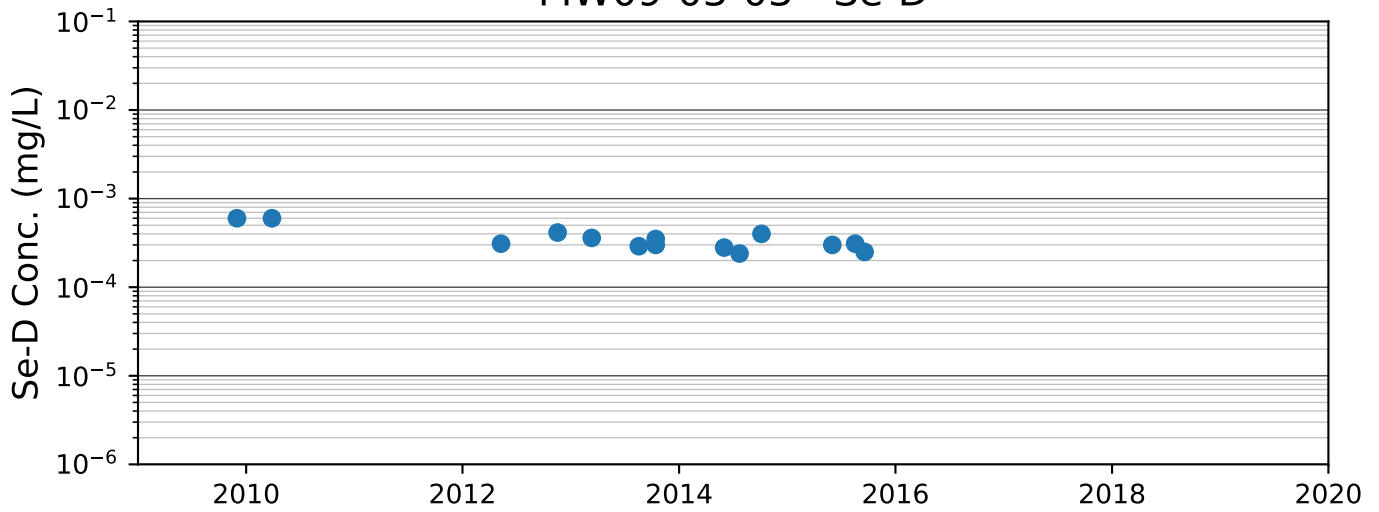
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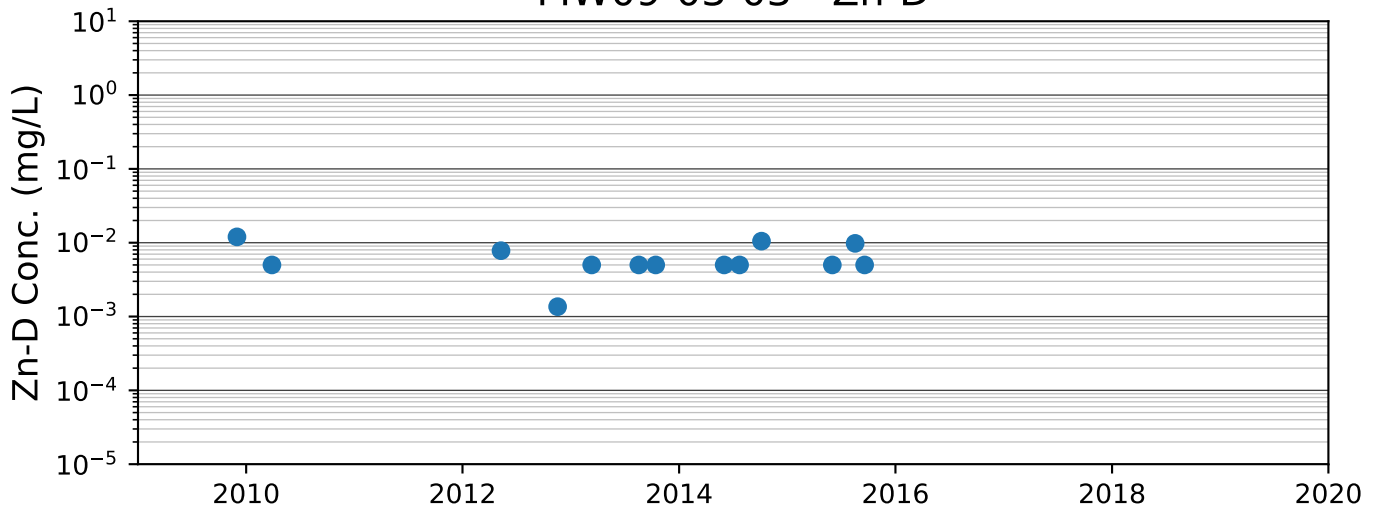
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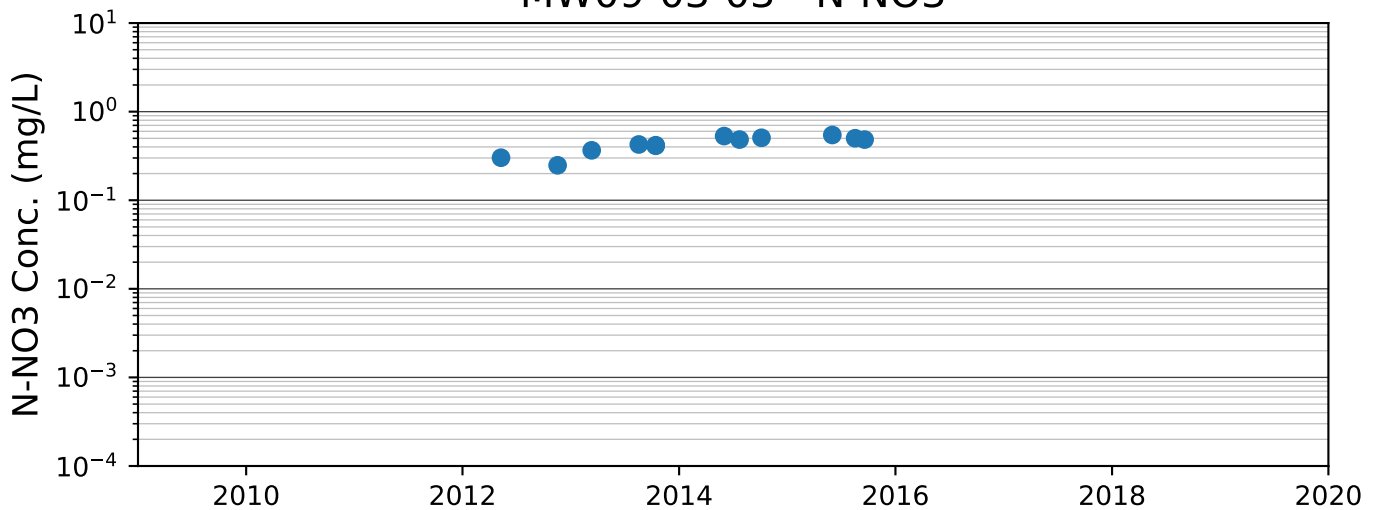
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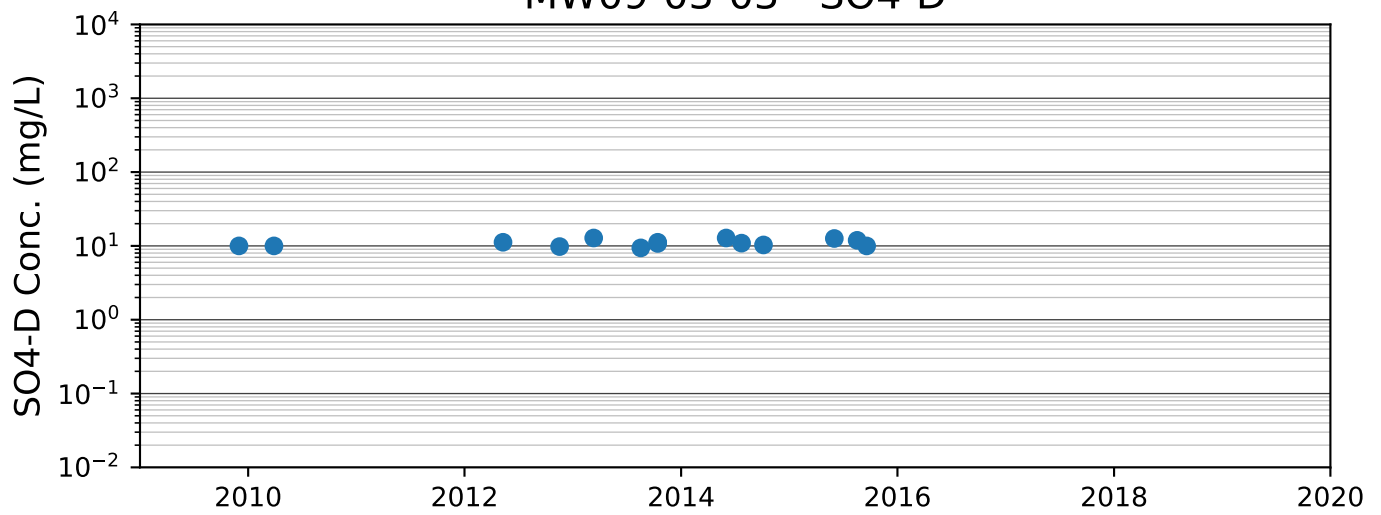
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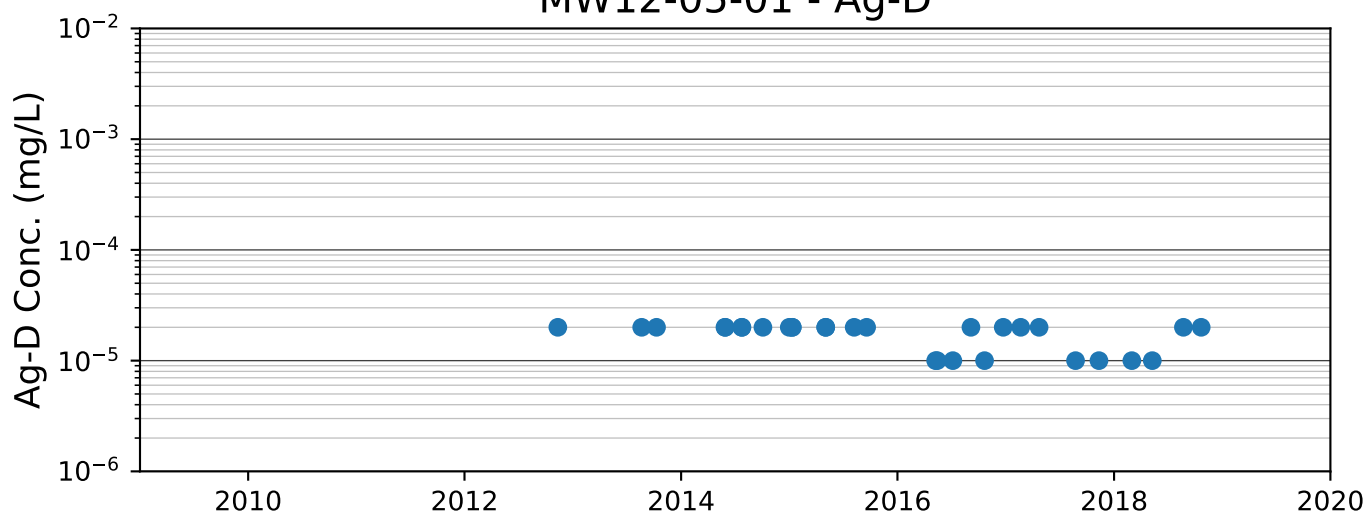


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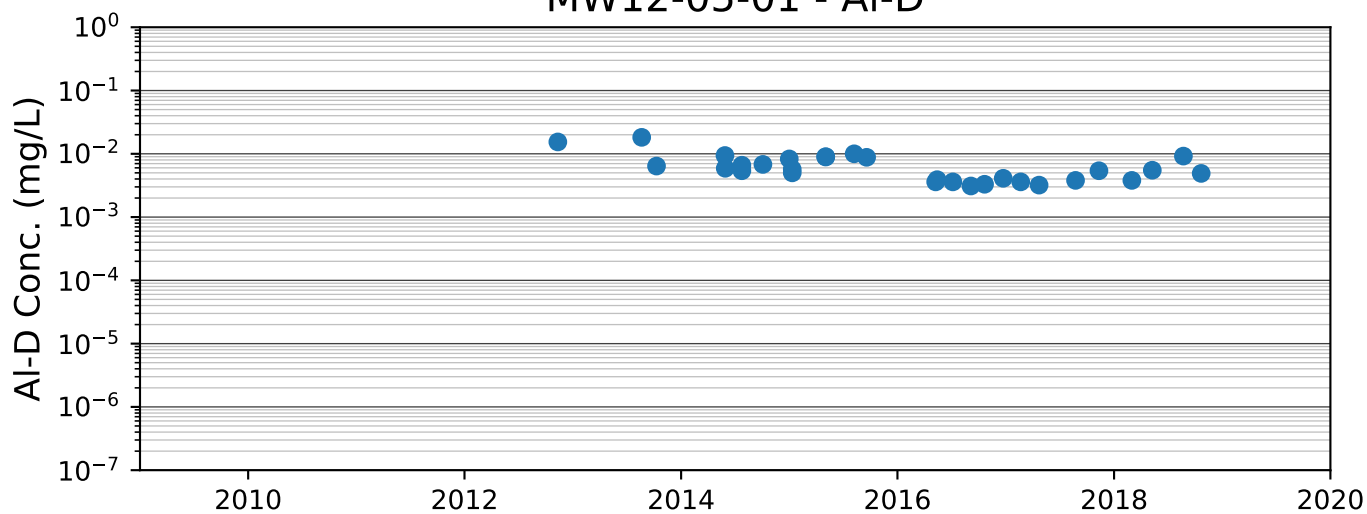


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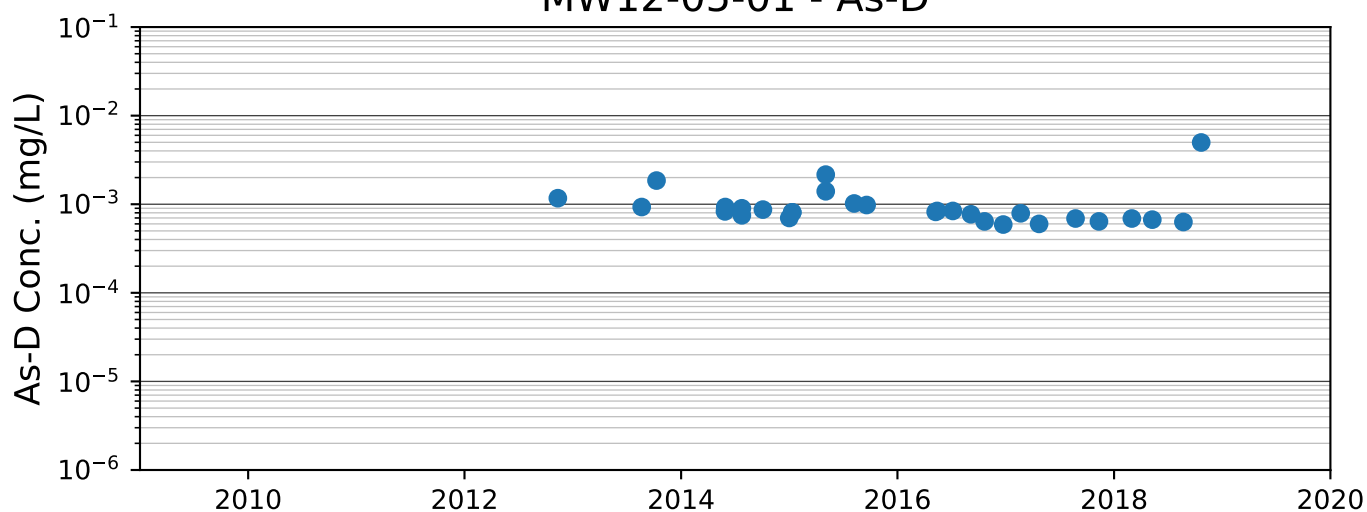
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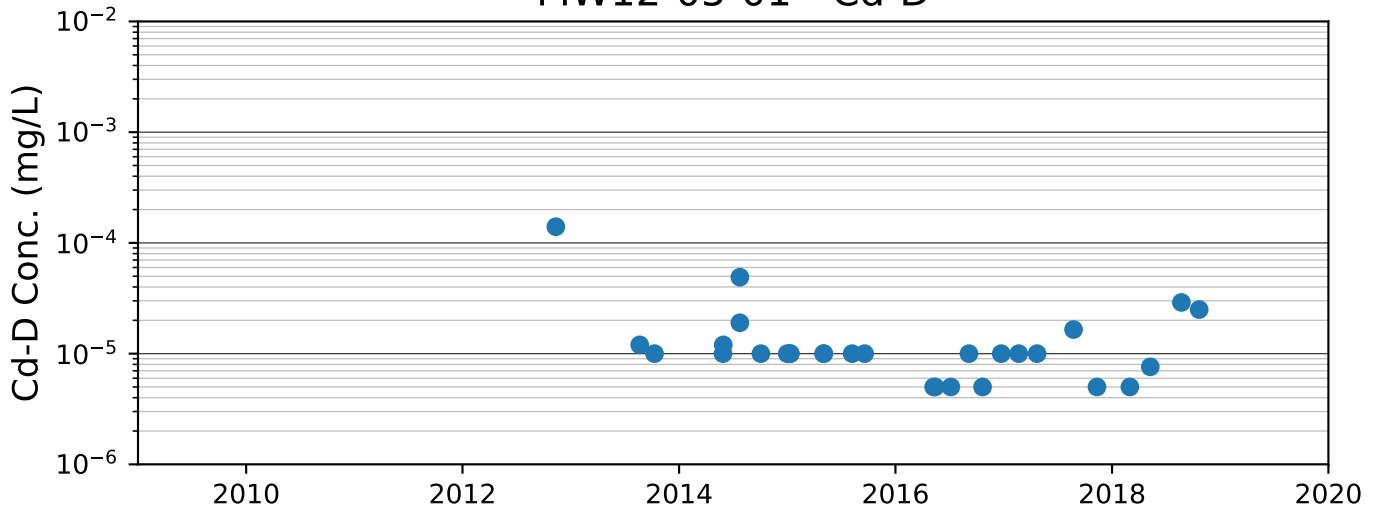


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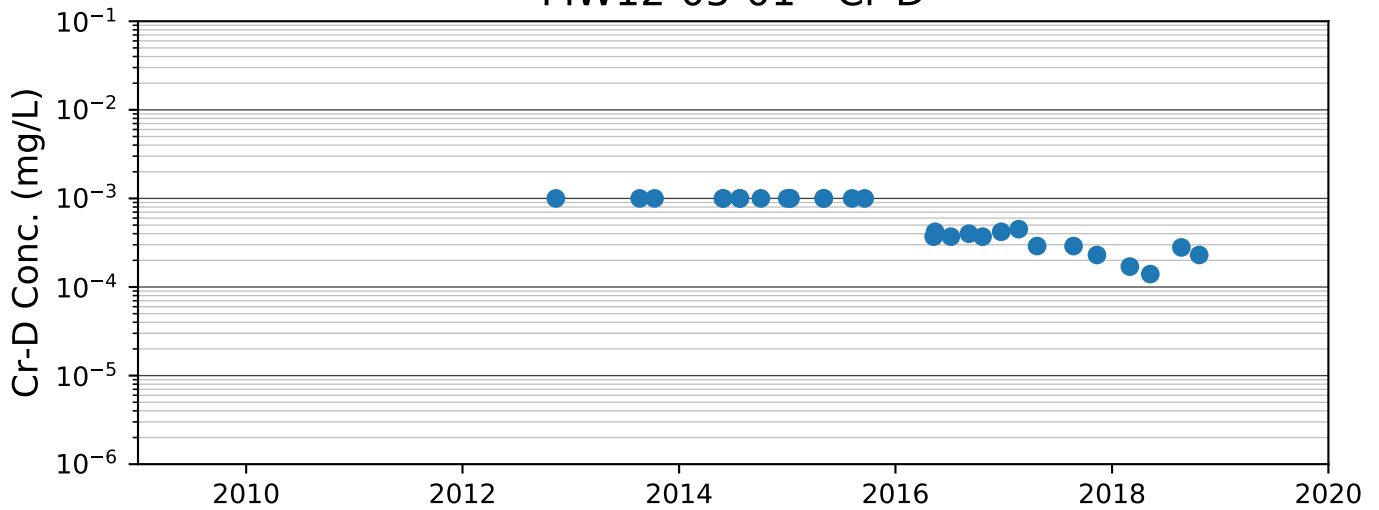


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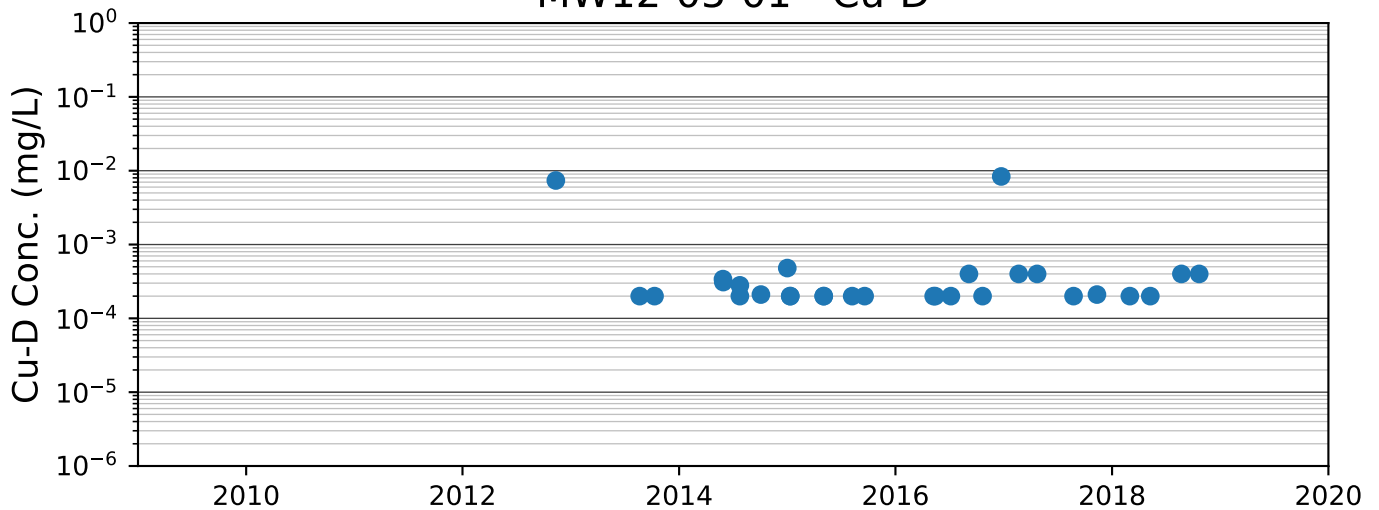
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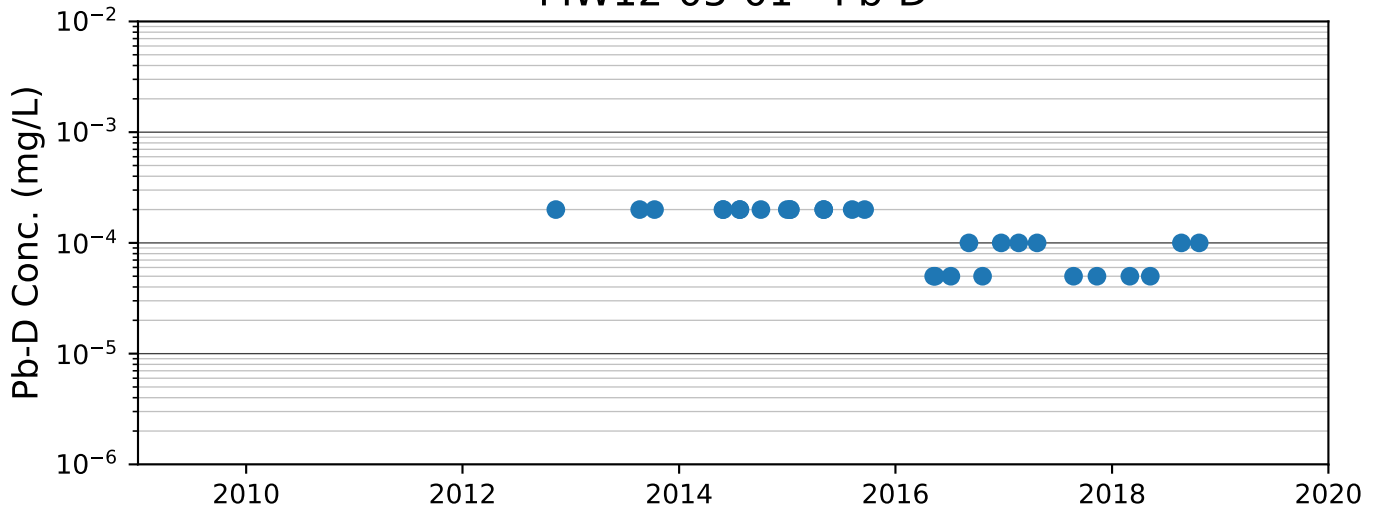


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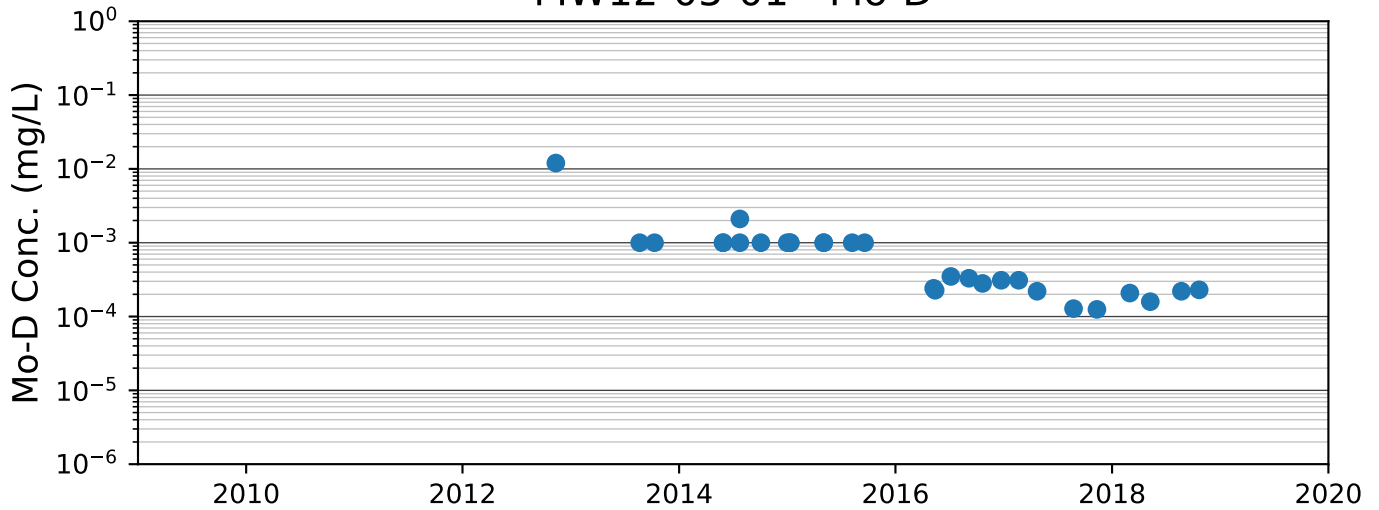


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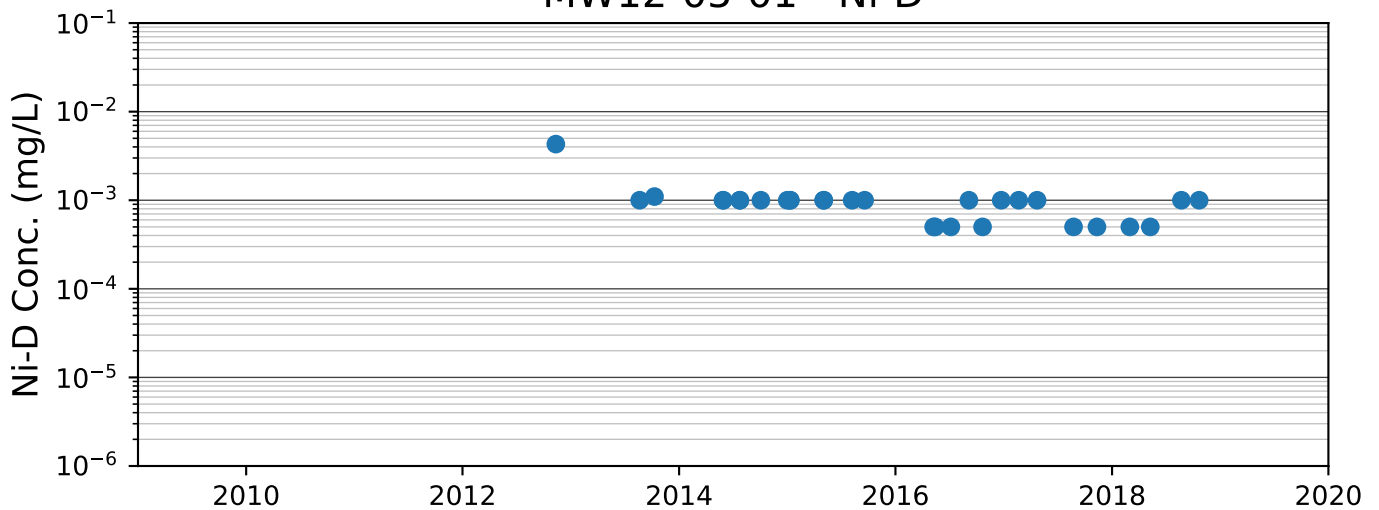
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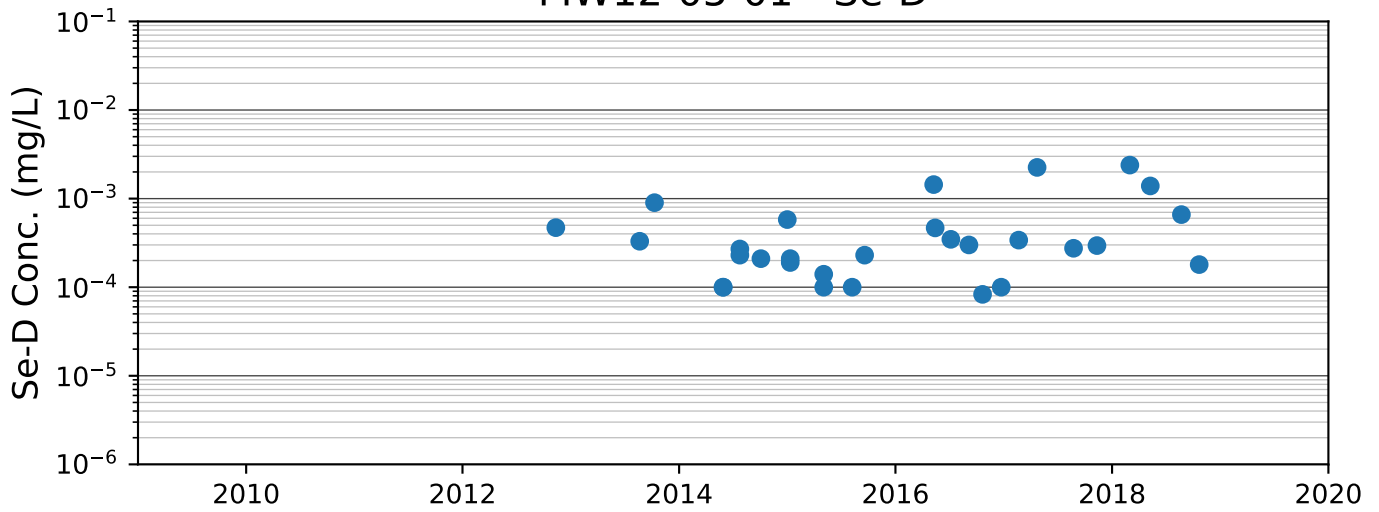


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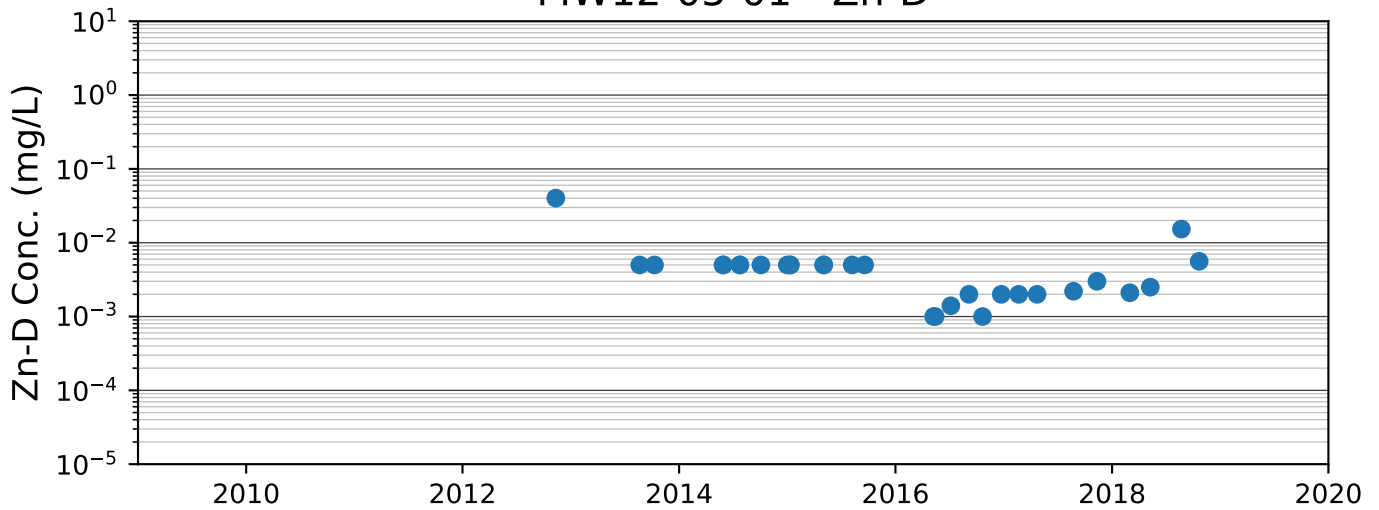


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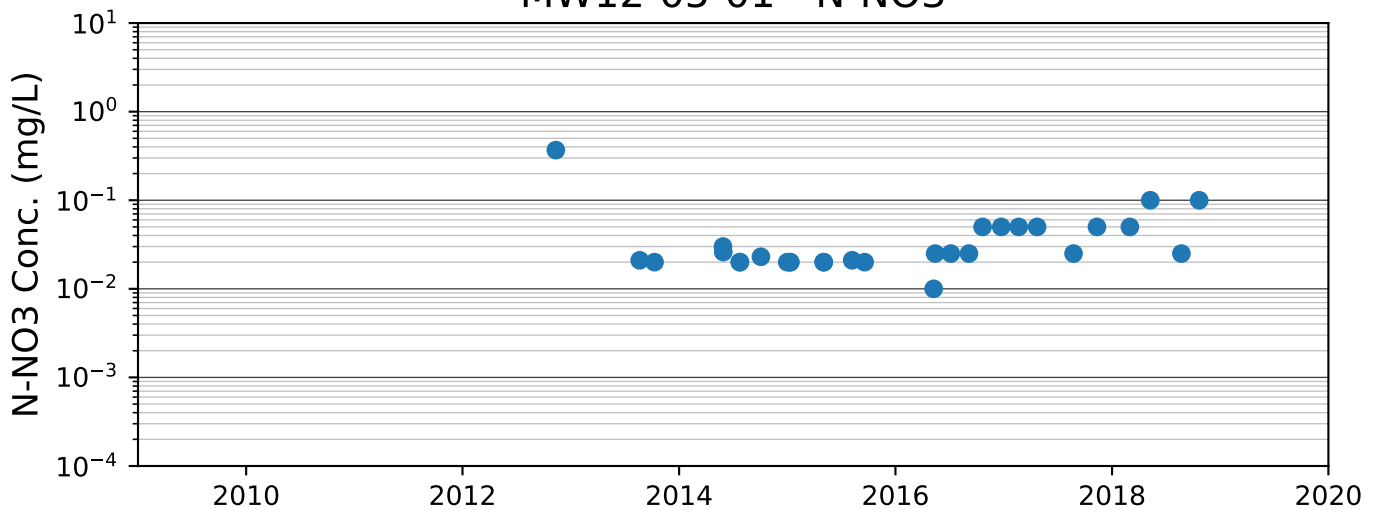
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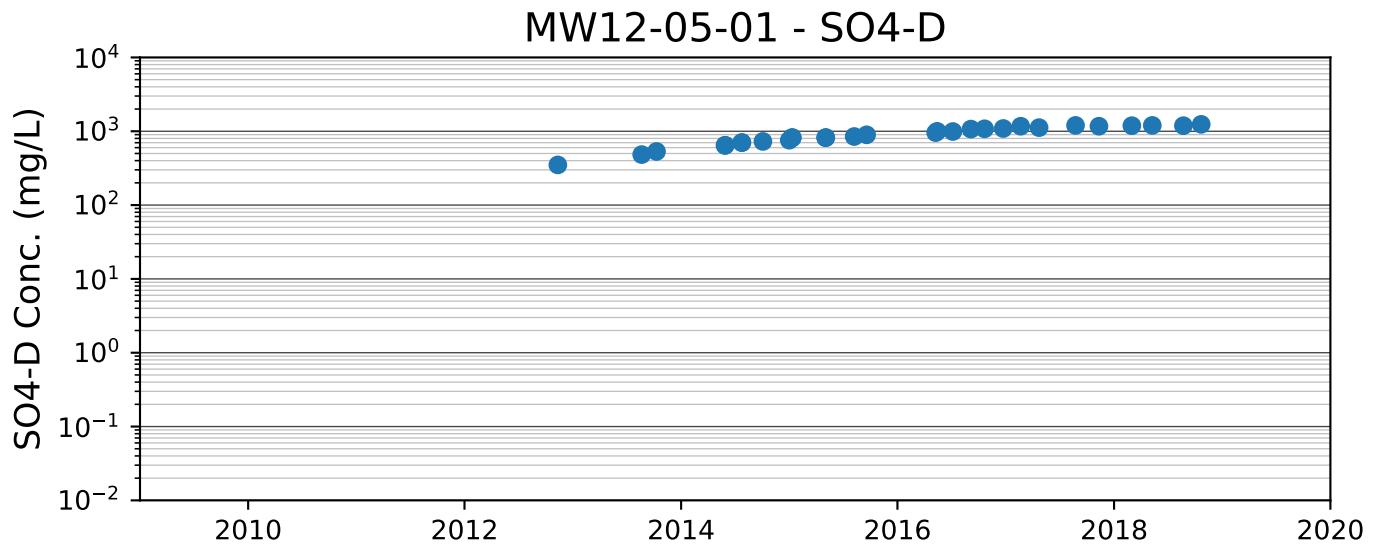


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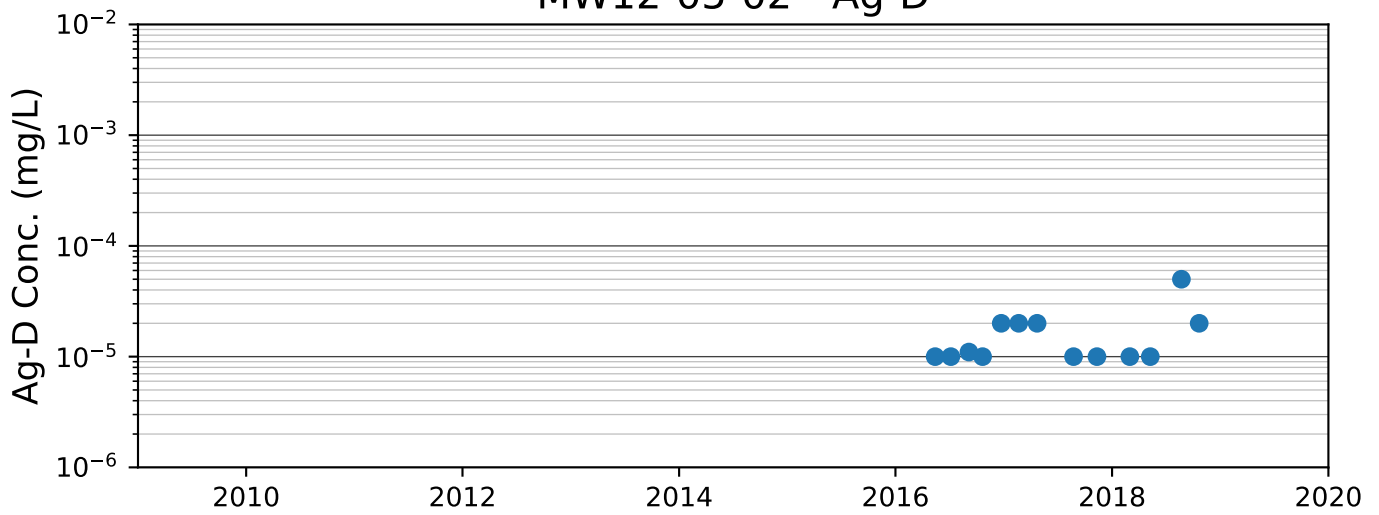


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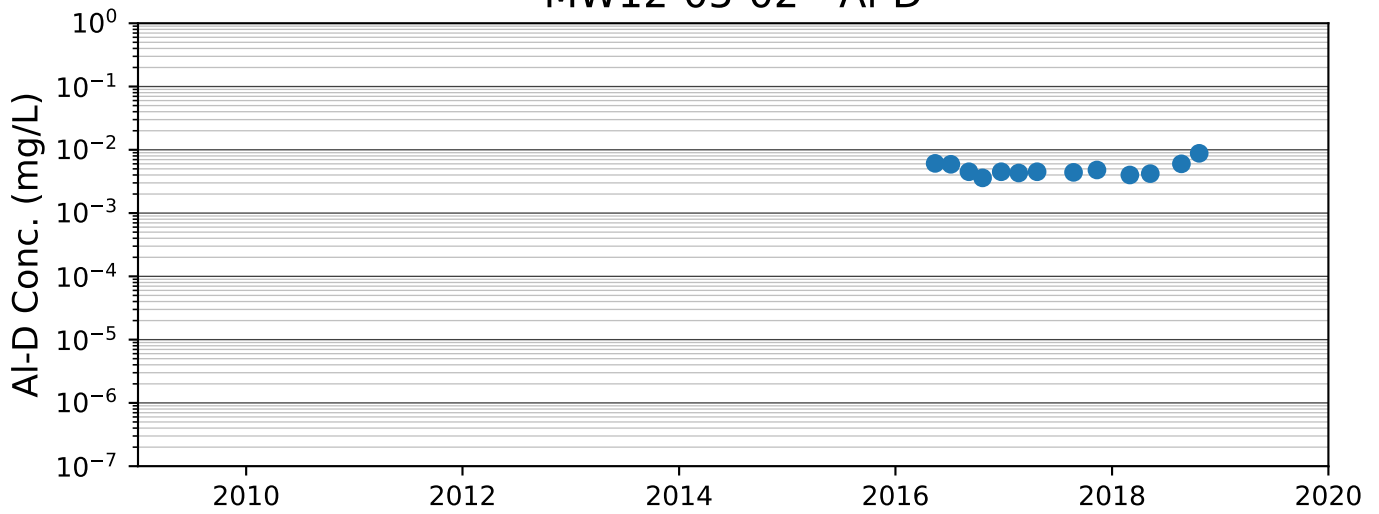




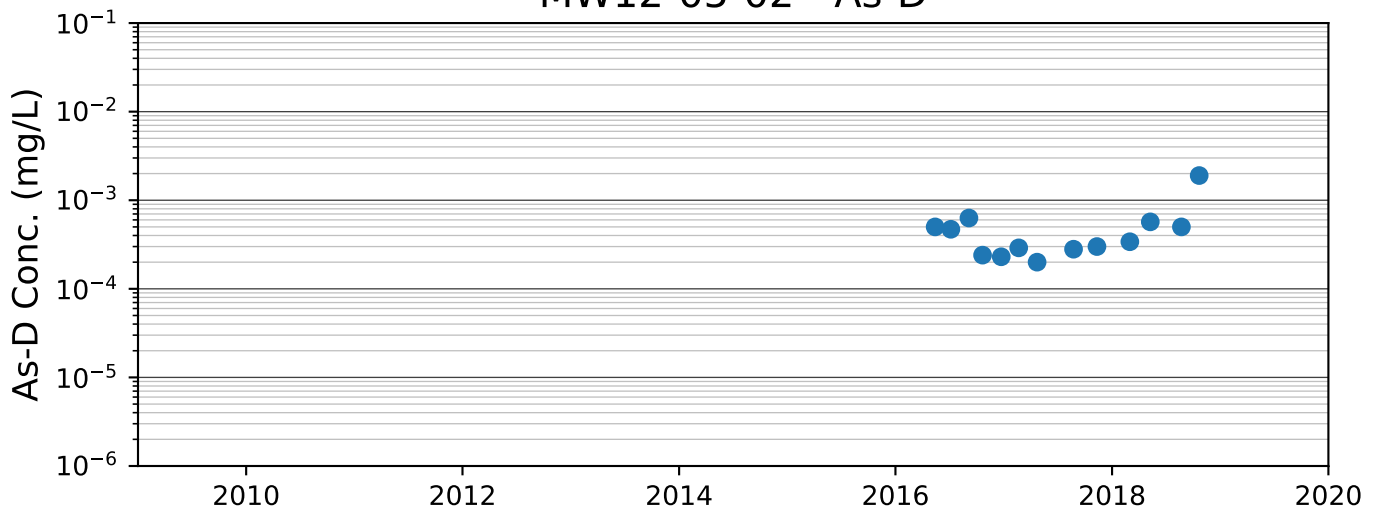
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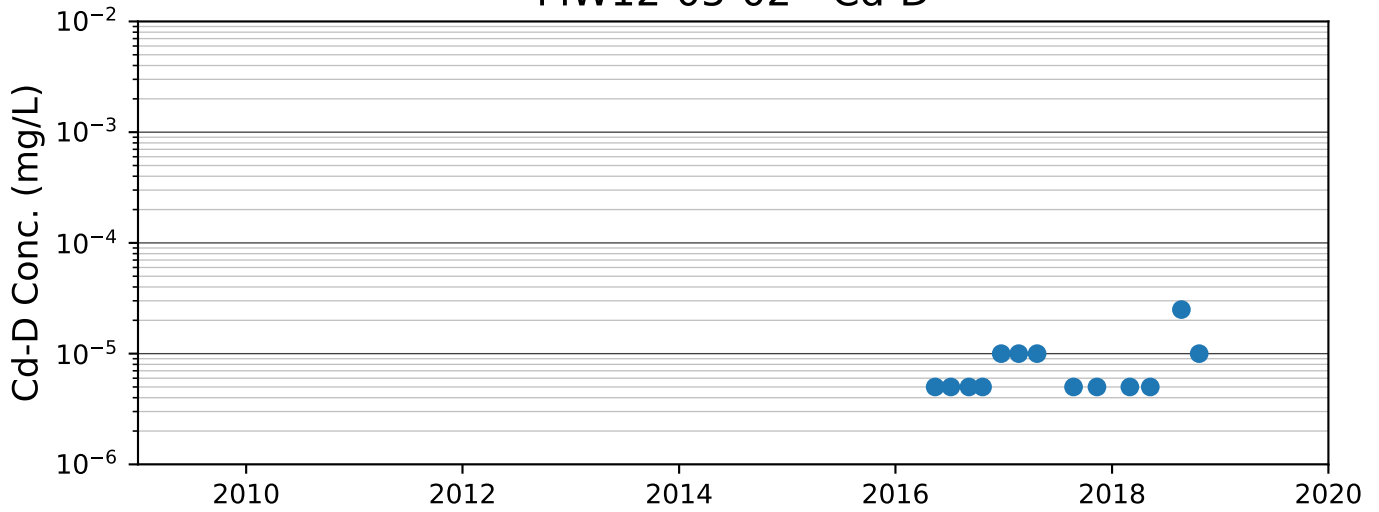


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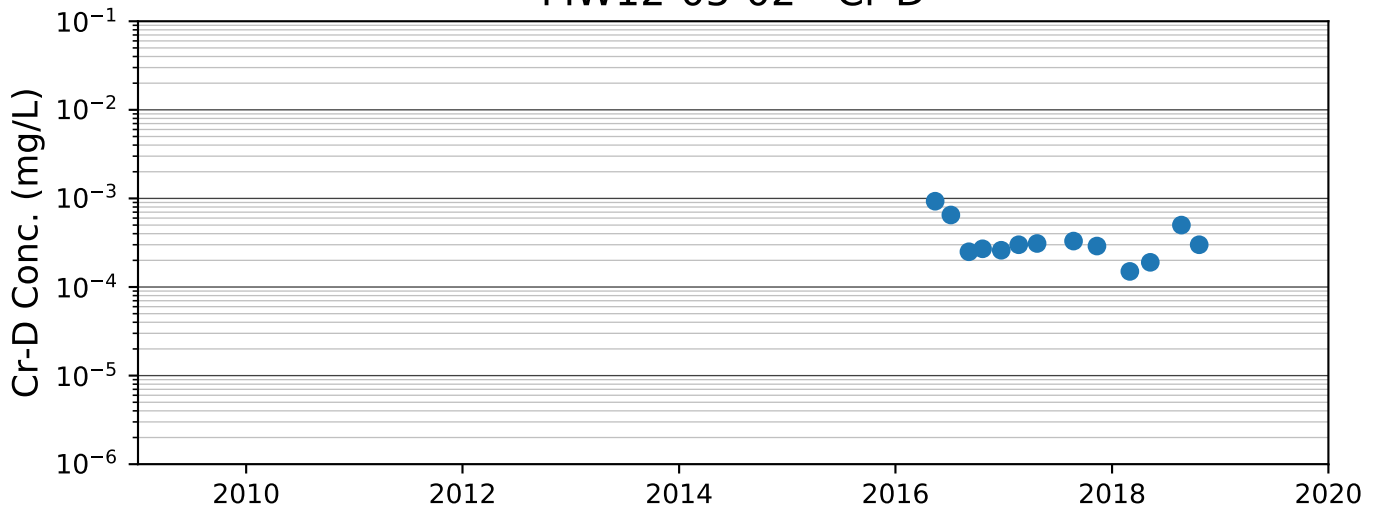


Attachment 2: Groundwater Monitoring Data for All CoCs

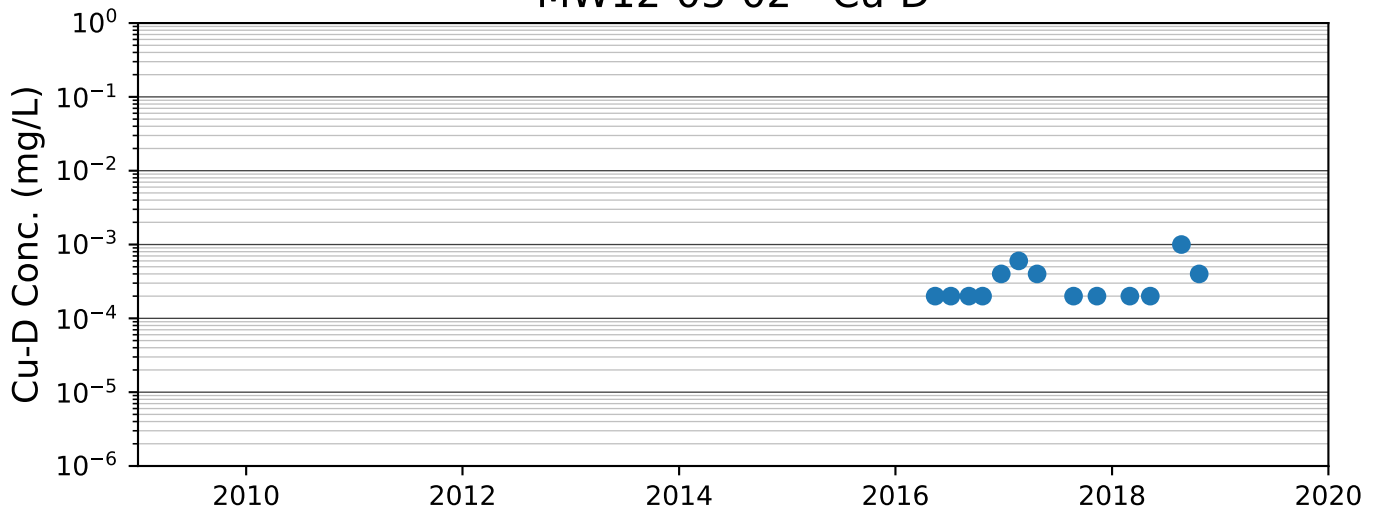
MW12-05-02 - Cd-D



MW12-05-02 - Cr-D

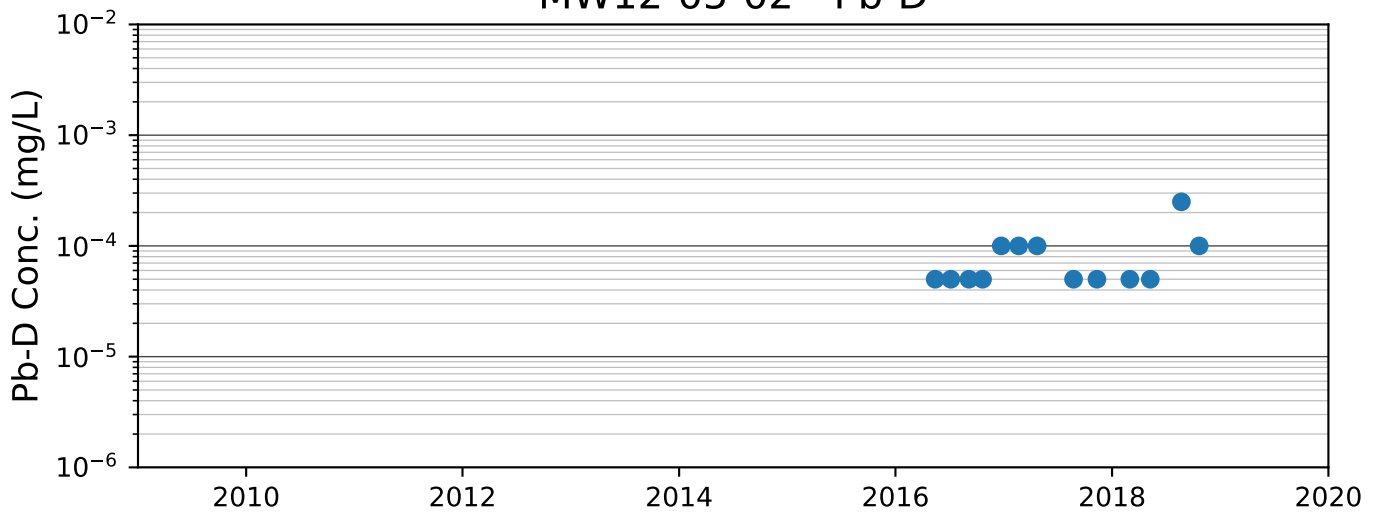


MW12-05-02 - Cu-D

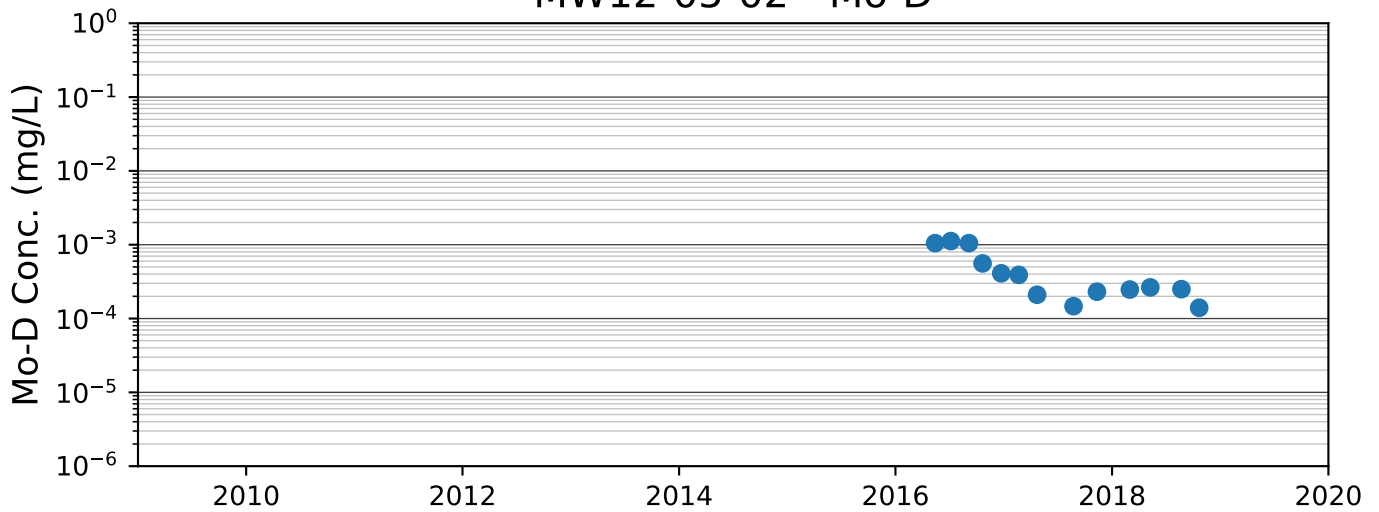


Attachment 2: Groundwater Monitoring Data for All CoCs

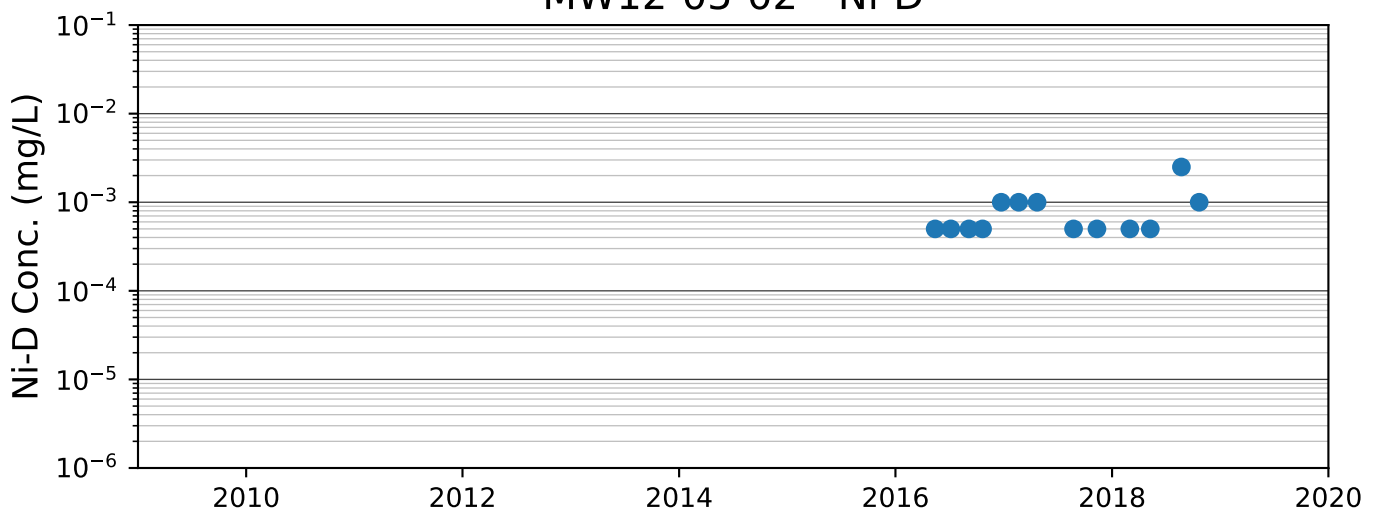
MW12-05-02 - Pb-D



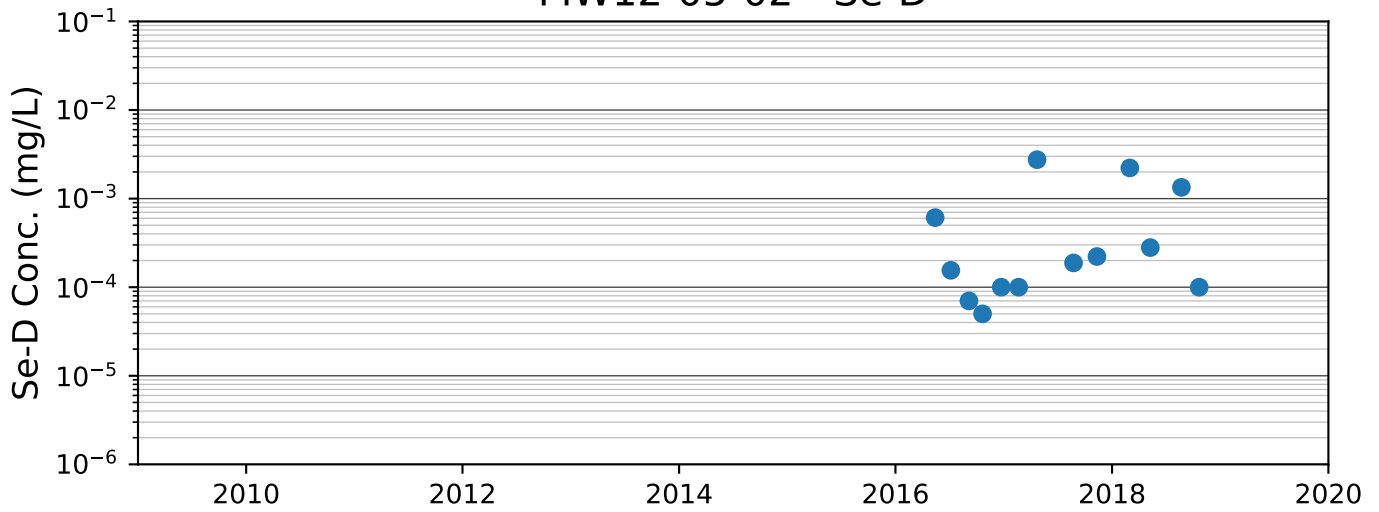
MW12-05-02 - Mo-D



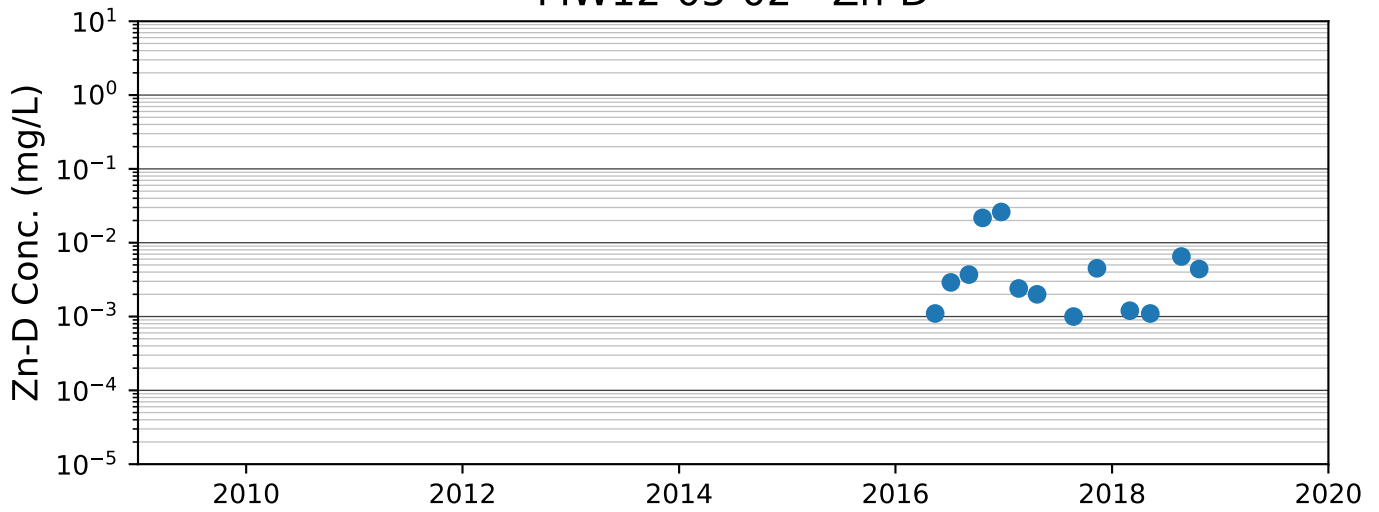
MW12-05-02 - Ni-D



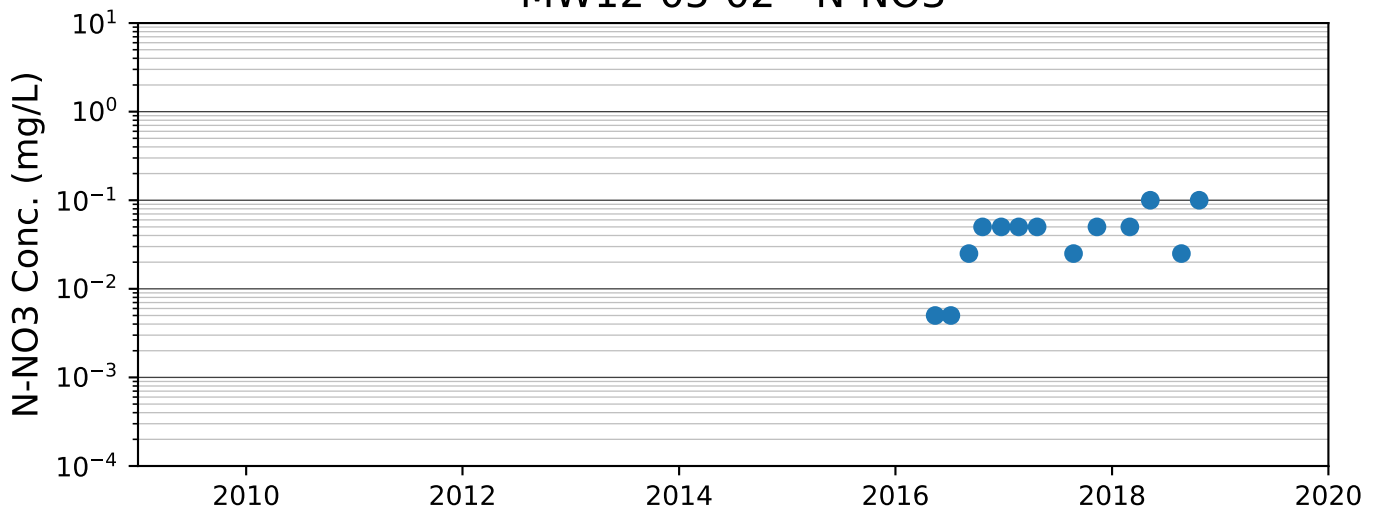
MW12-05-02 - Se-D



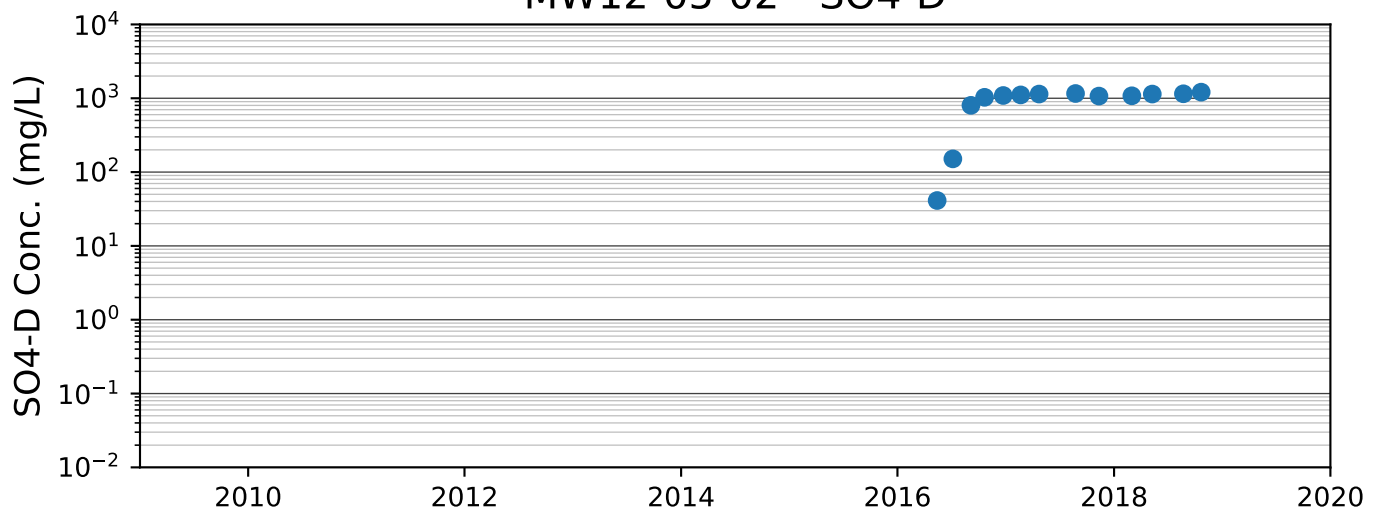
MW12-05-02 - Zn-D



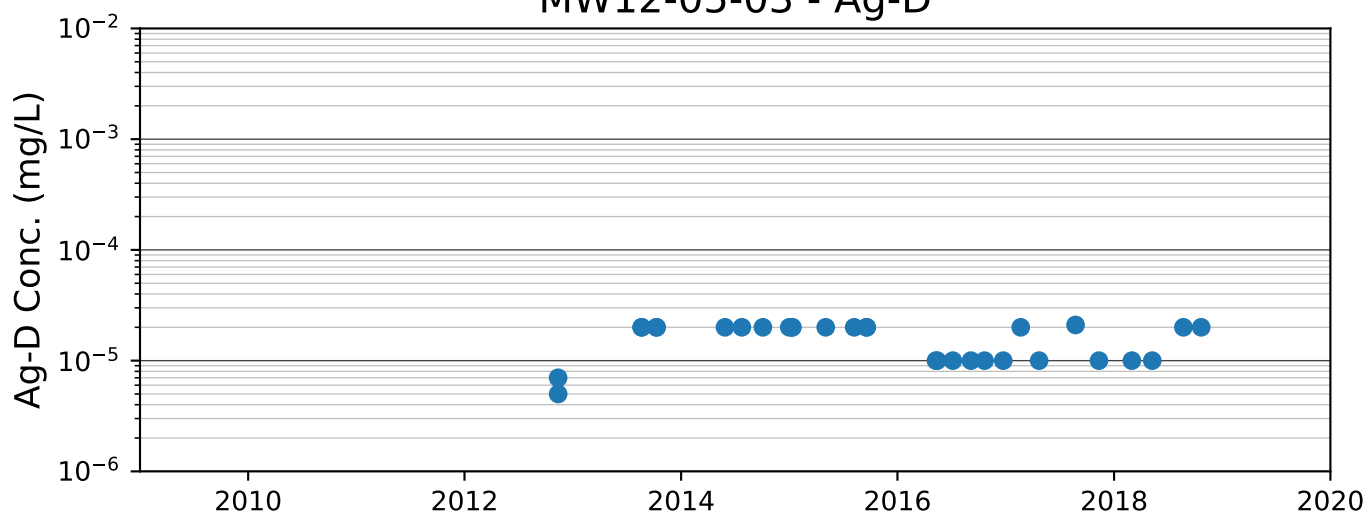
MW12-05-02 - N-NO3



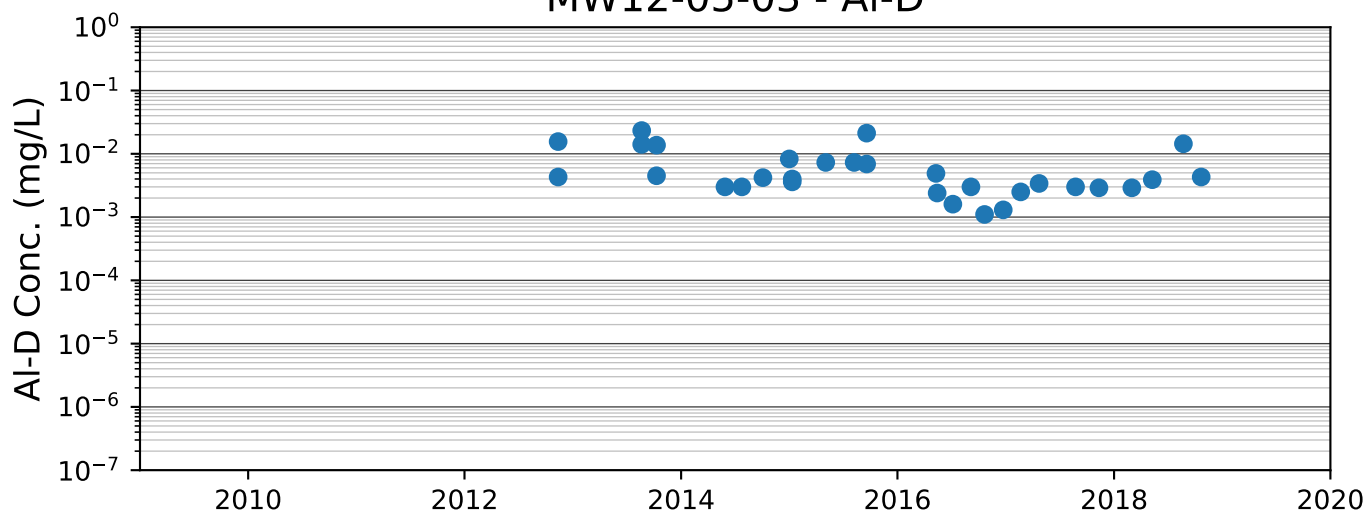
MW12-05-02 - SO4-D



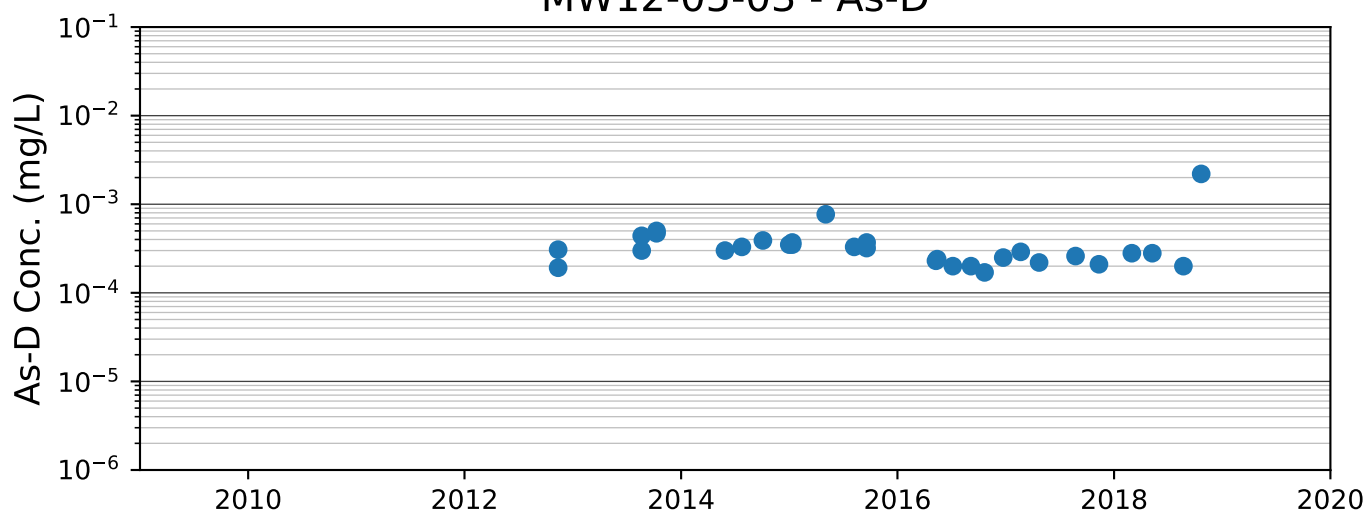
MW12-05-03 - Ag-D



MW12-05-03 - Al-D

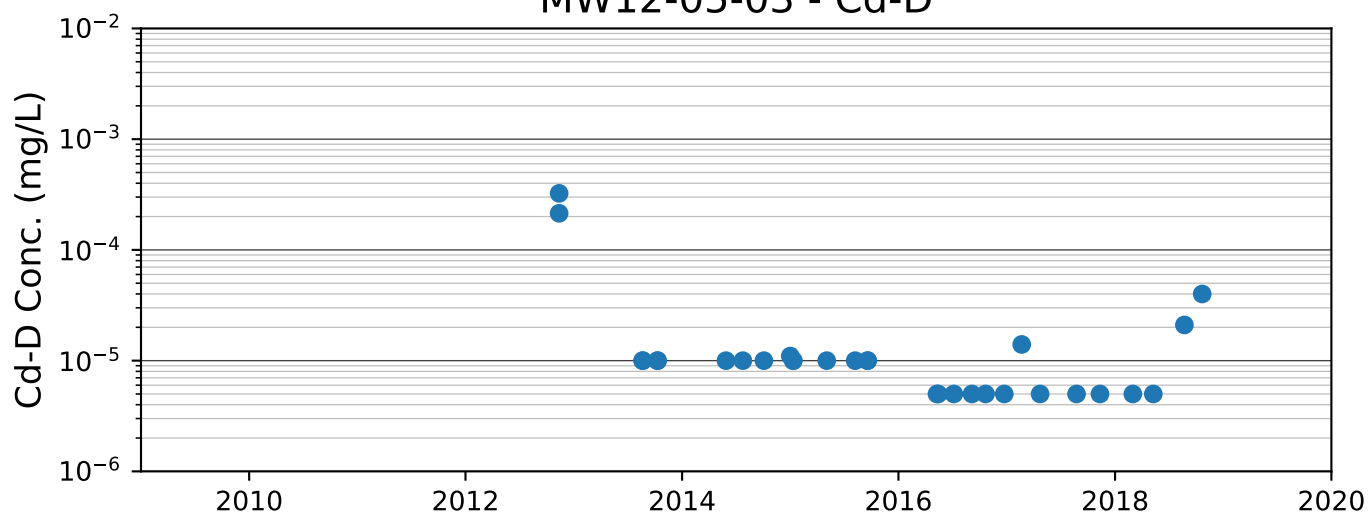


MW12-05-03 - As-D

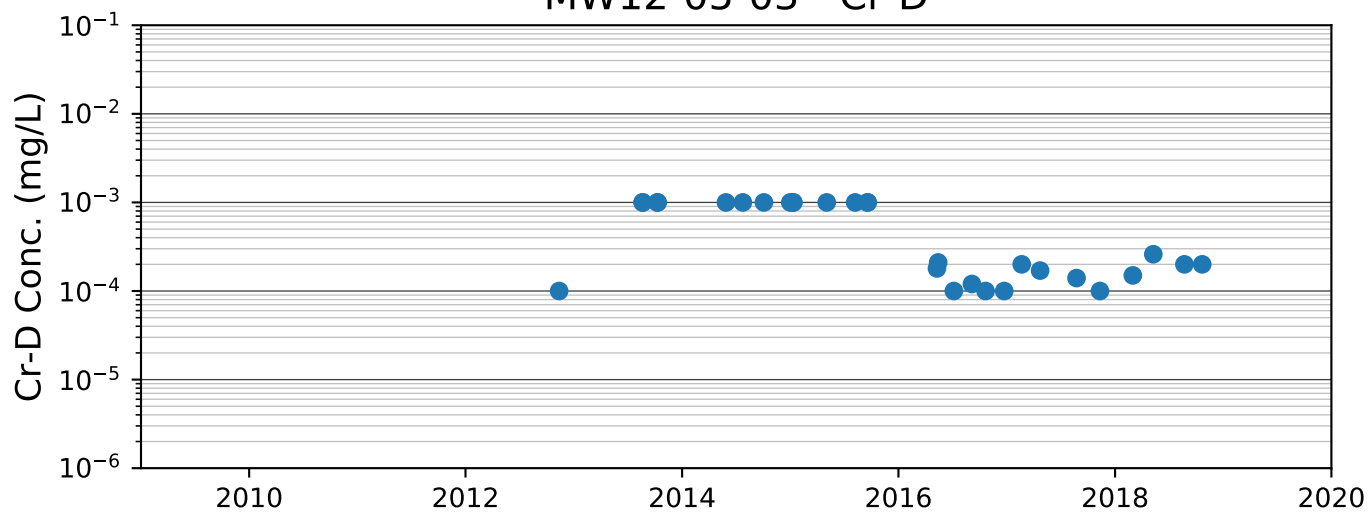


Attachment 2: Groundwater Monitoring Data for All CoCs

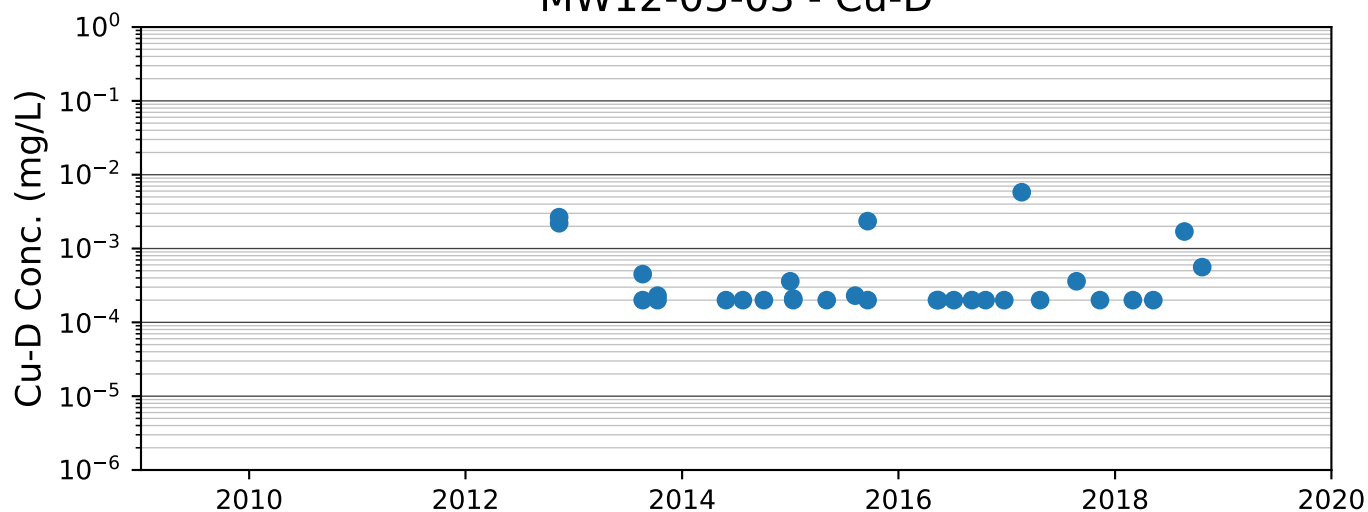
MW12-05-03 - Cd-D



MW12-05-03 - Cr-D

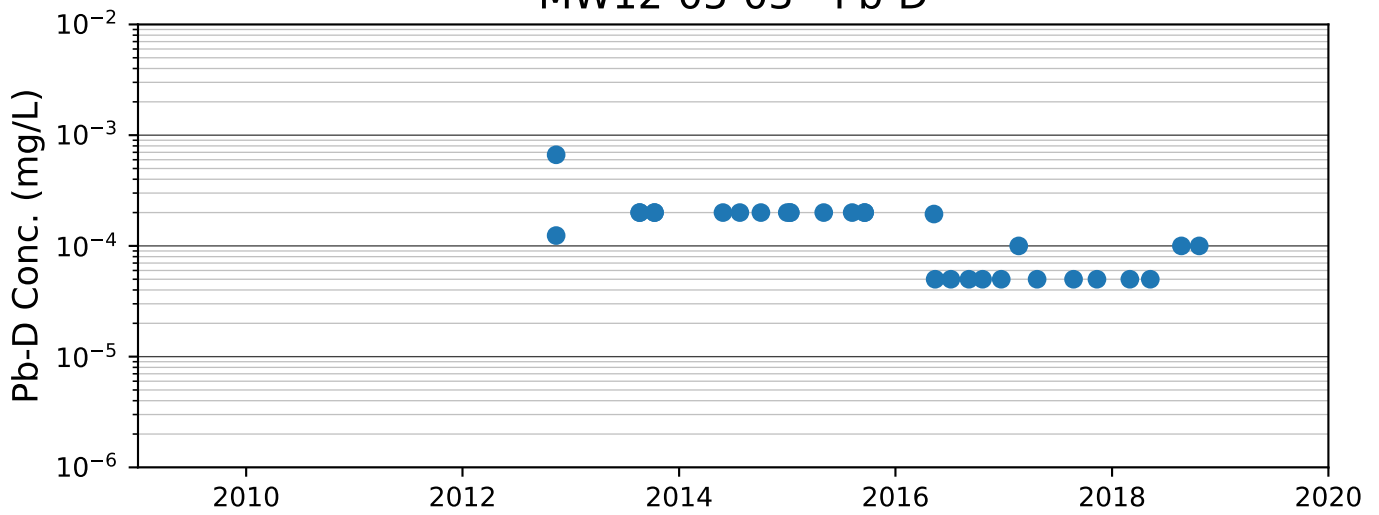


MW12-05-03 - Cu-D

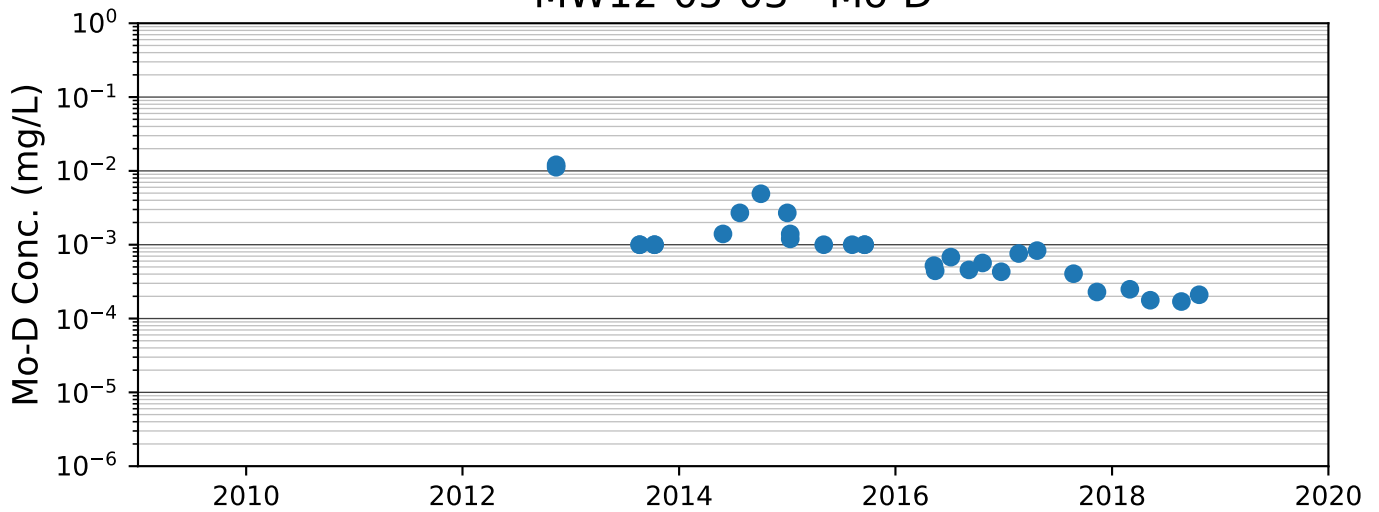


Attachment 2: Groundwater Monitoring Data for All CoCs

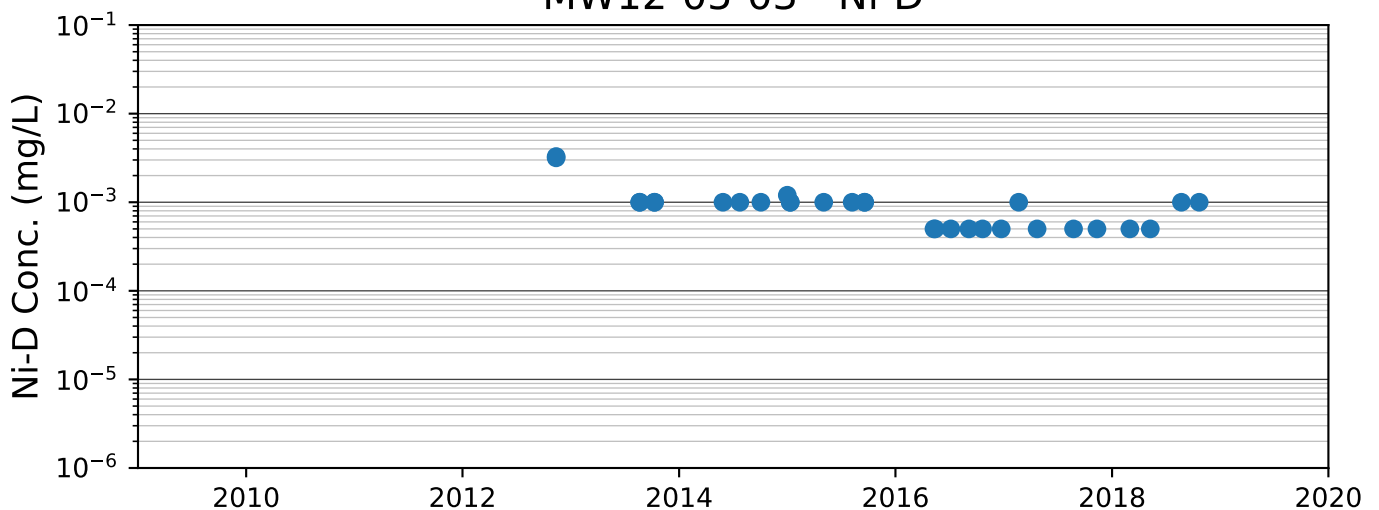
MW12-05-03 - Pb-D



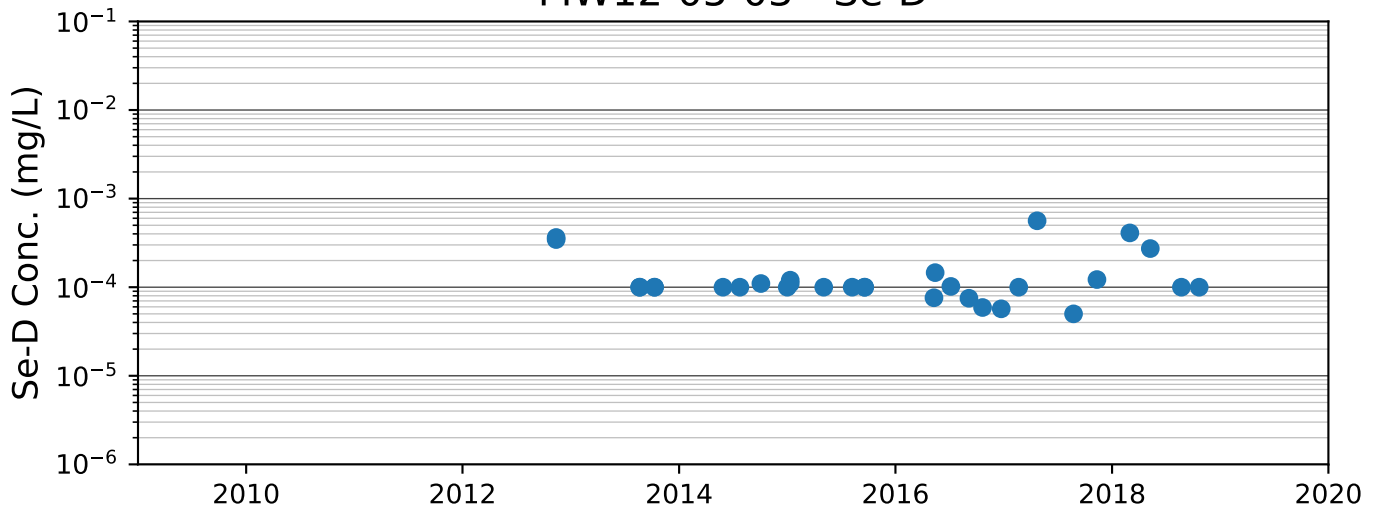
MW12-05-03 - Mo-D



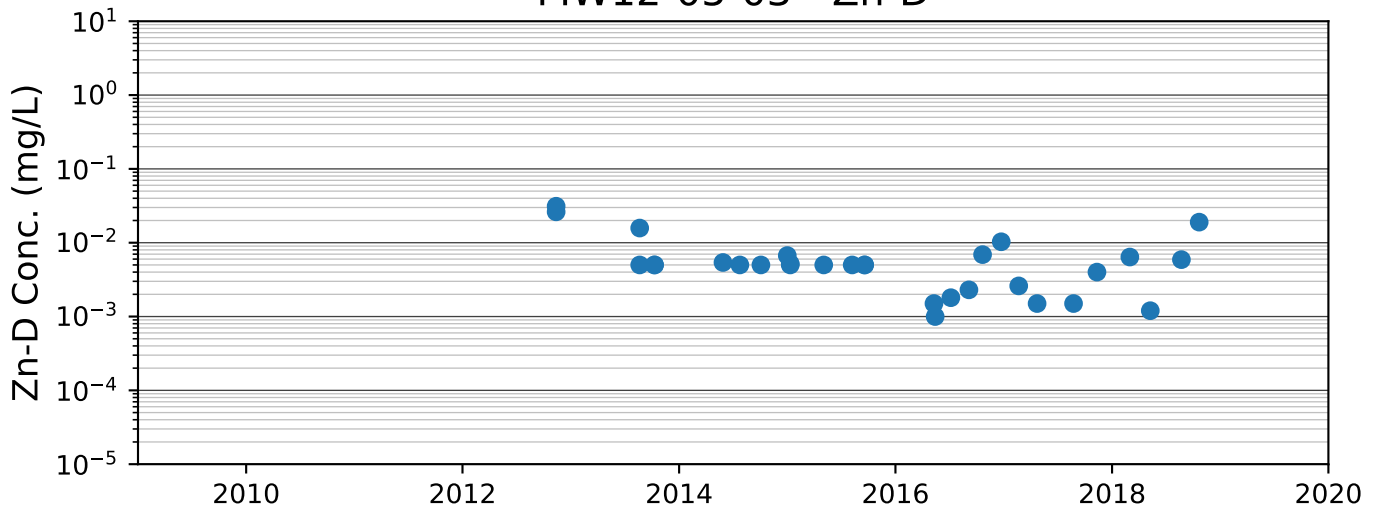
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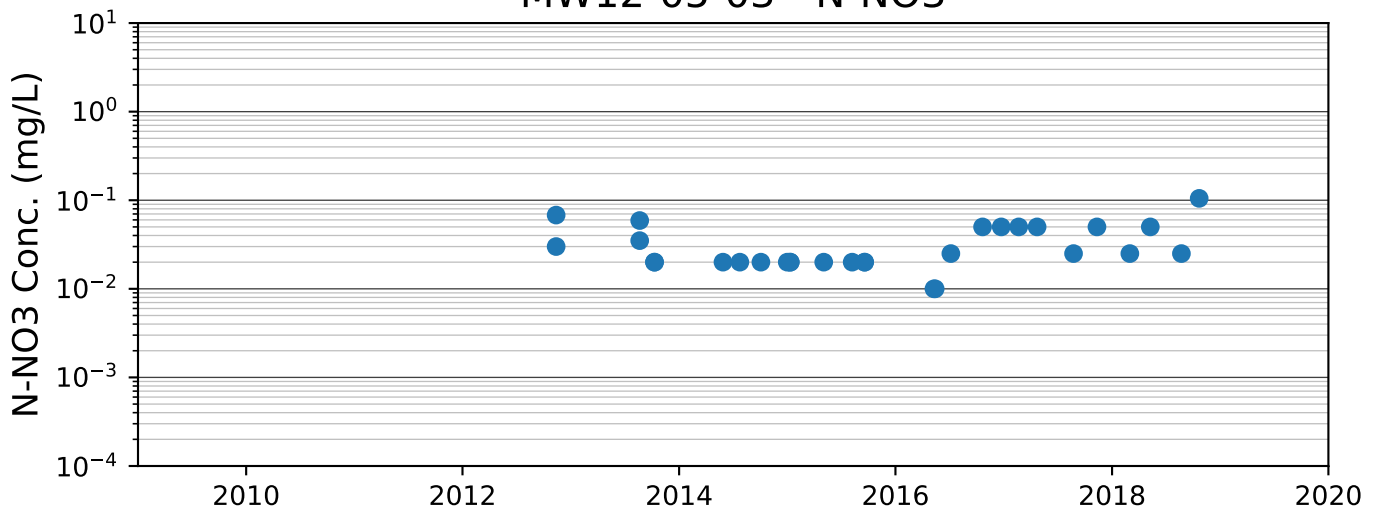
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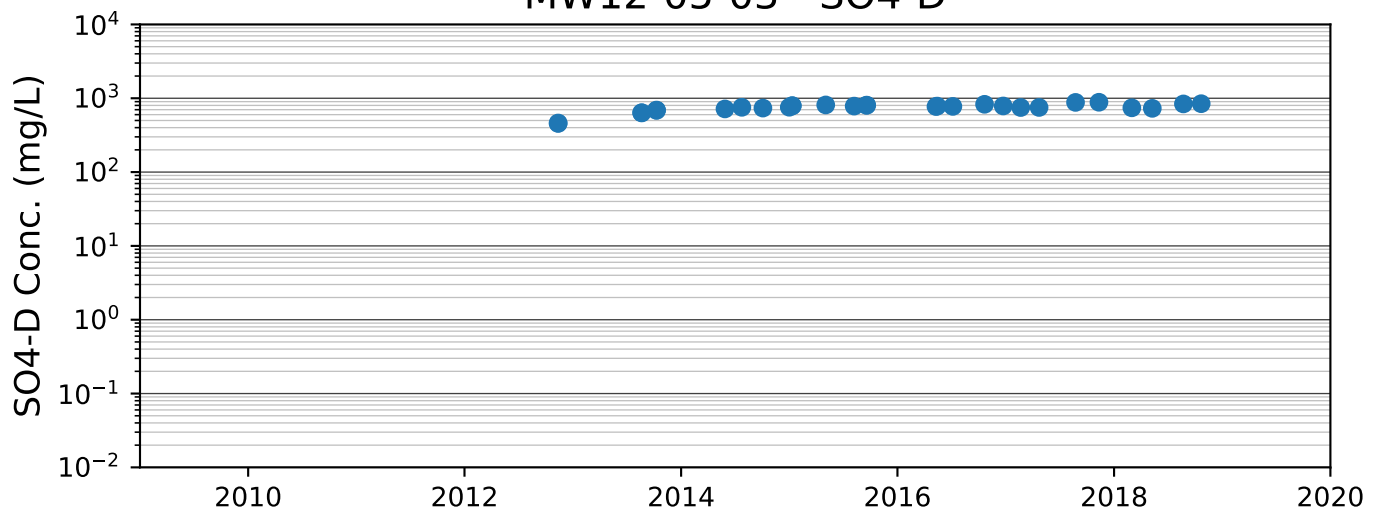
MW12-05-03 - Zn-D



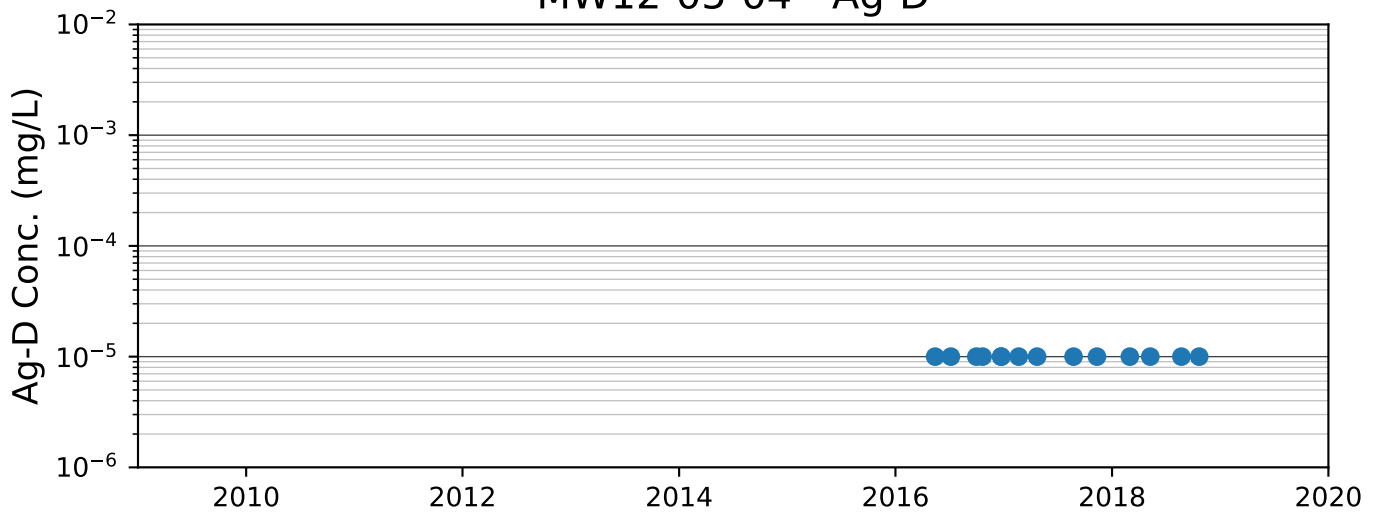
MW12-05-03 - N-NO3



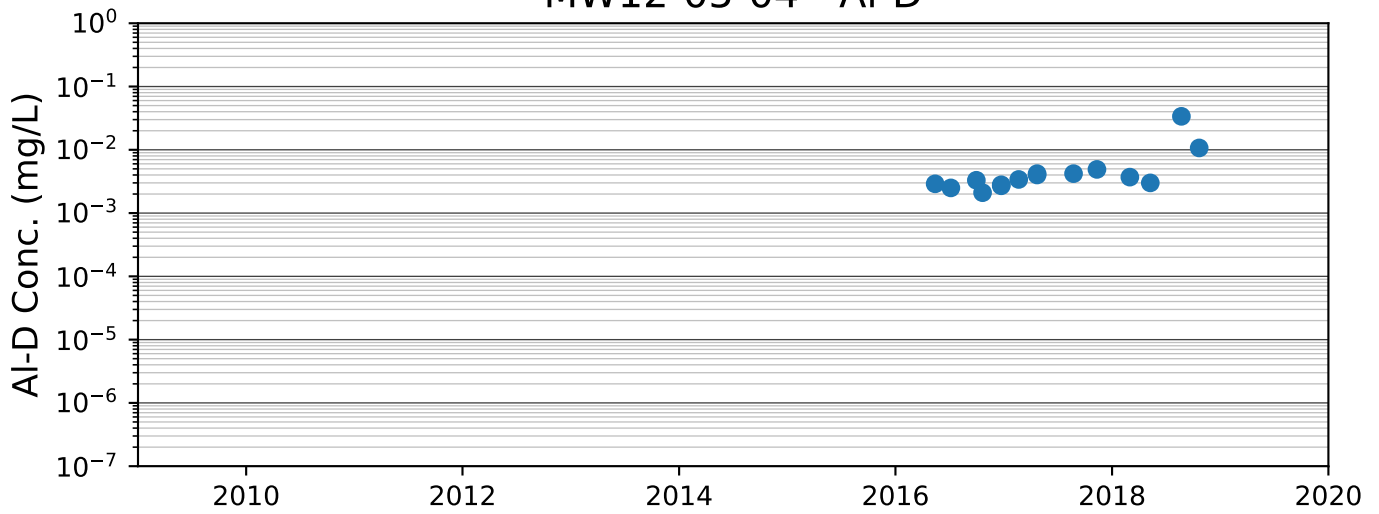
MW12-05-03 - SO4-D



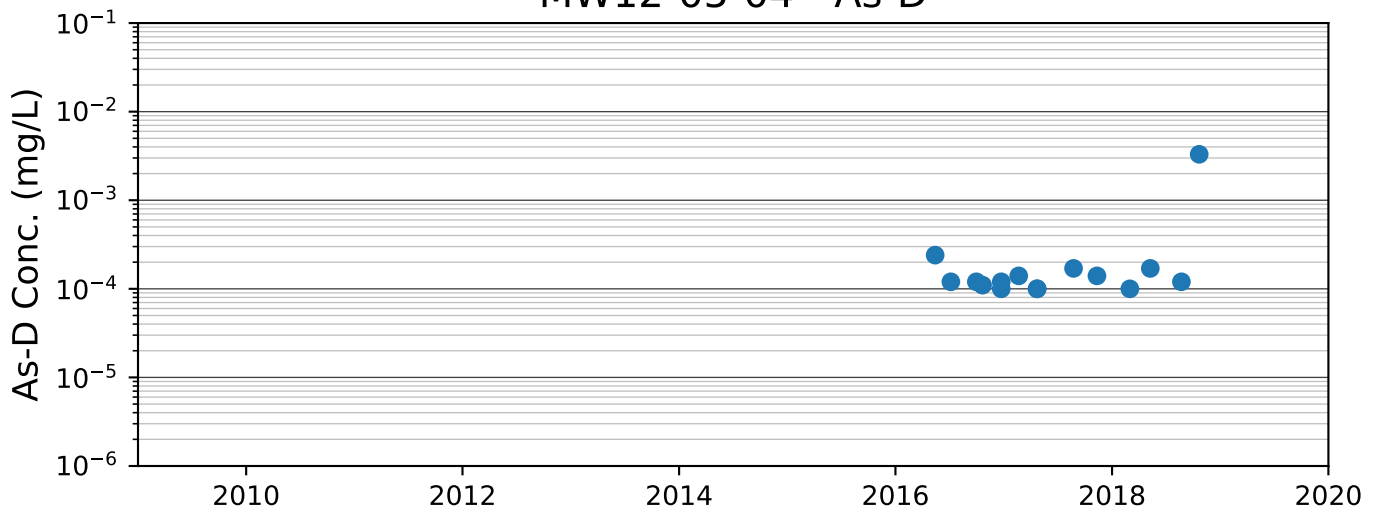
MW12-05-04 - Ag-D



MW12-05-04 - Al-D

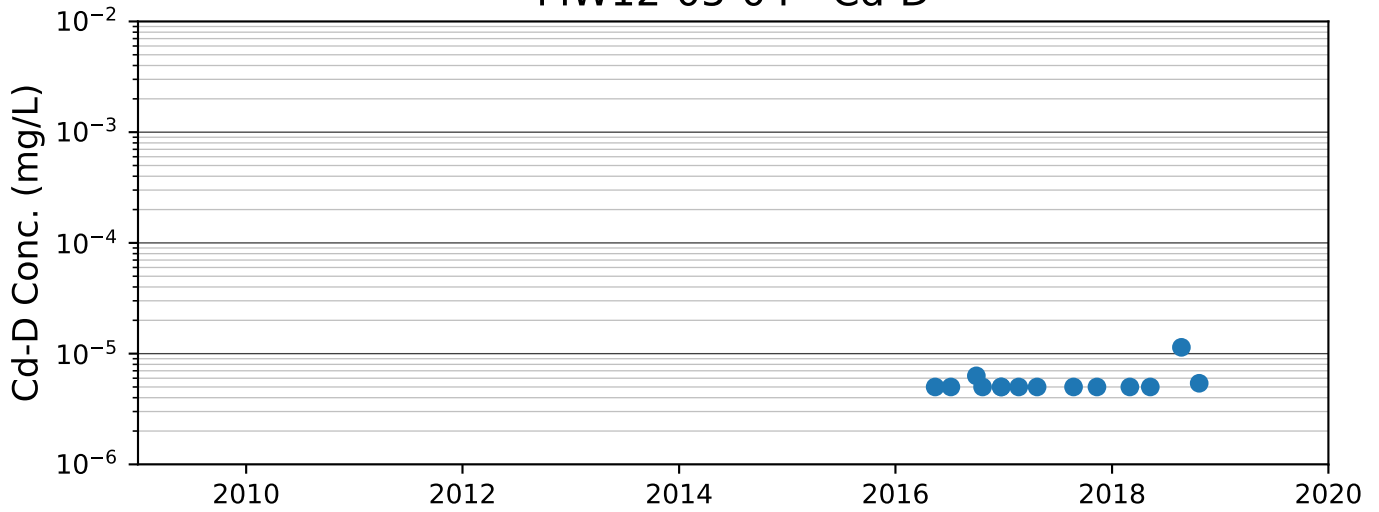


MW12-05-04 - As-D

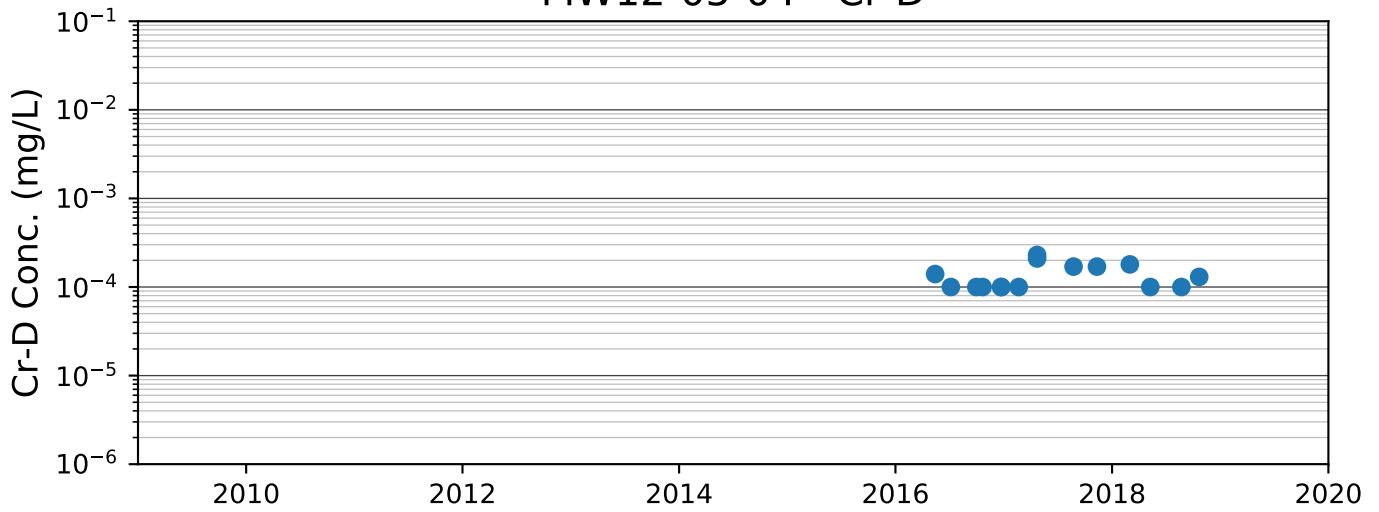


Attachment 2: Groundwater Monitoring Data for All CoCs

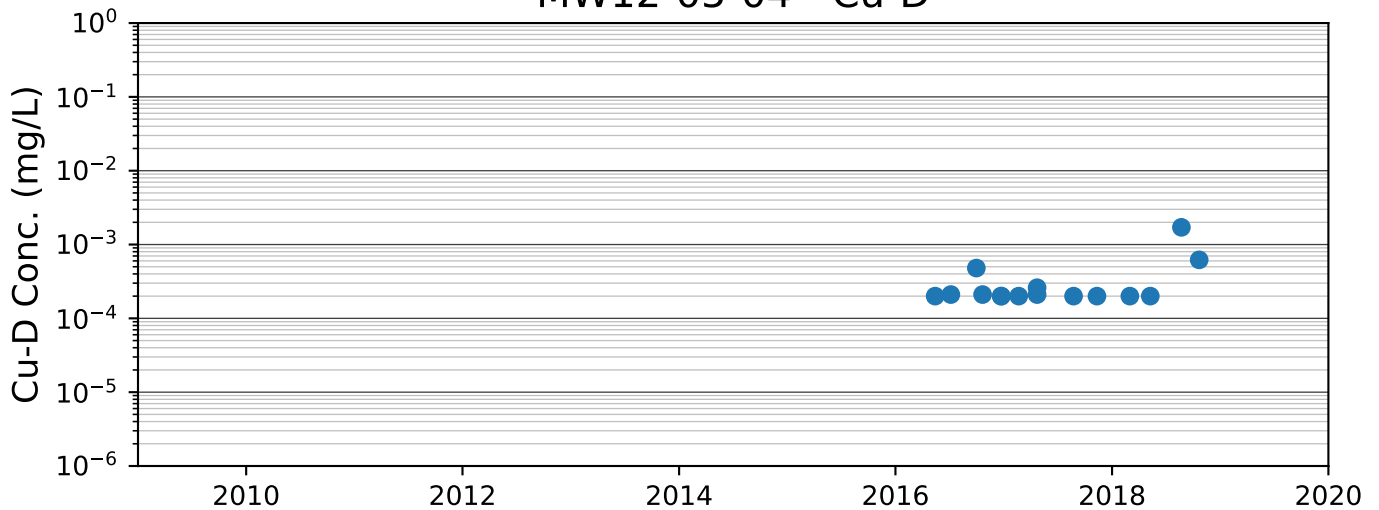
MW12-05-04 - Cd-D



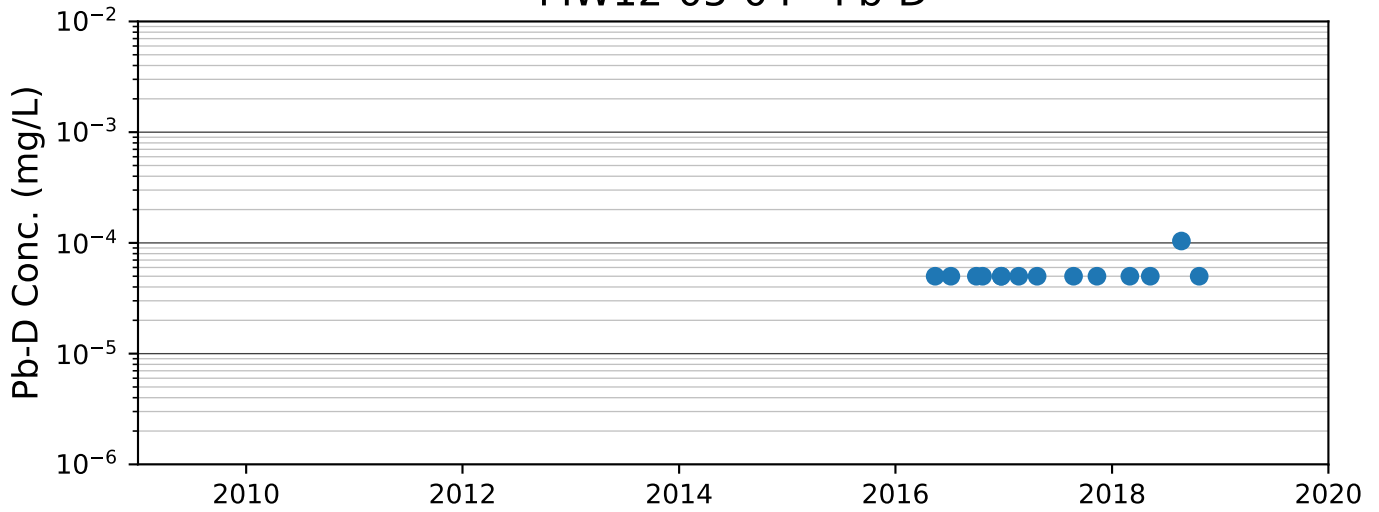
MW12-05-04 - Cr-D



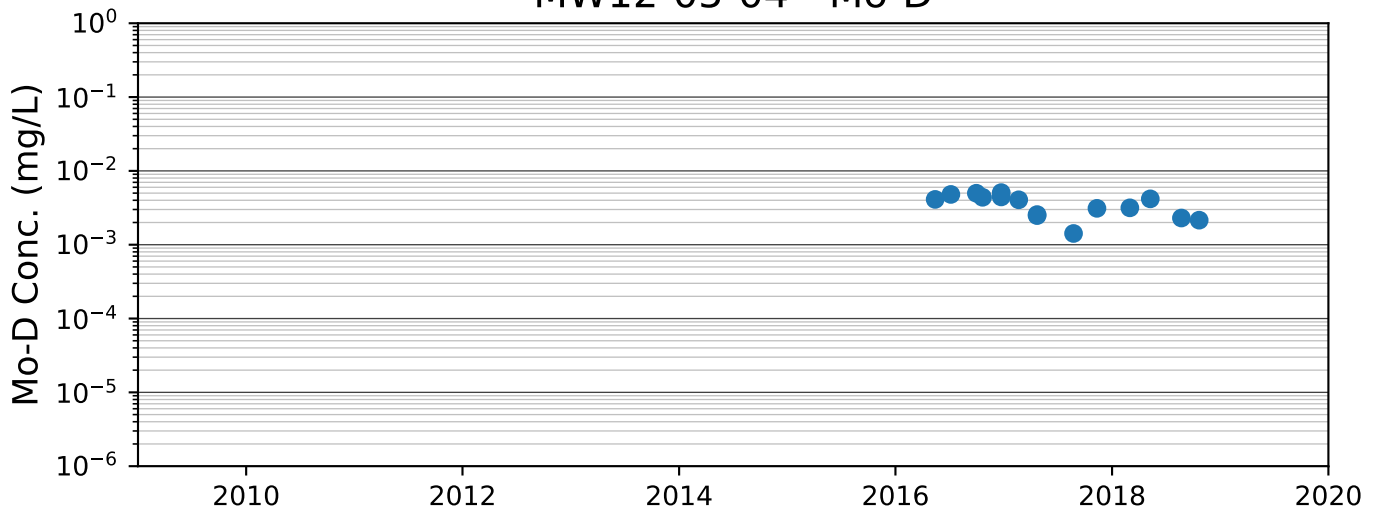
MW12-05-04 - Cu-D



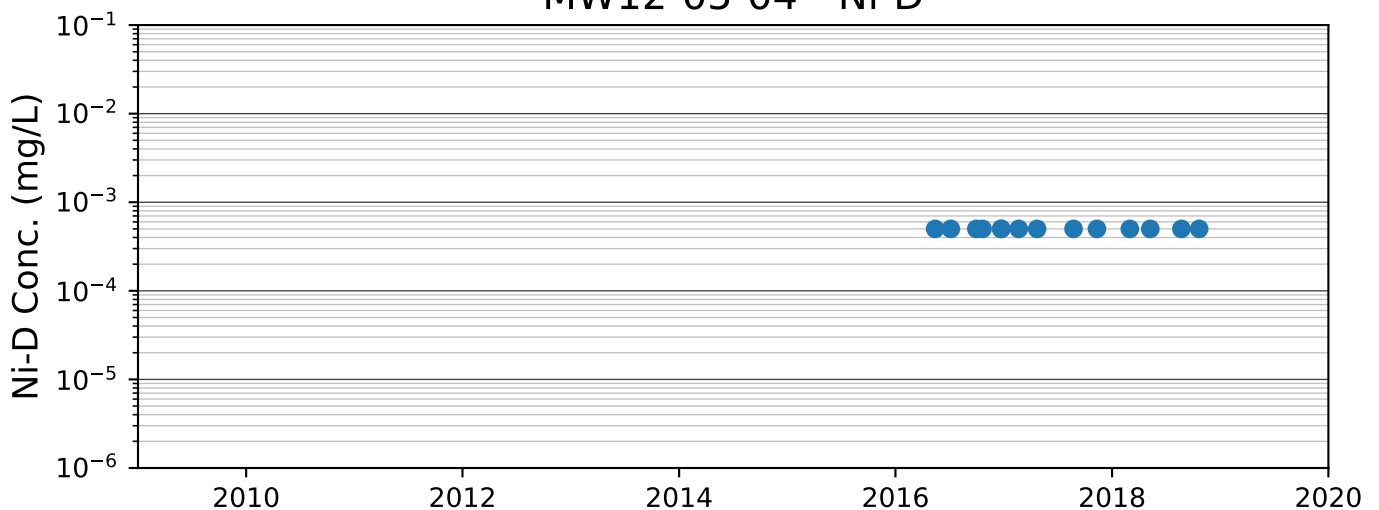
MW12-05-04 - Pb-D



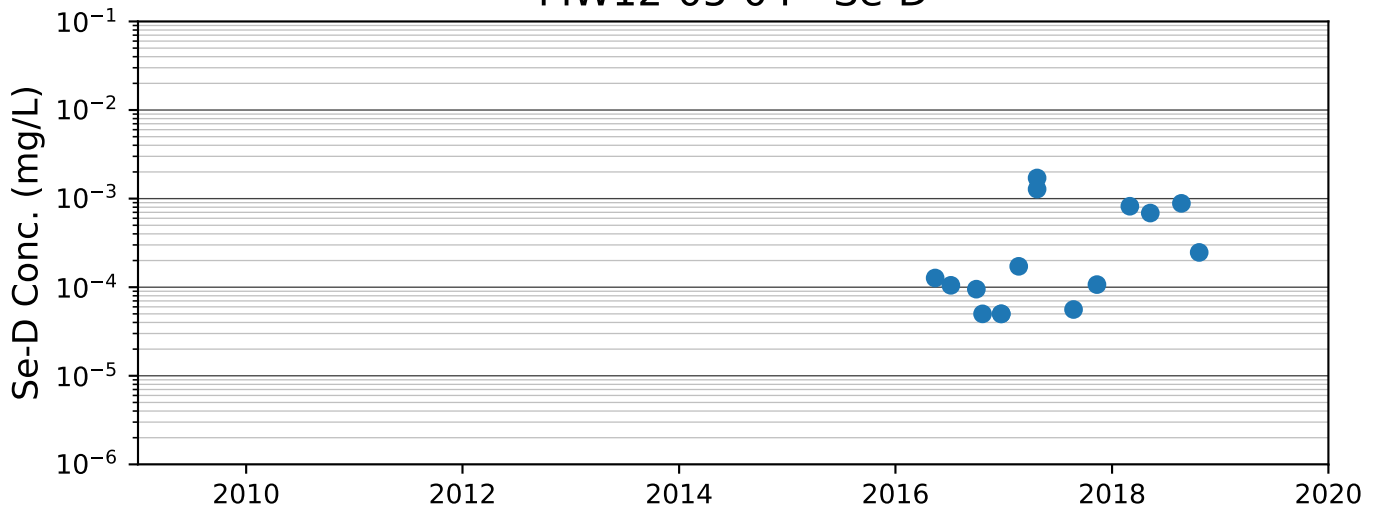
MW12-05-04 - Mo-D



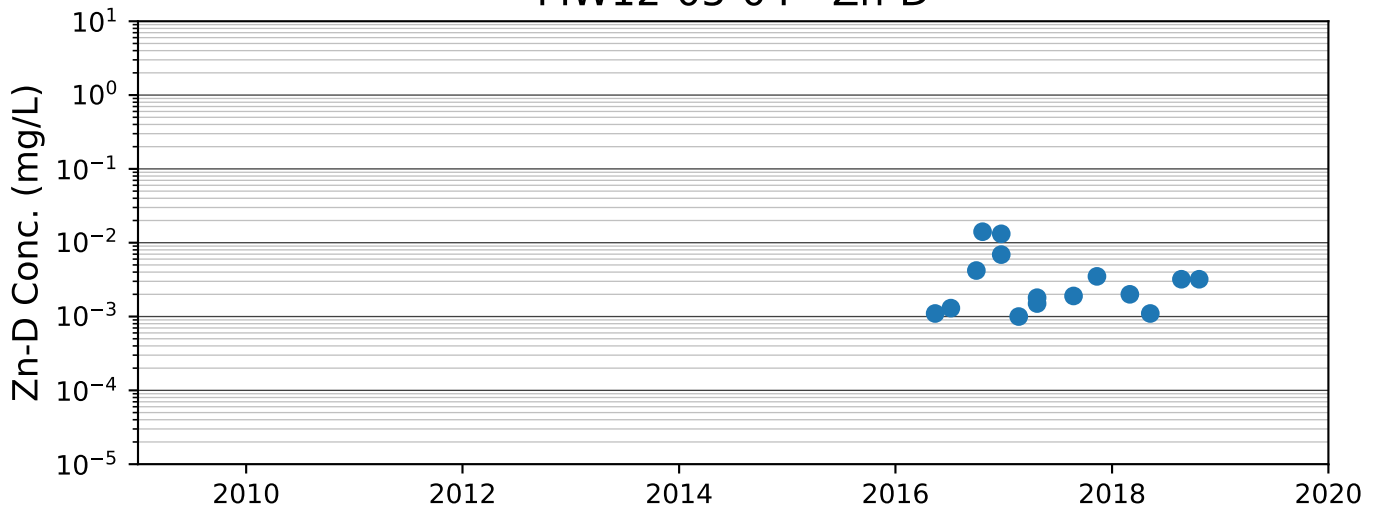
MW12-05-04 - Ni-D



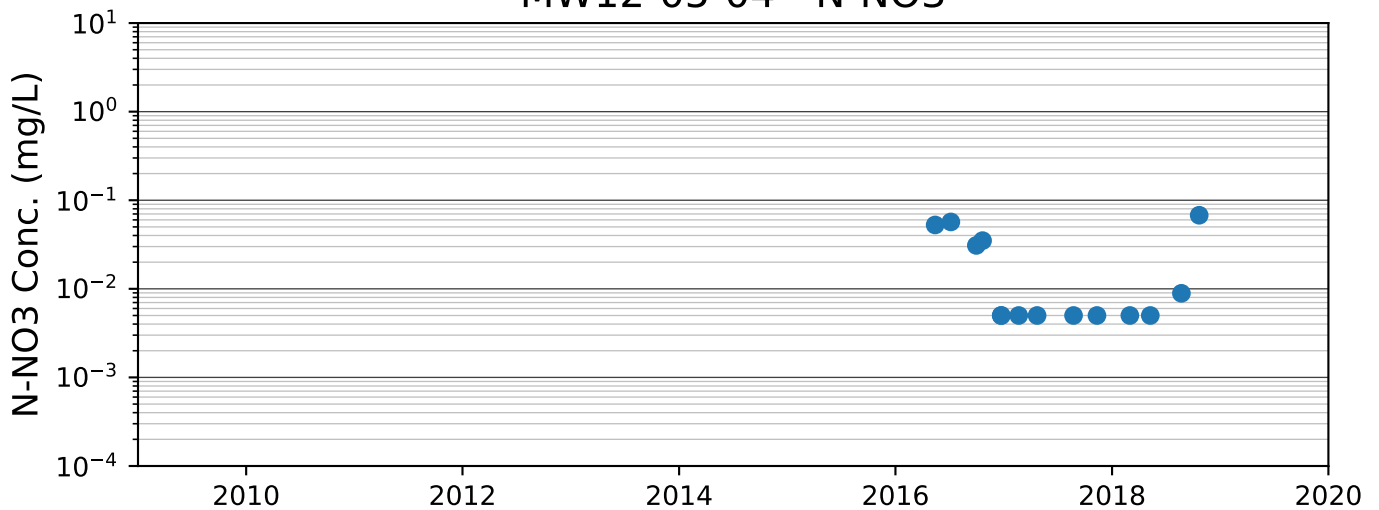
MW12-05-04 - Se-D



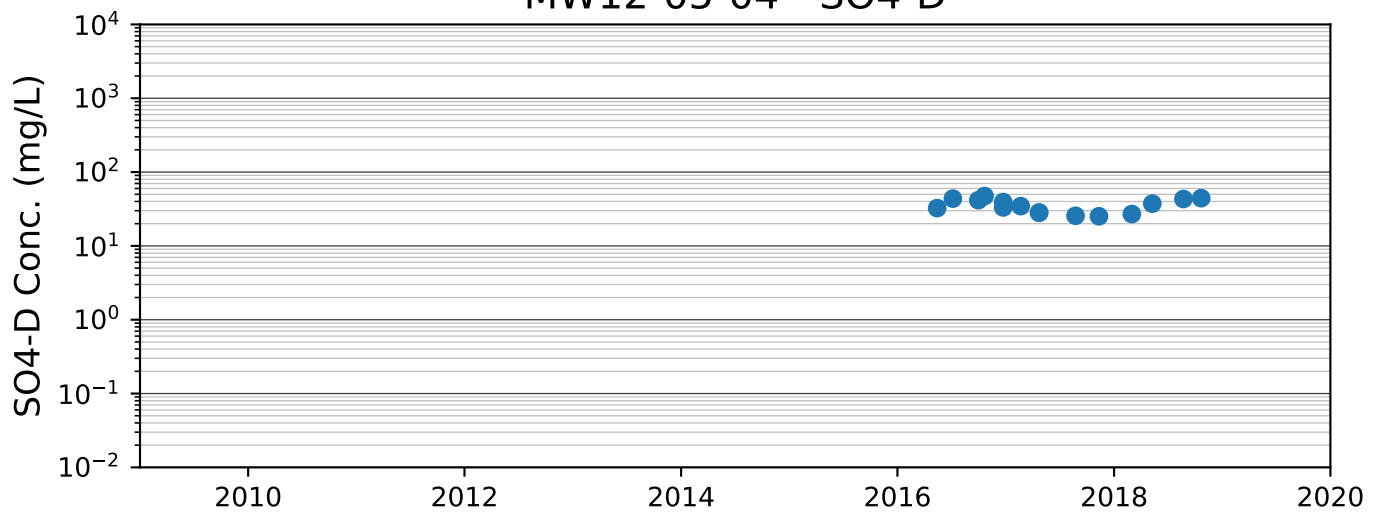
MW12-05-04 - Zn-D



MW12-05-04 - N-NO3

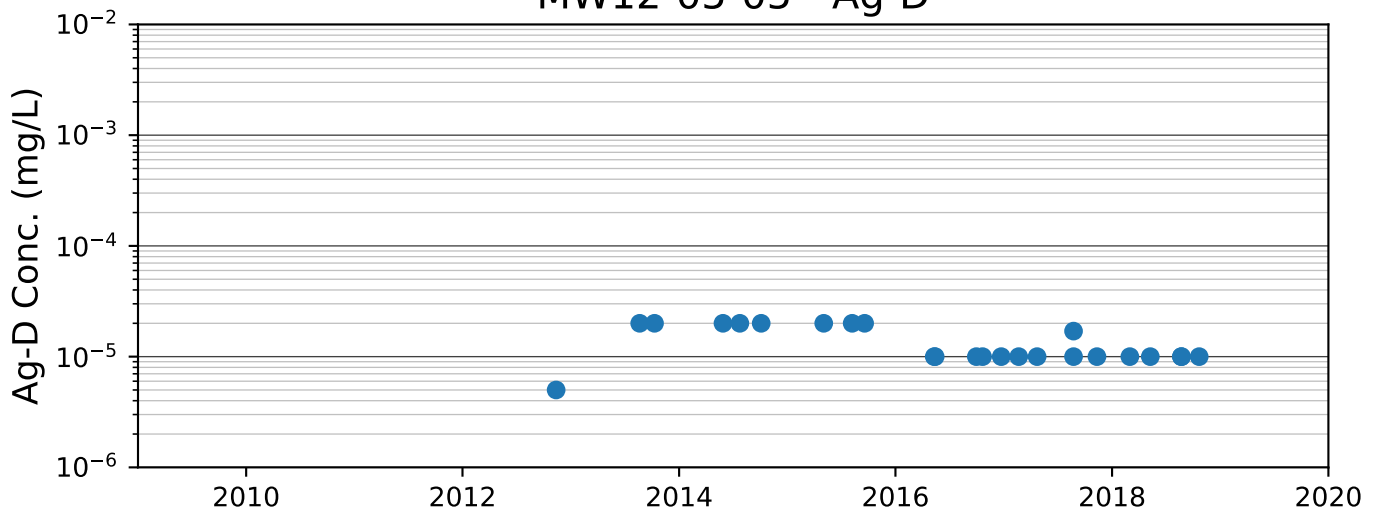


MW12-05-04 - SO4-D

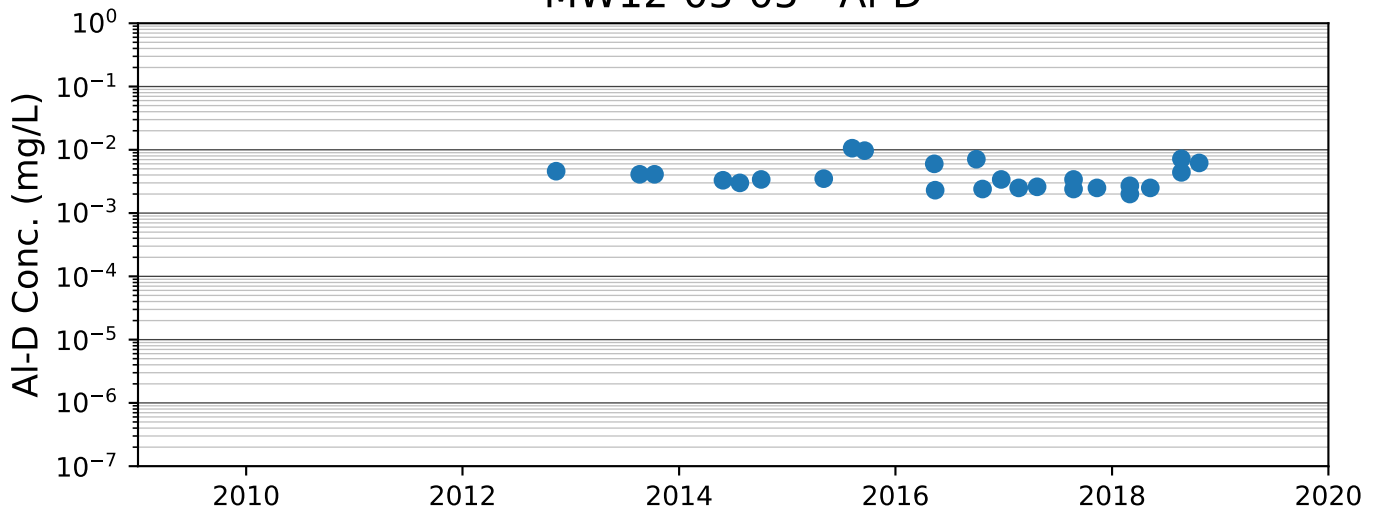


Attachment 2: Groundwater Monitoring Data for All CoCs

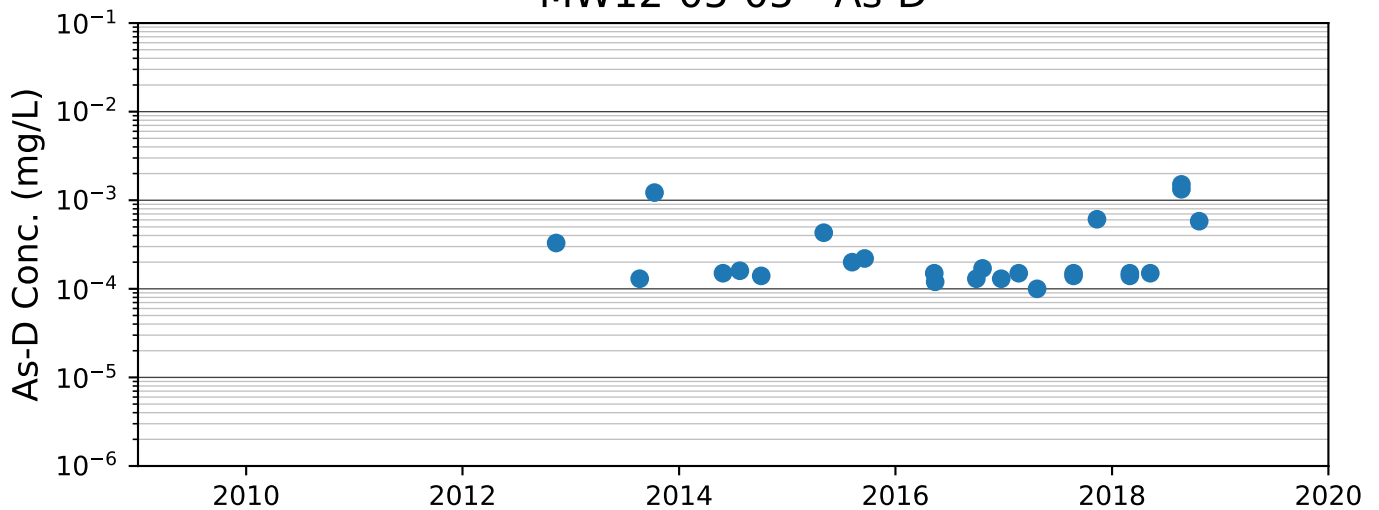
MW12-05-05 - Ag-D



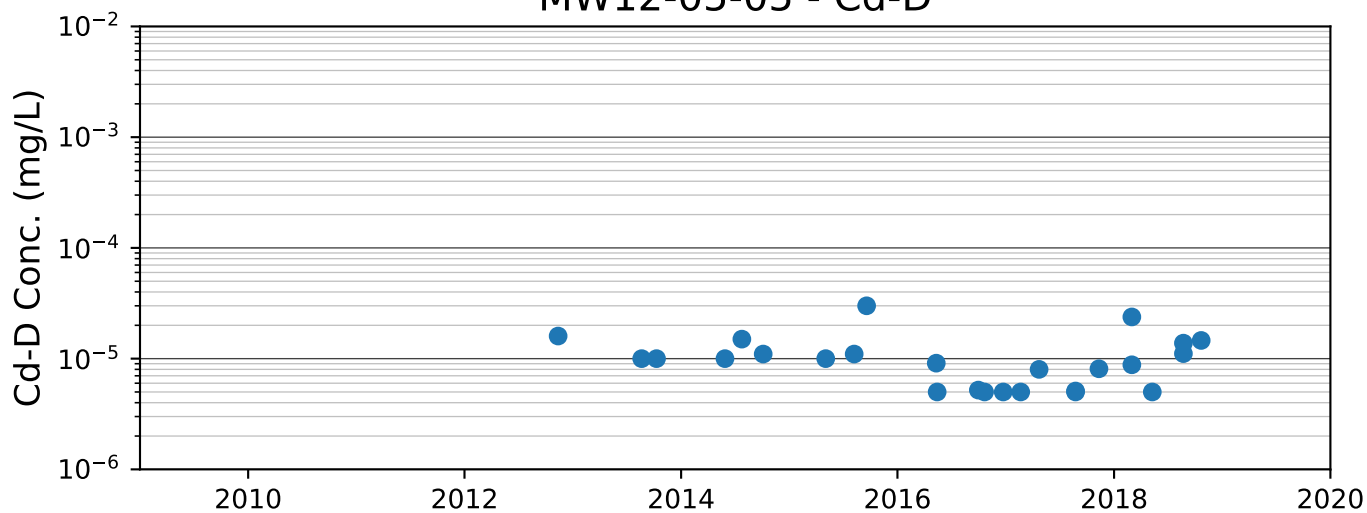
MW12-05-05 - Al-D



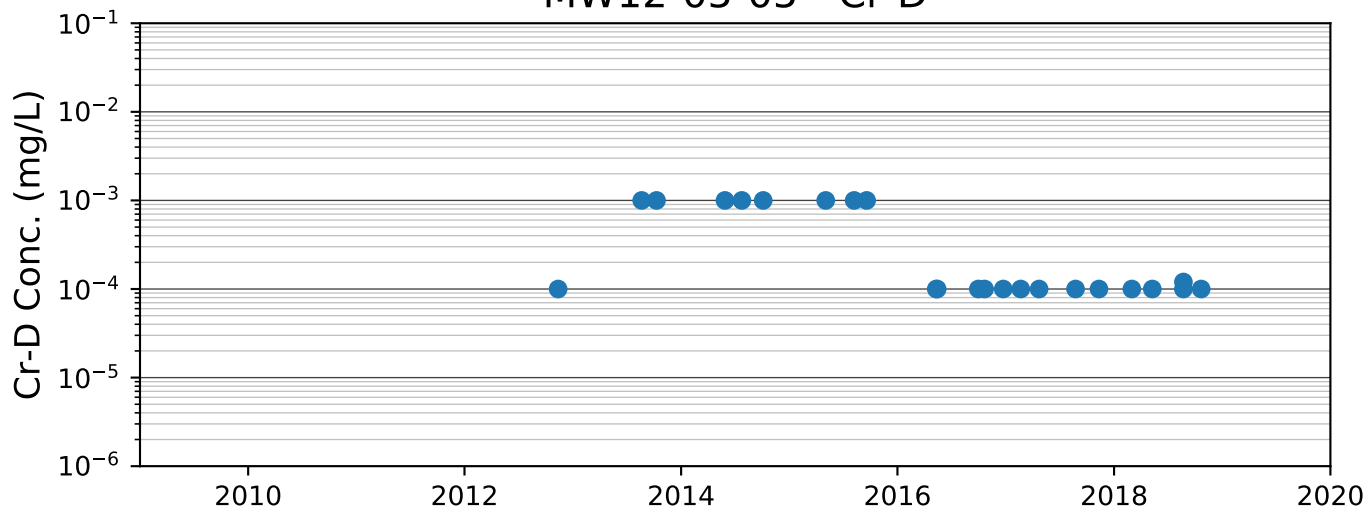
MW12-05-05 - As-D



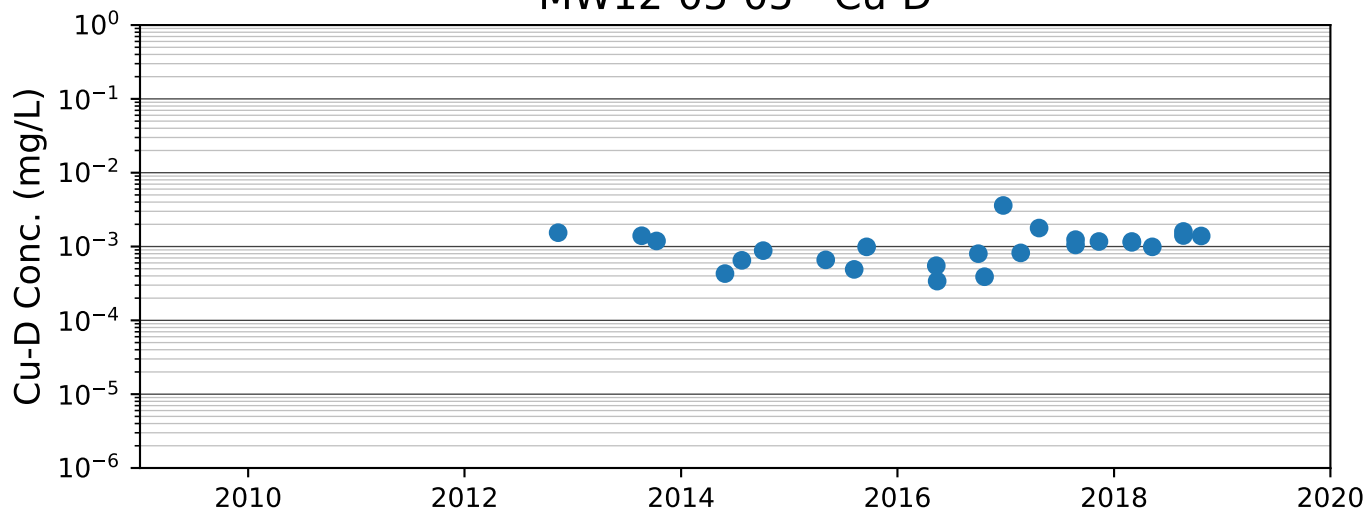
MW12-05-05 - Cd-D



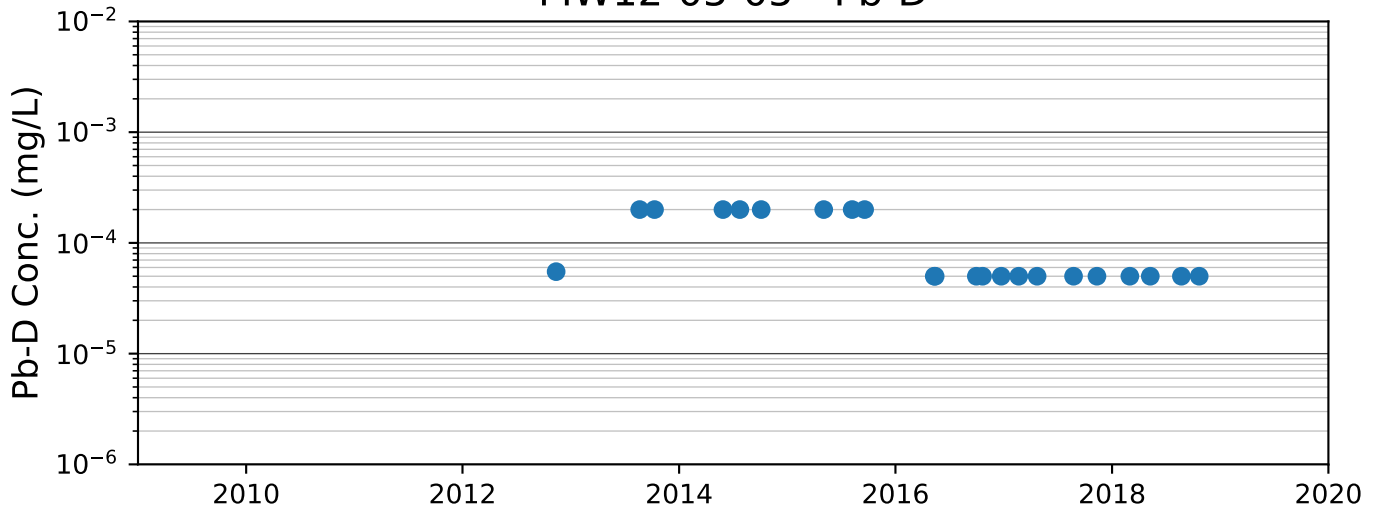
MW12-05-05 - Cr-D



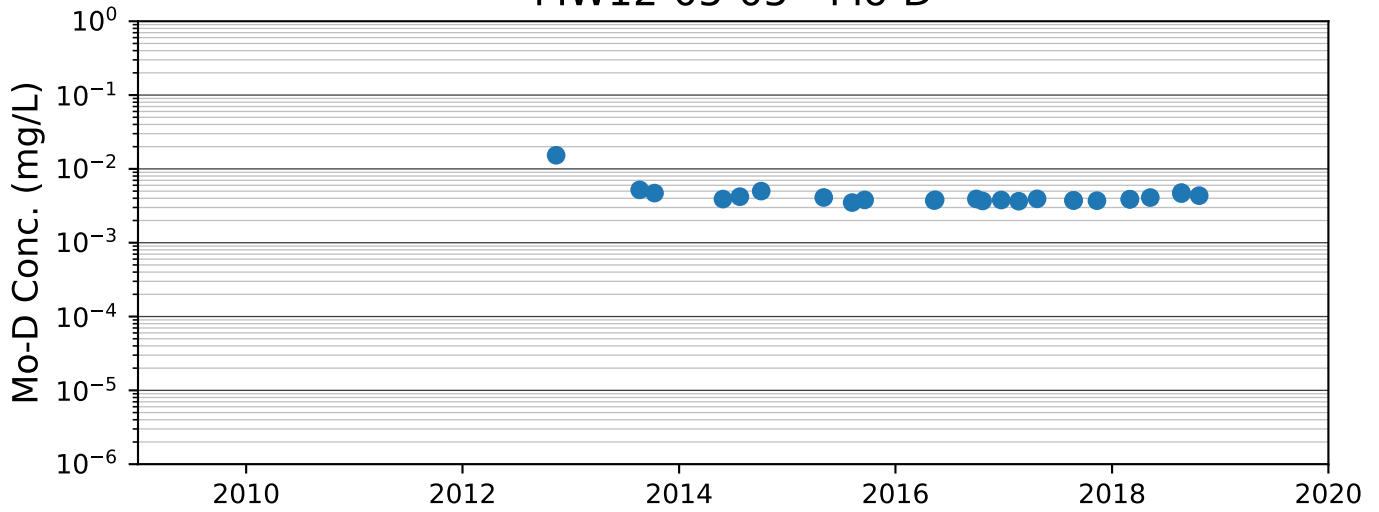
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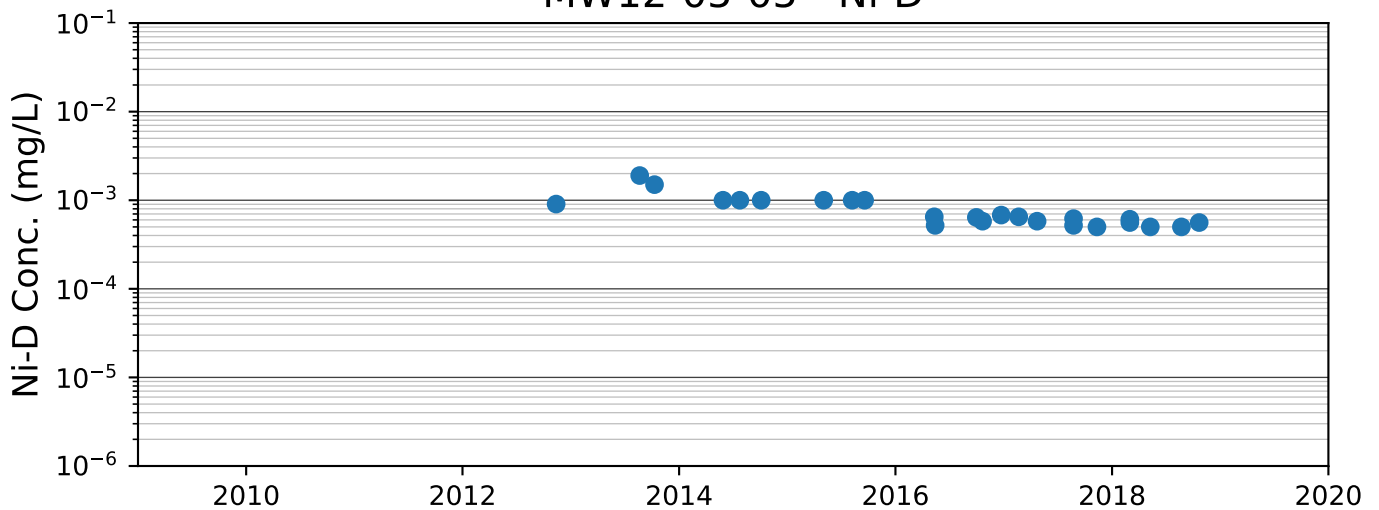
MW12-05-05 - Pb-D



MW12-05-05 - Mo-D

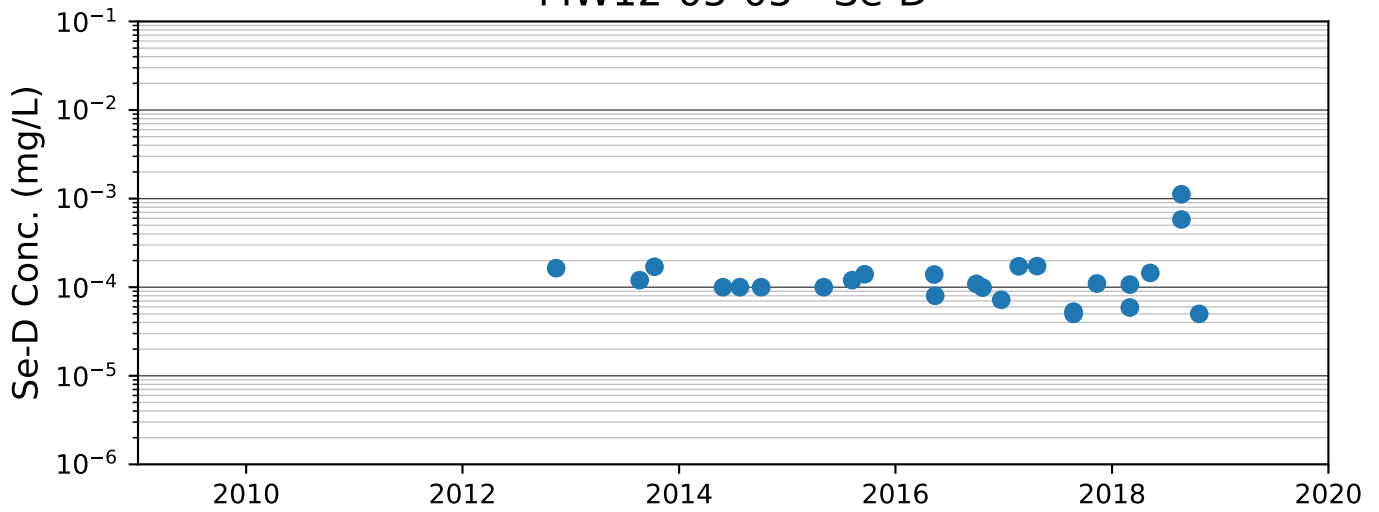


MW12-05-05 - Ni-D

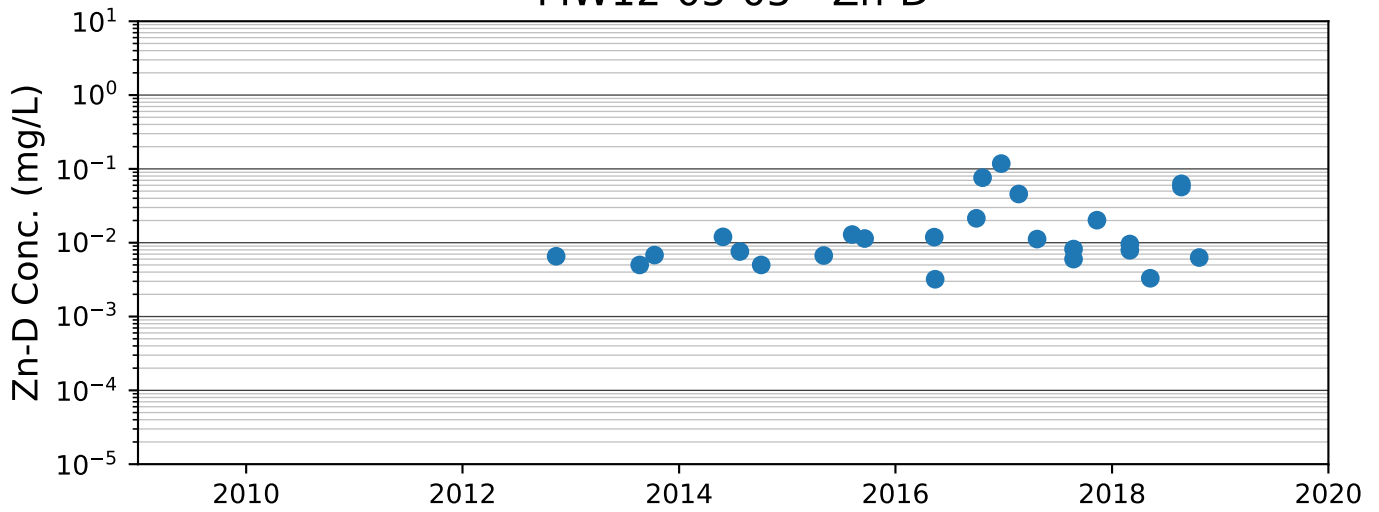


Attachment 2: Groundwater Monitoring Data for All CoCs

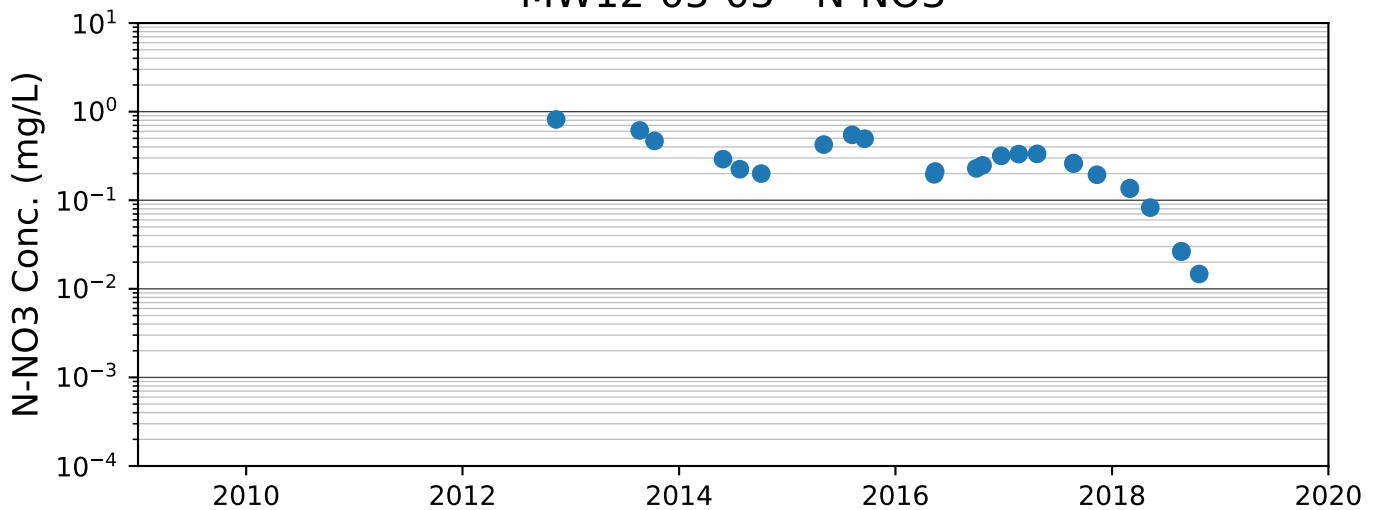
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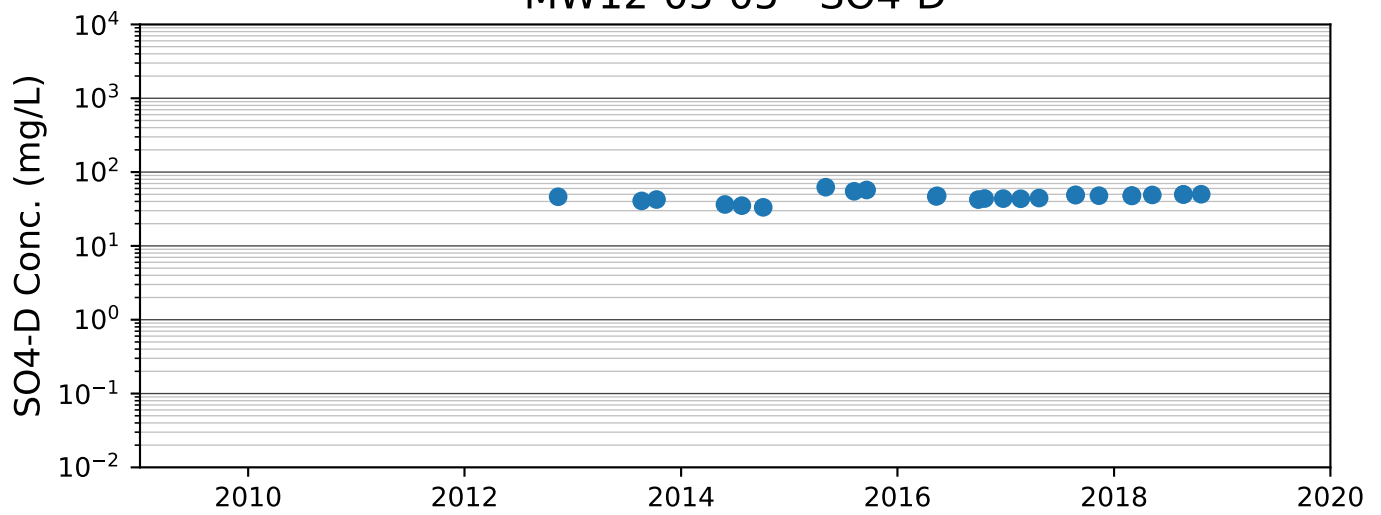
MW12-05-05 - Zn-D



MW12-05-05 - N-NO3

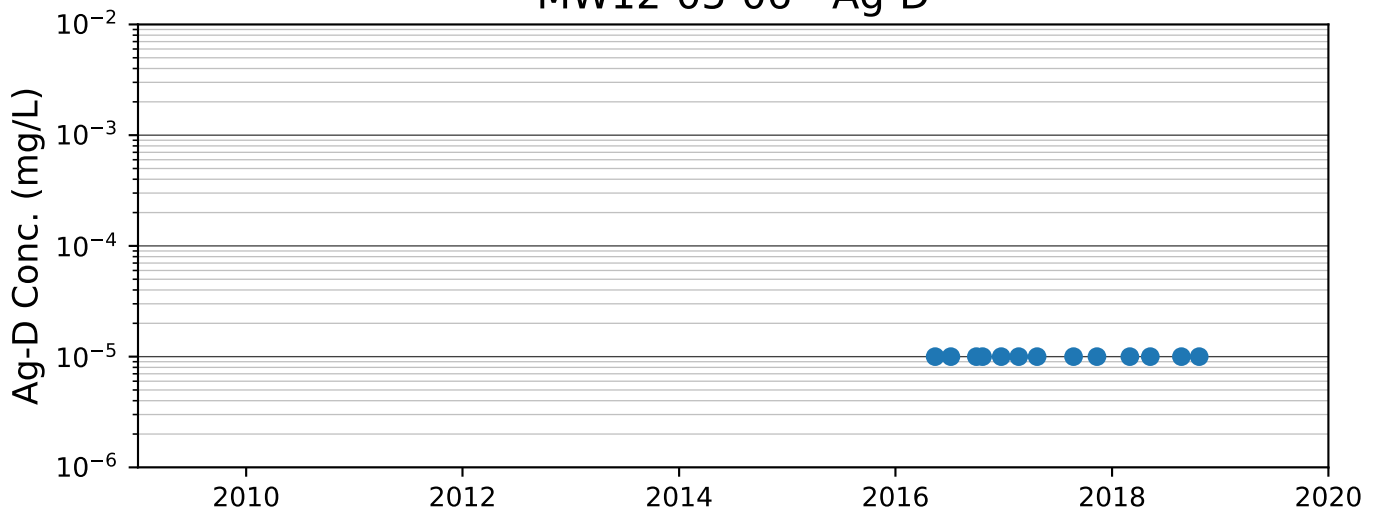


MW12-05-05 - SO4-D

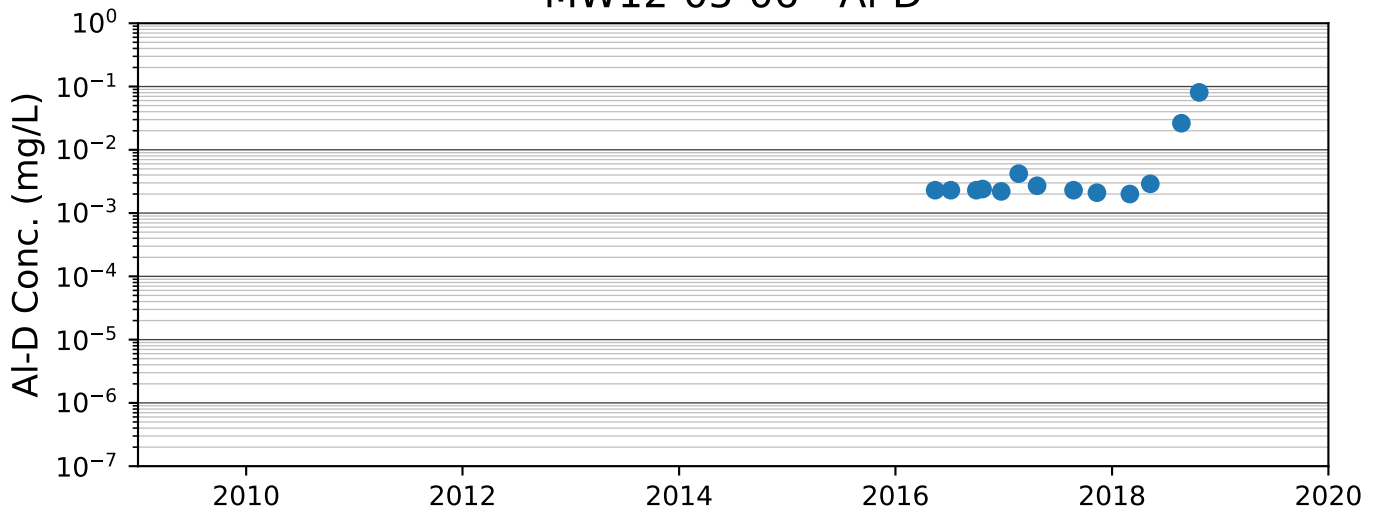


Attachment 2: Groundwater Monitoring Data for All CoCs

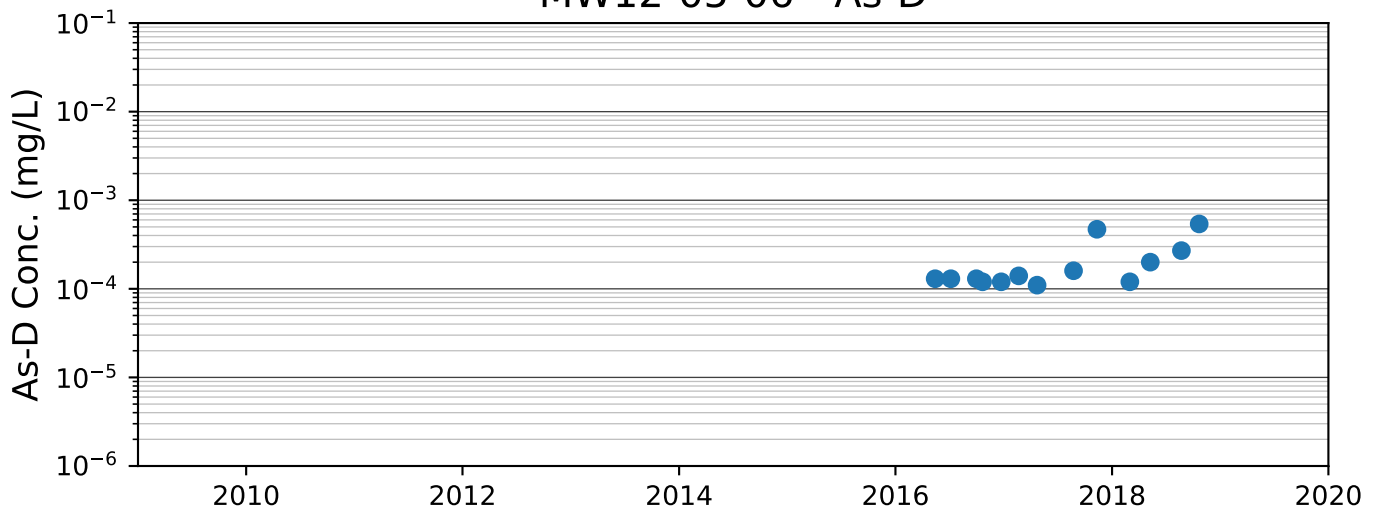
MW12-05-06 - Ag-D



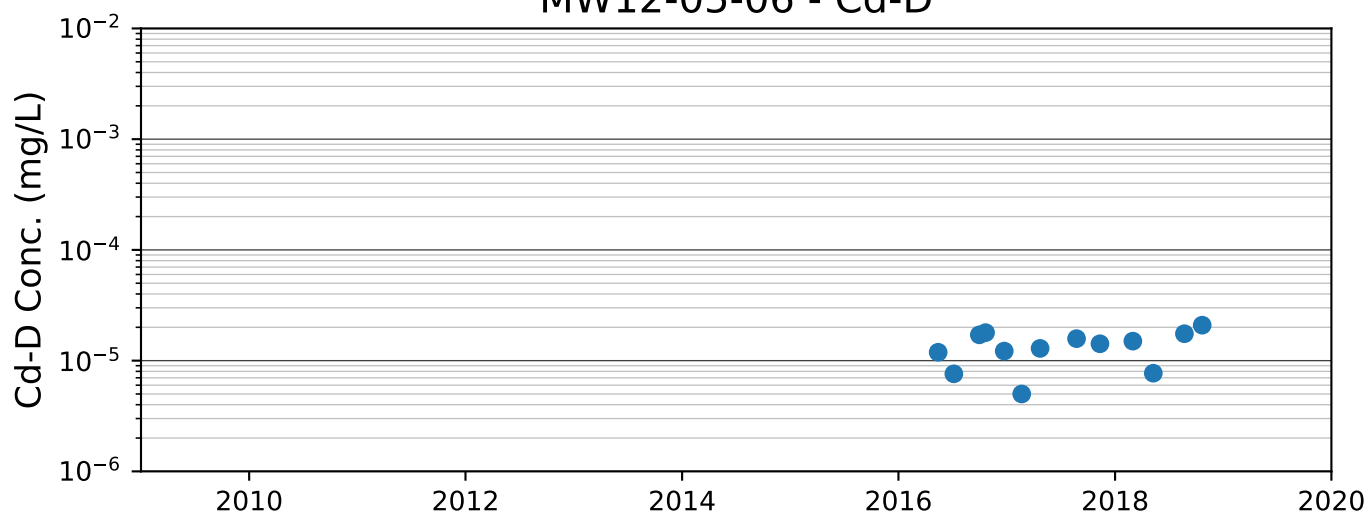
MW12-05-06 - Al-D



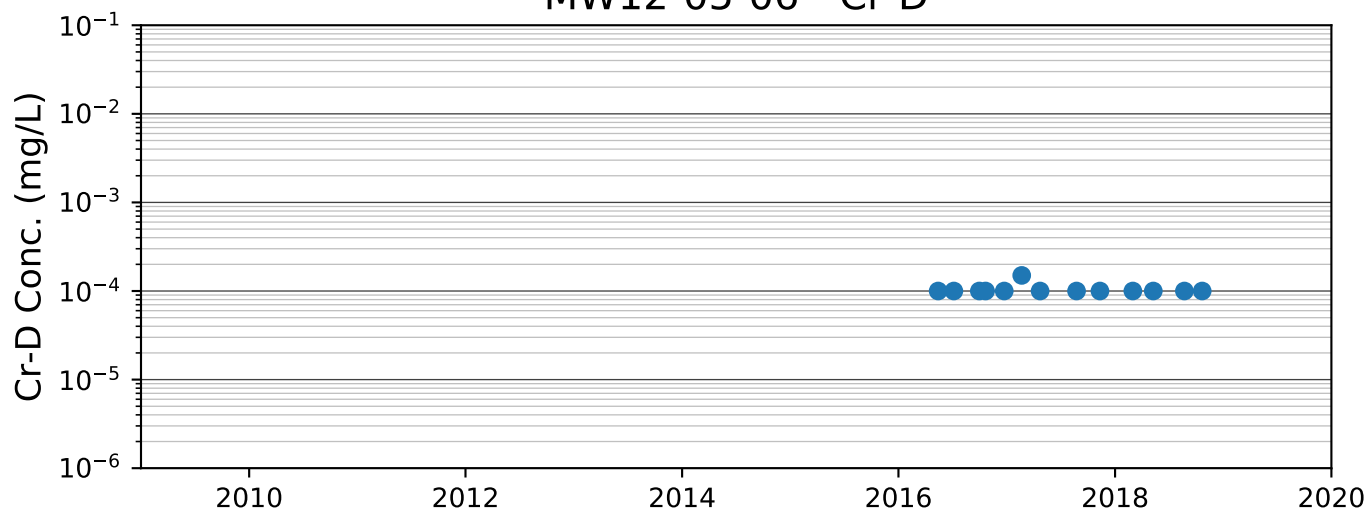
MW12-05-06 - As-D



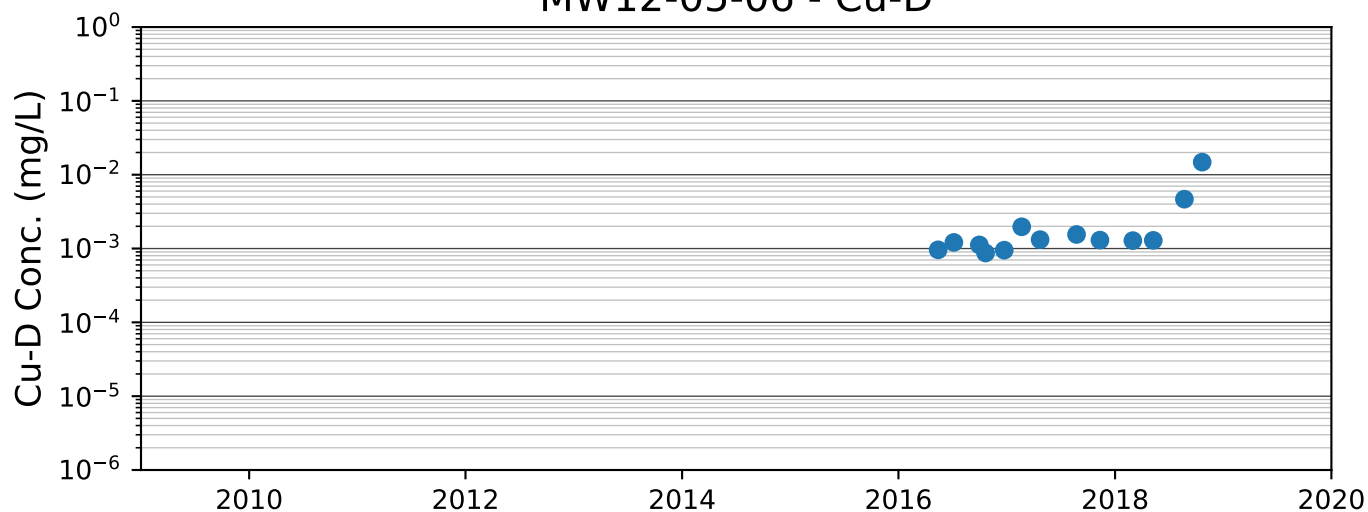
MW12-05-06 - Cd-D



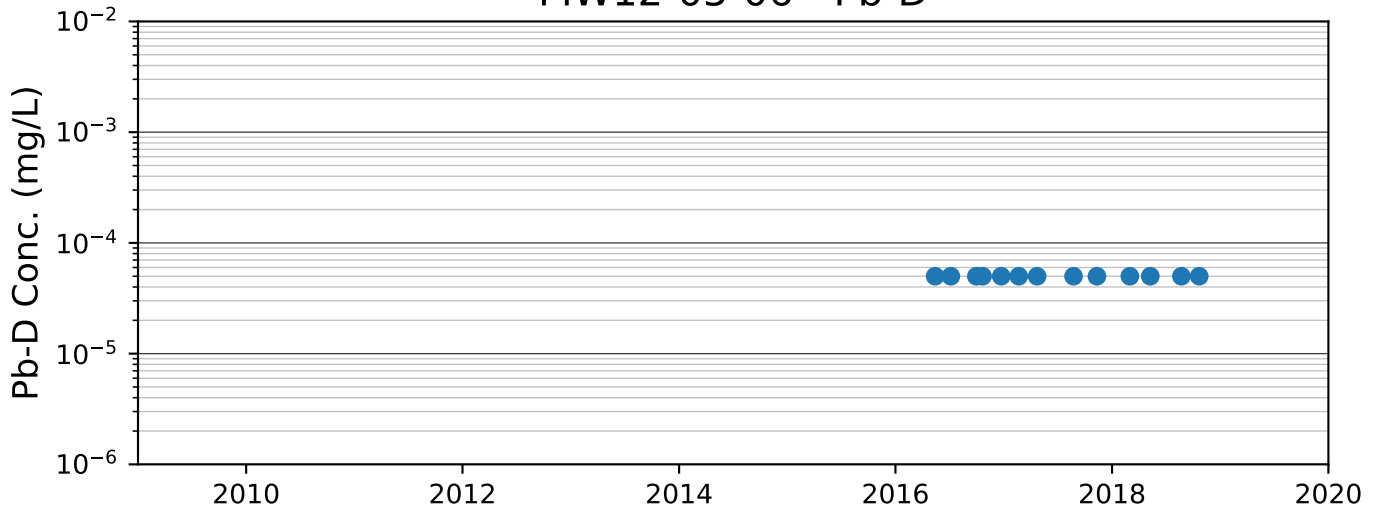
MW12-05-06 - Cr-D



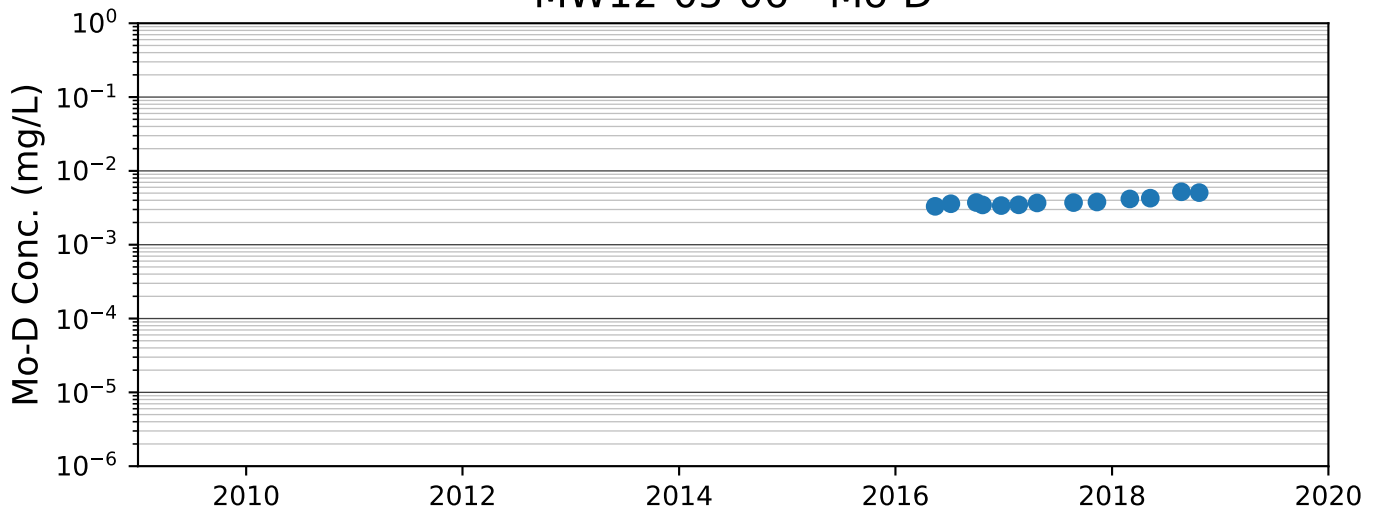
MW12-05-06 - Cu-D



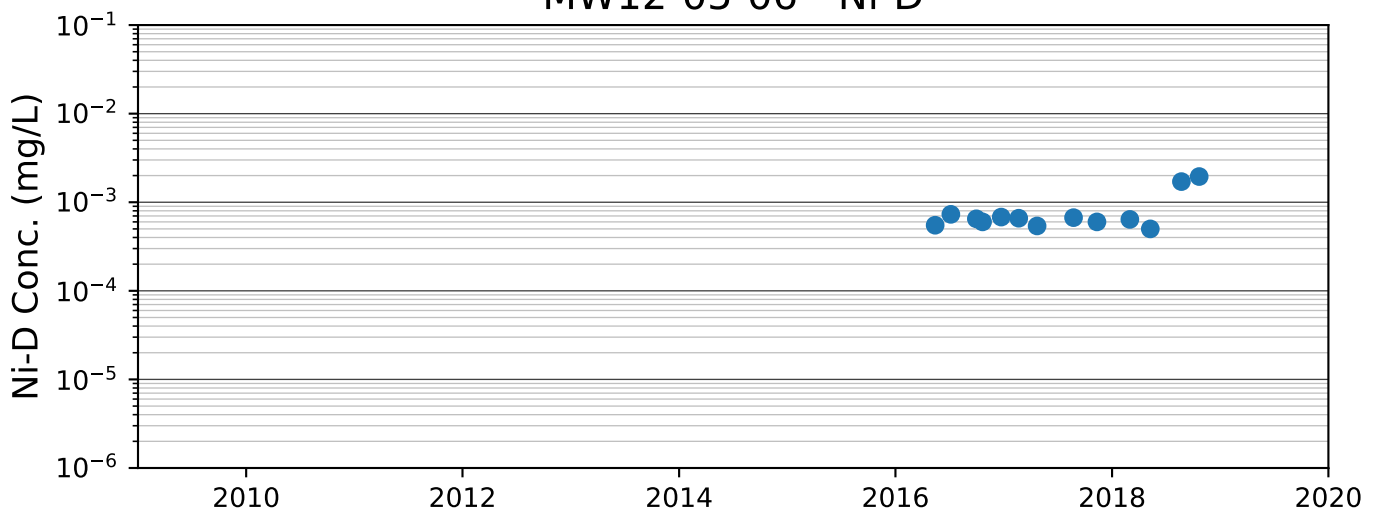
MW12-05-06 - Pb-D



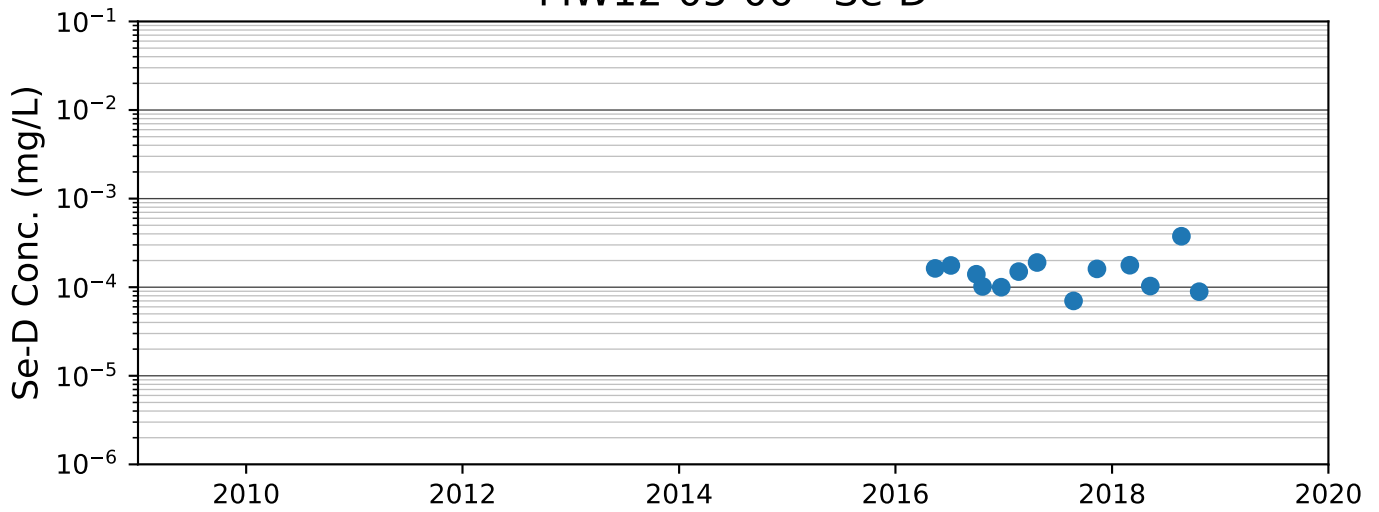
MW12-05-06 - Mo-D



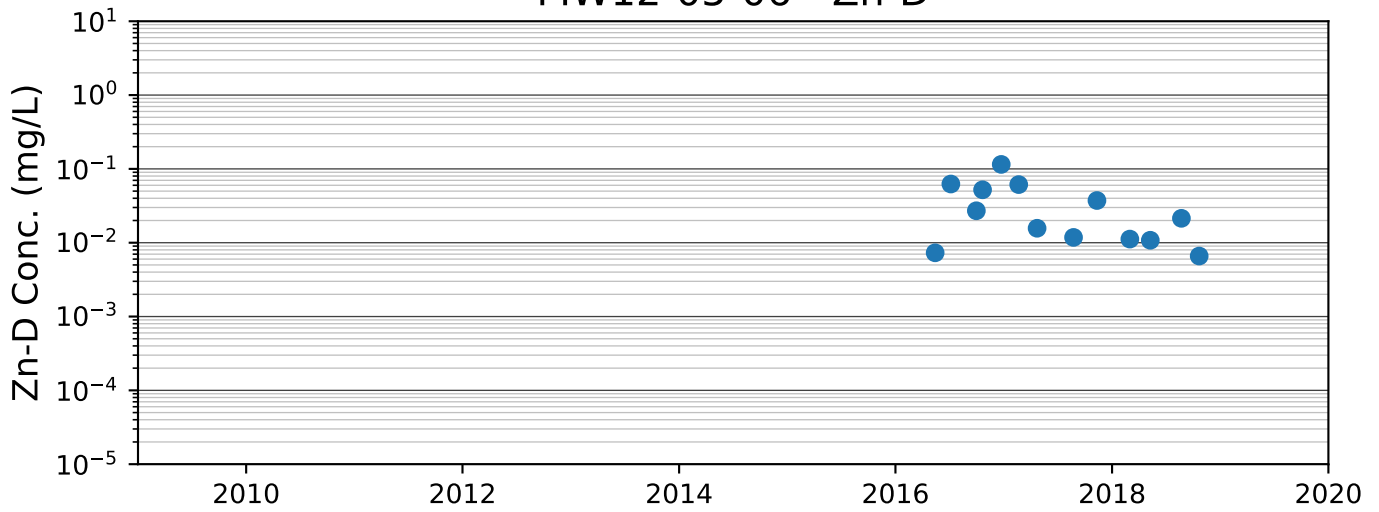
MW12-05-06 - Ni-D



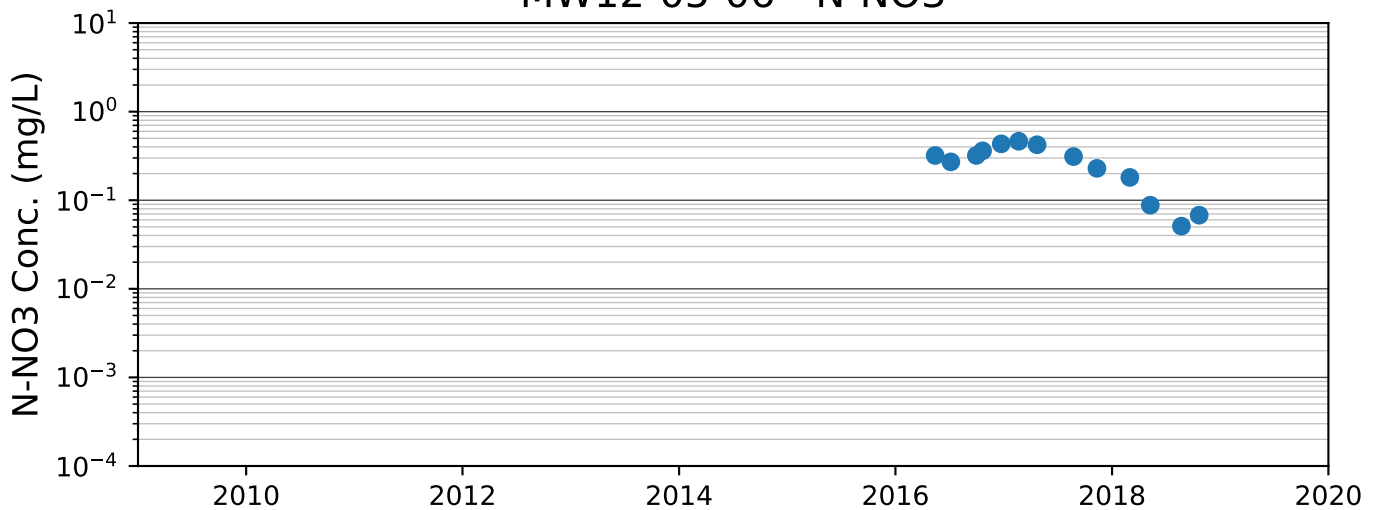
MW12-05-06 - Se-D



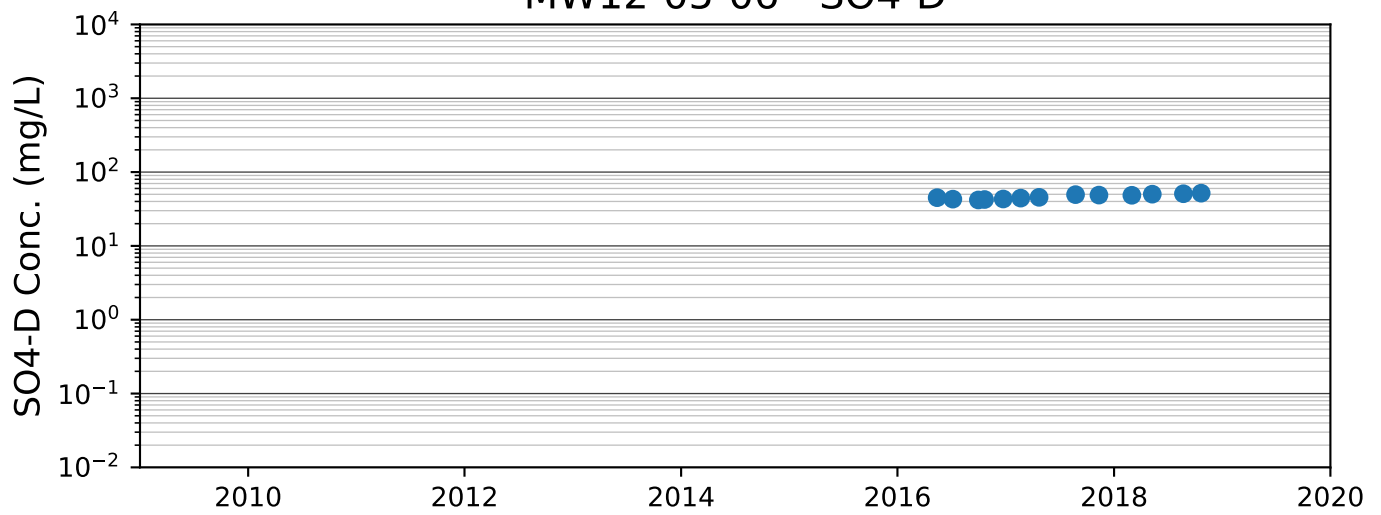
MW12-05-06 - Zn-D



MW12-05-06 - N-NO3

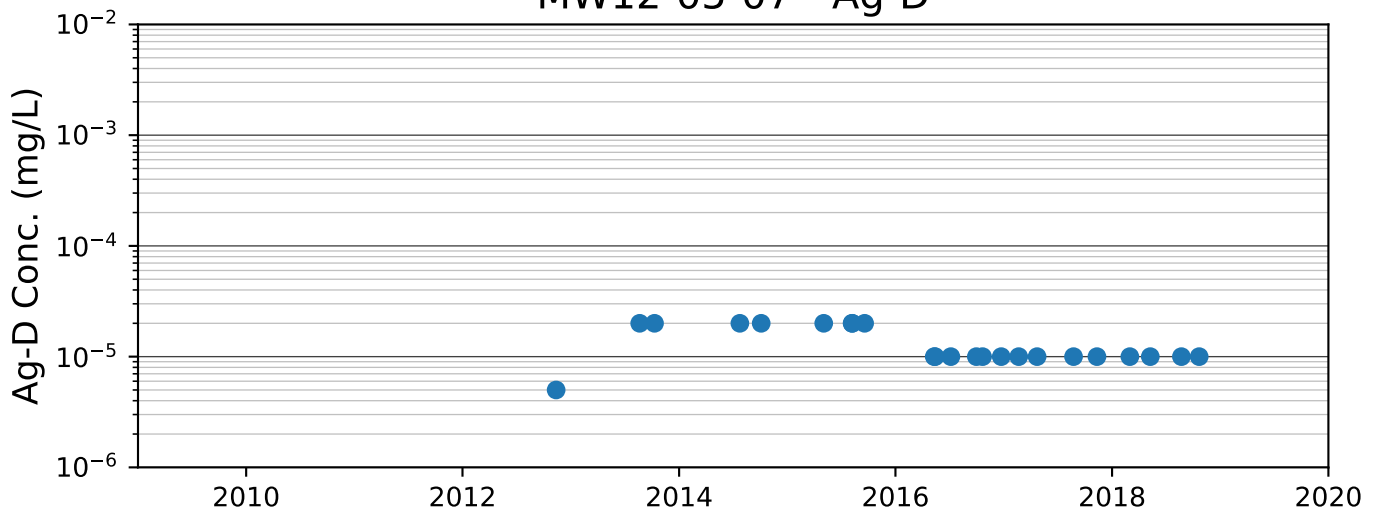


MW12-05-06 - SO4-D

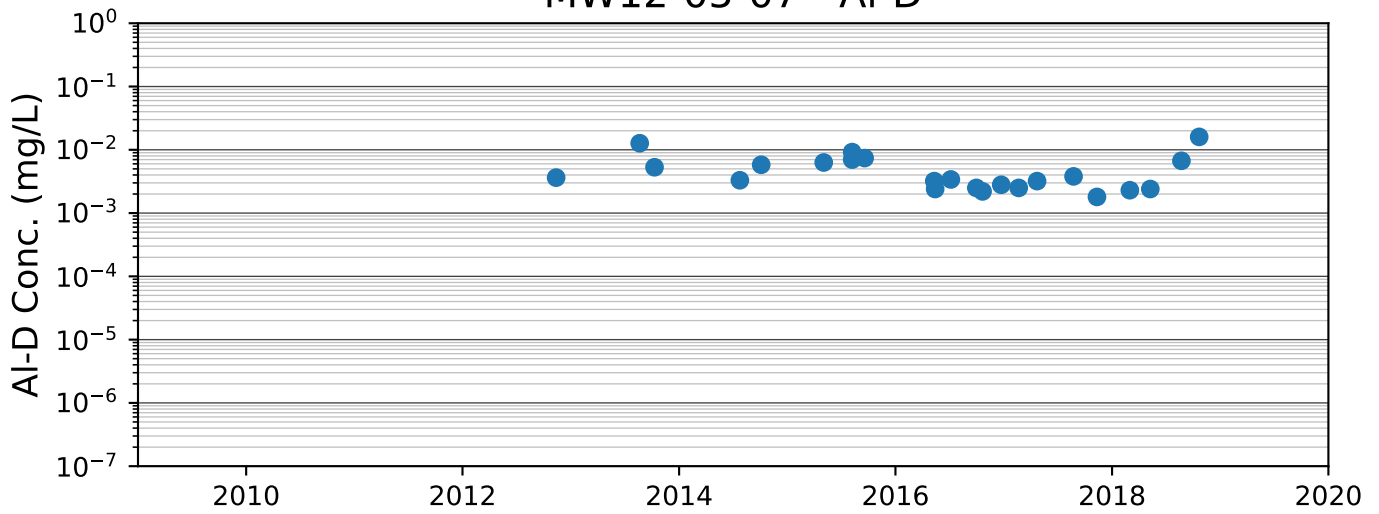


Attachment 2: Groundwater Monitoring Data for All CoCs

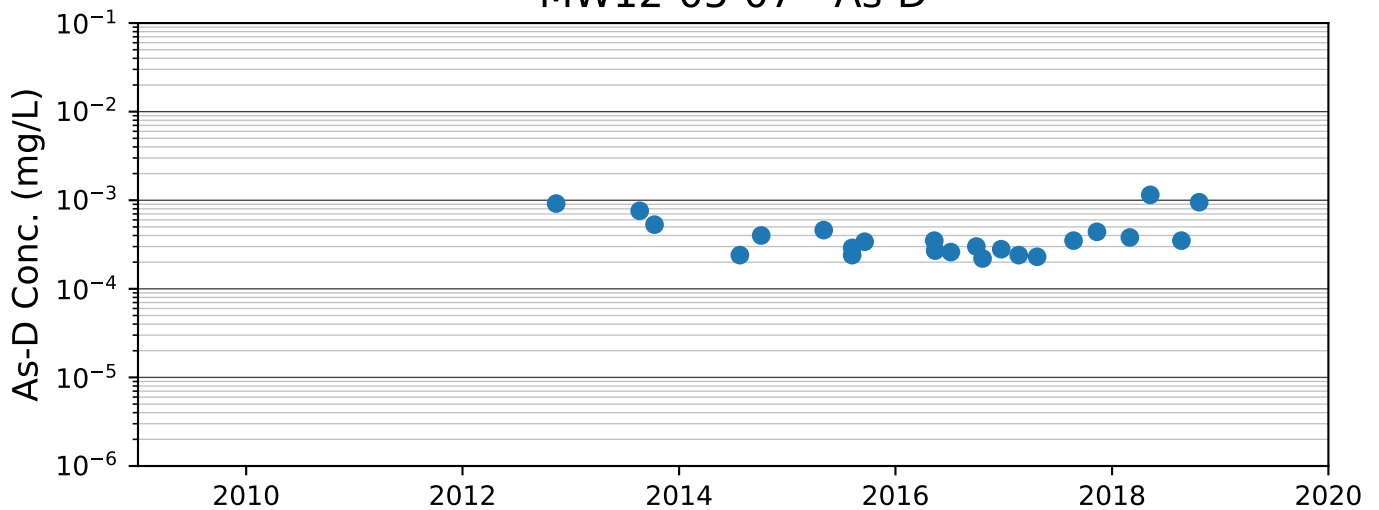
MW12-05-07 - Ag-D



MW12-05-07 - Al-D

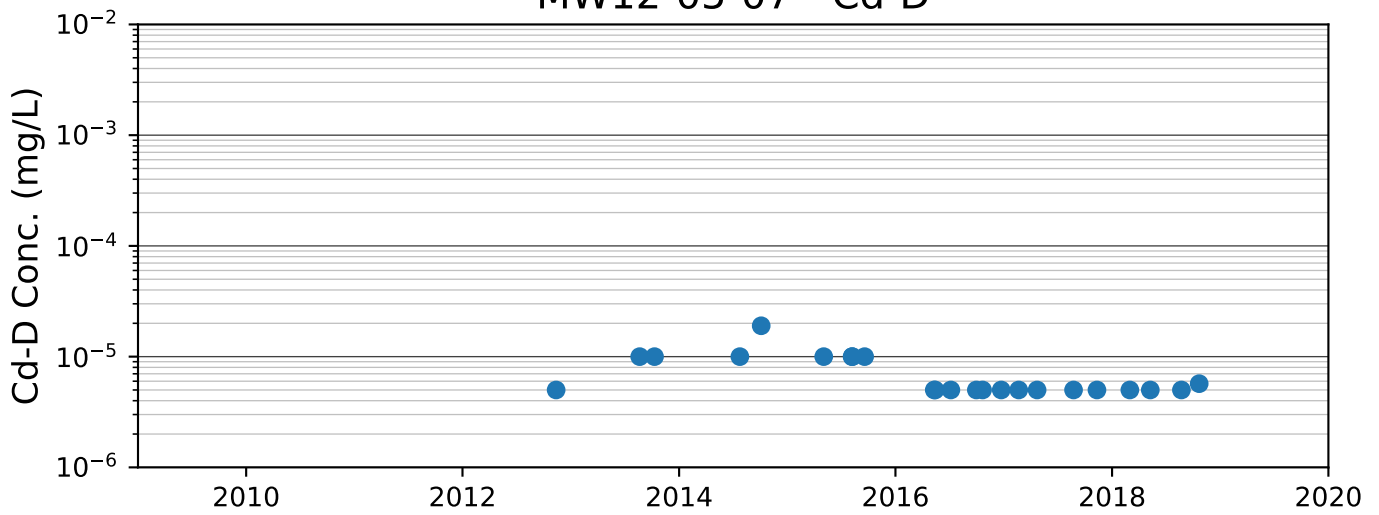


MW12-05-07 - As-D

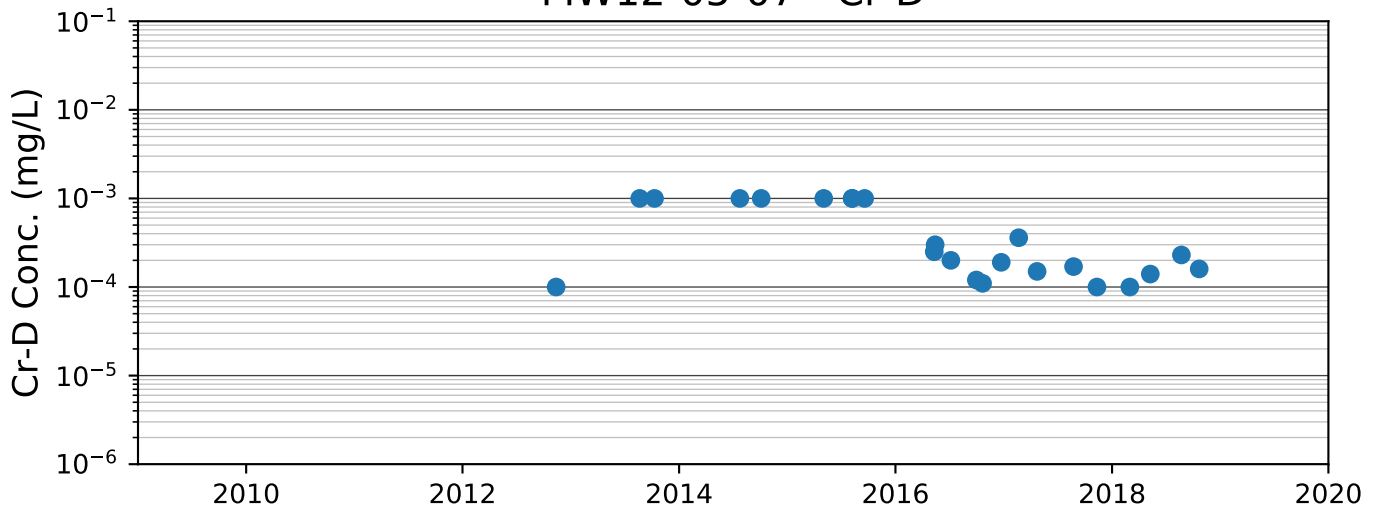


Attachment 2: Groundwater Monitoring Data for All CoCs

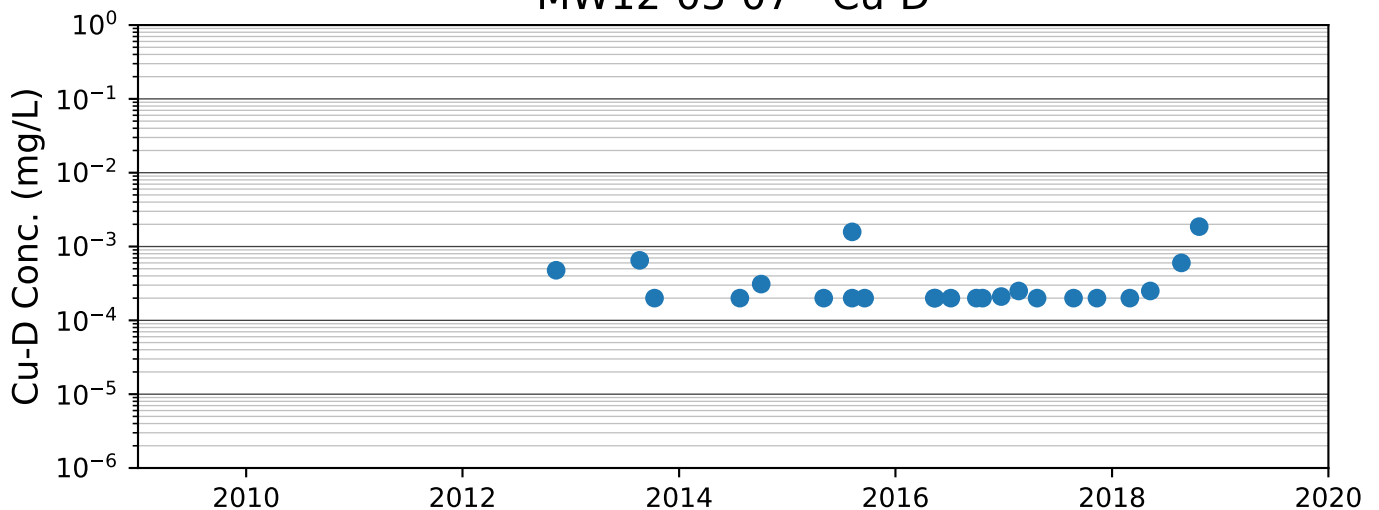
MW12-05-07 - Cd-D



MW12-05-07 - Cr-D

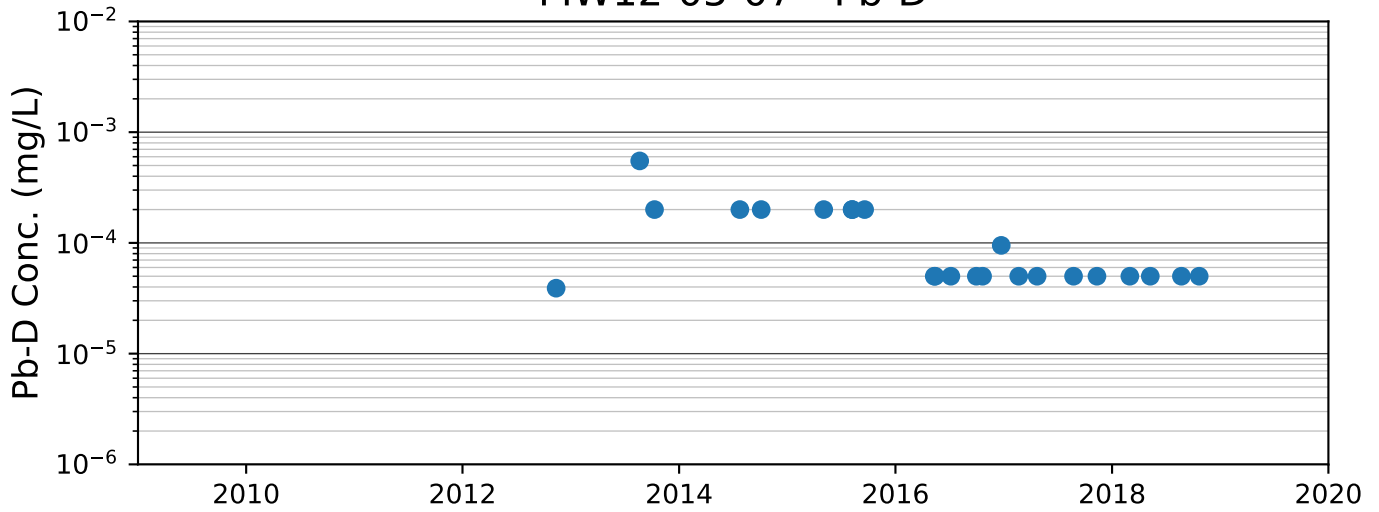


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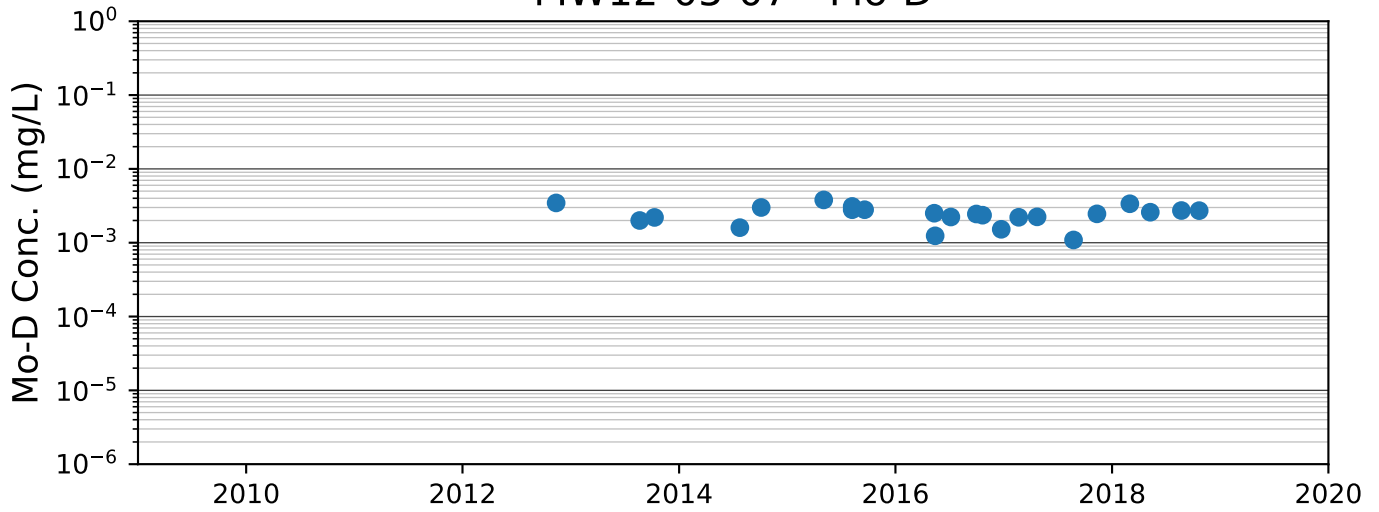


Attachment 2: Groundwater Monitoring Data for All CoCs

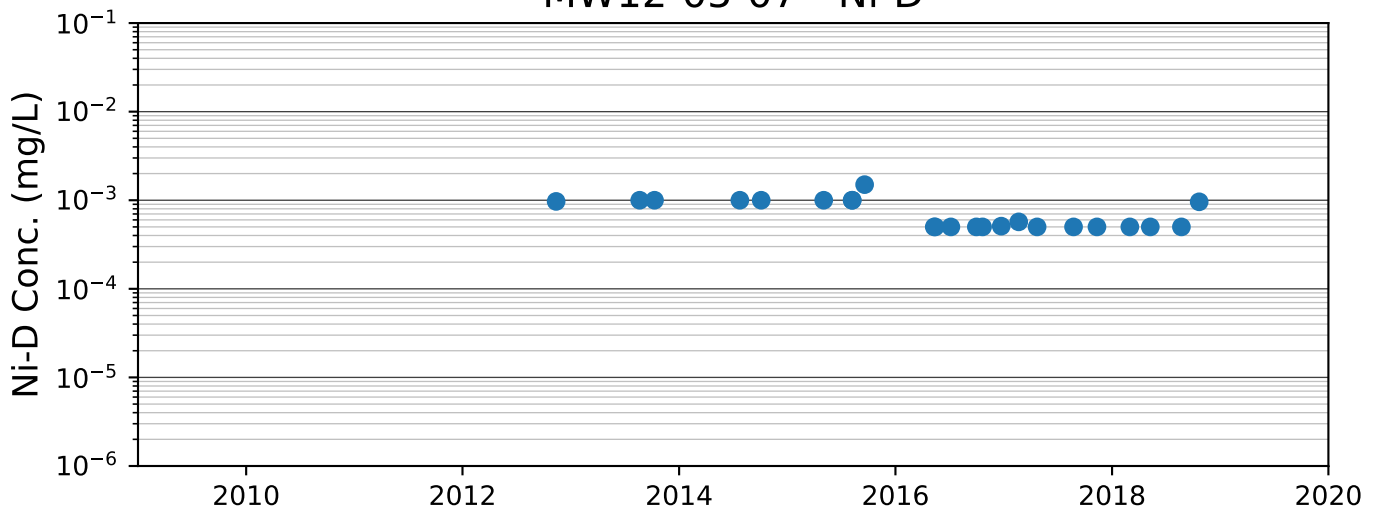
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MW12-05-07 - Mo-D

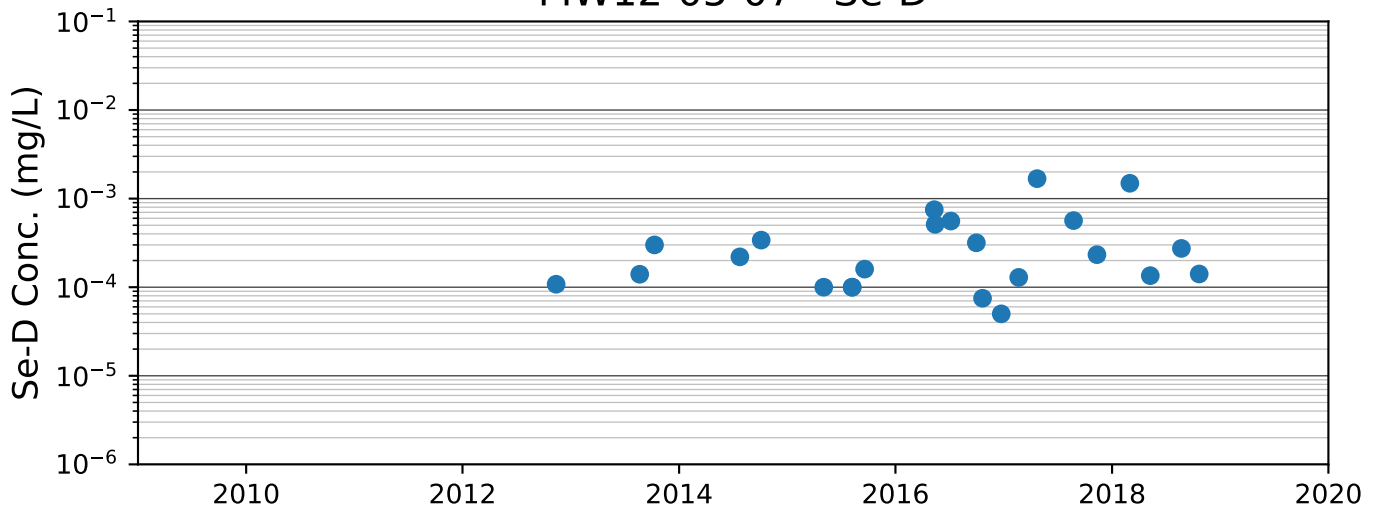


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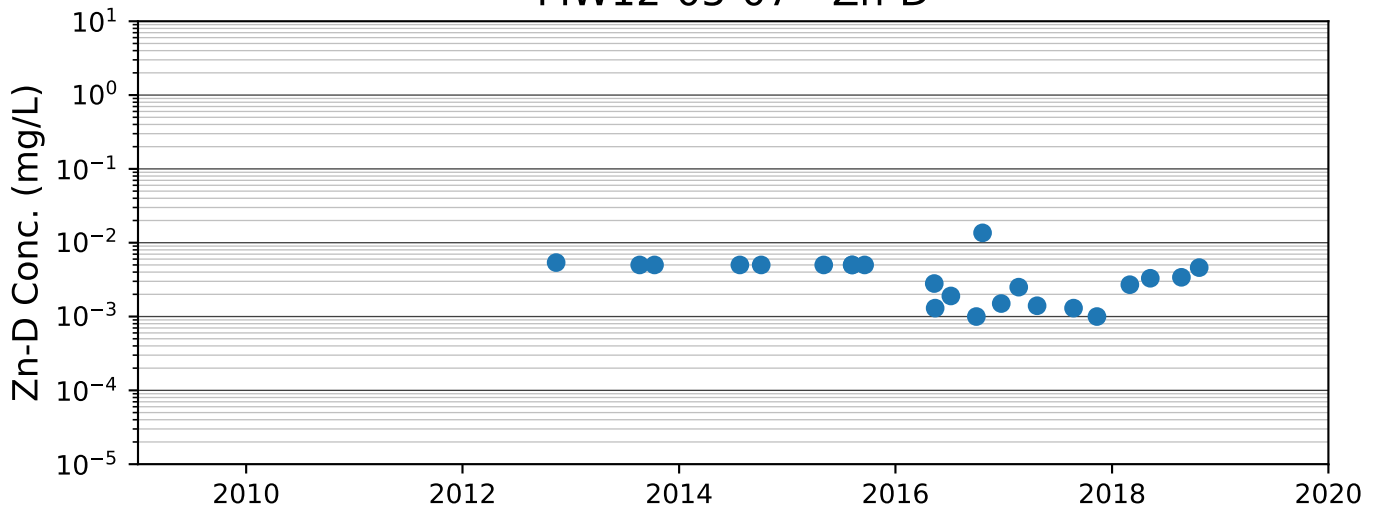


Attachment 2: Groundwater Monitoring Data for All CoCs

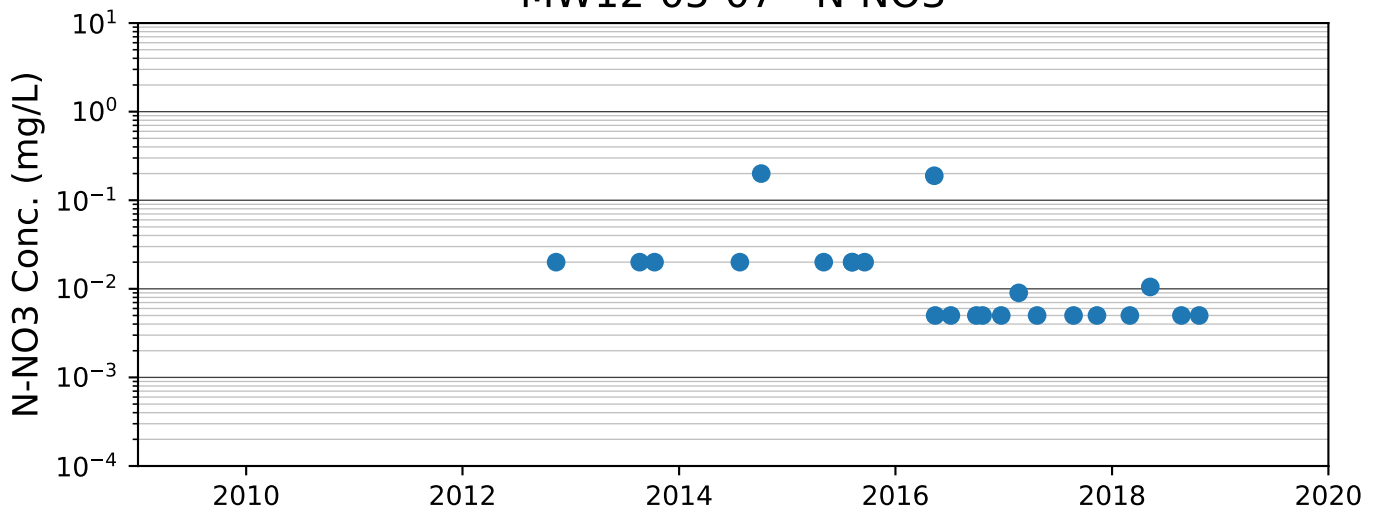
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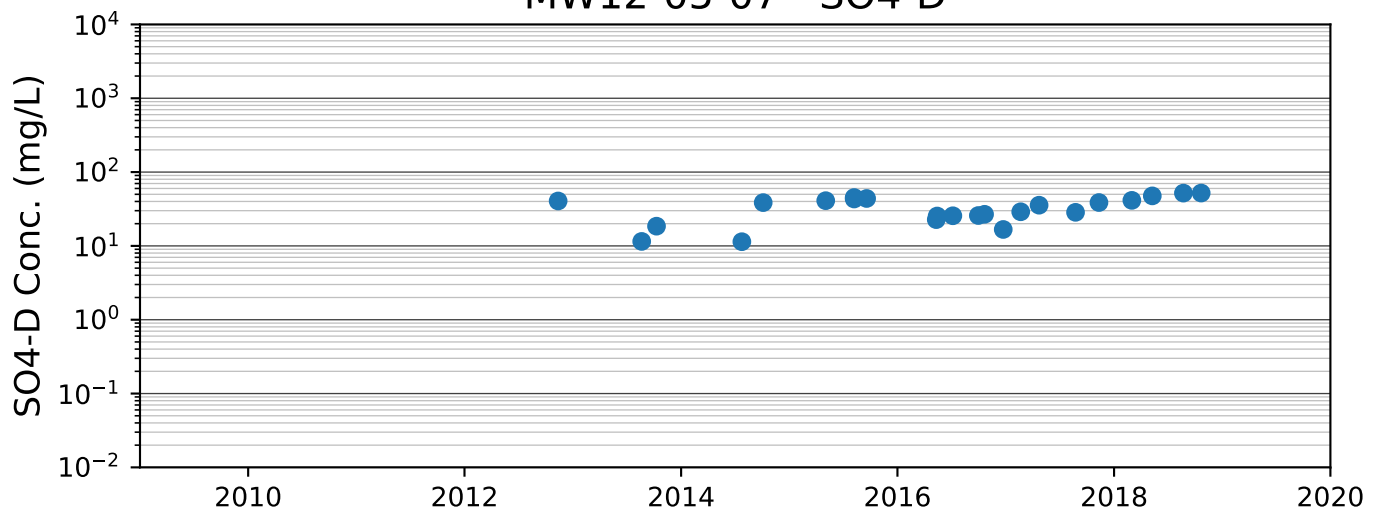
MW12-05-07 - Zn-D



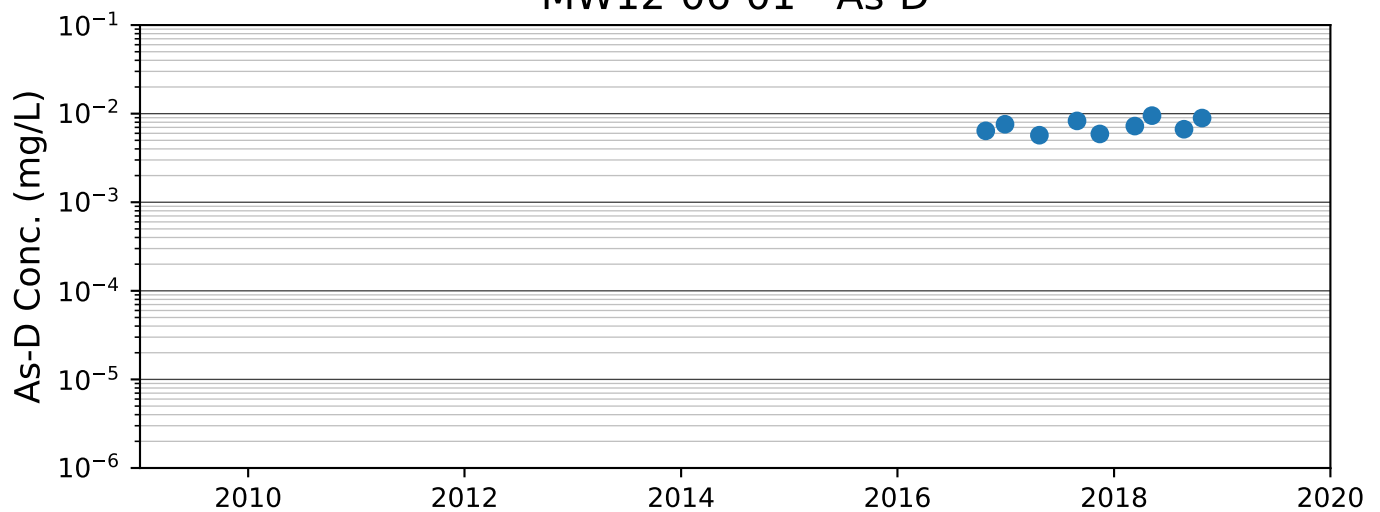
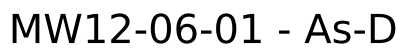
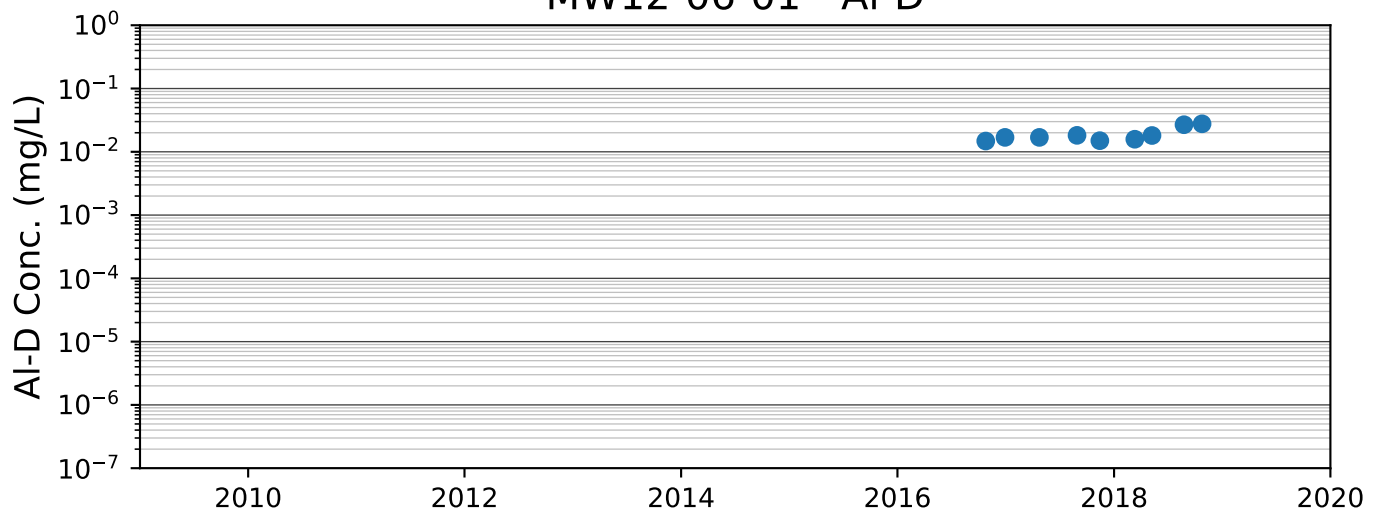
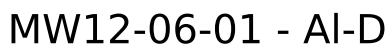
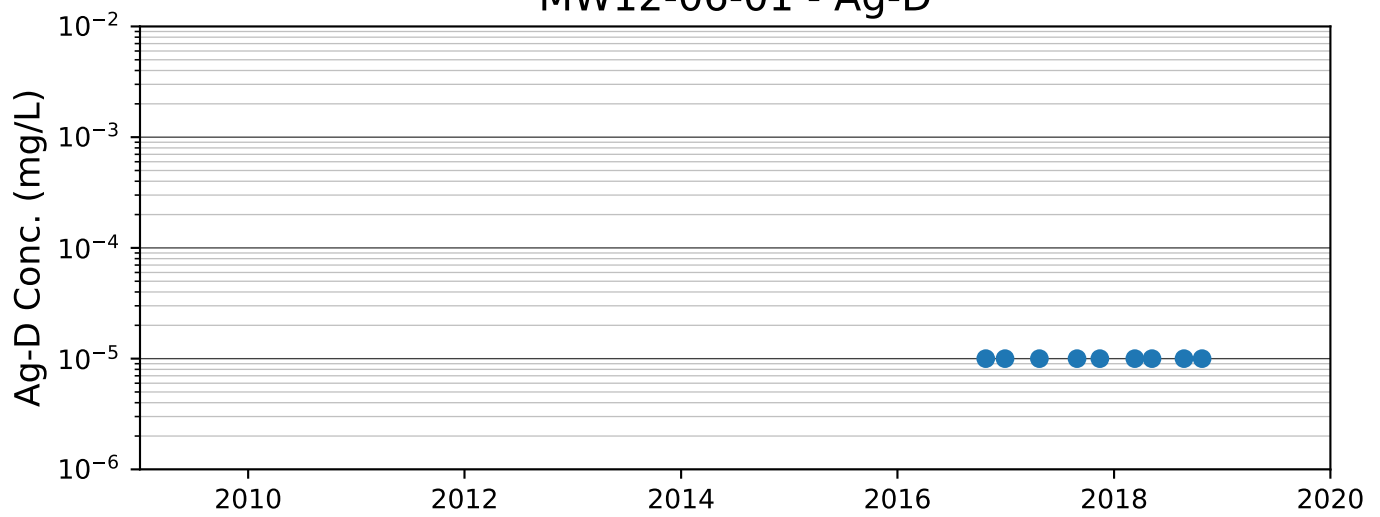
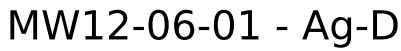
MW12-05-07 - N-NO3



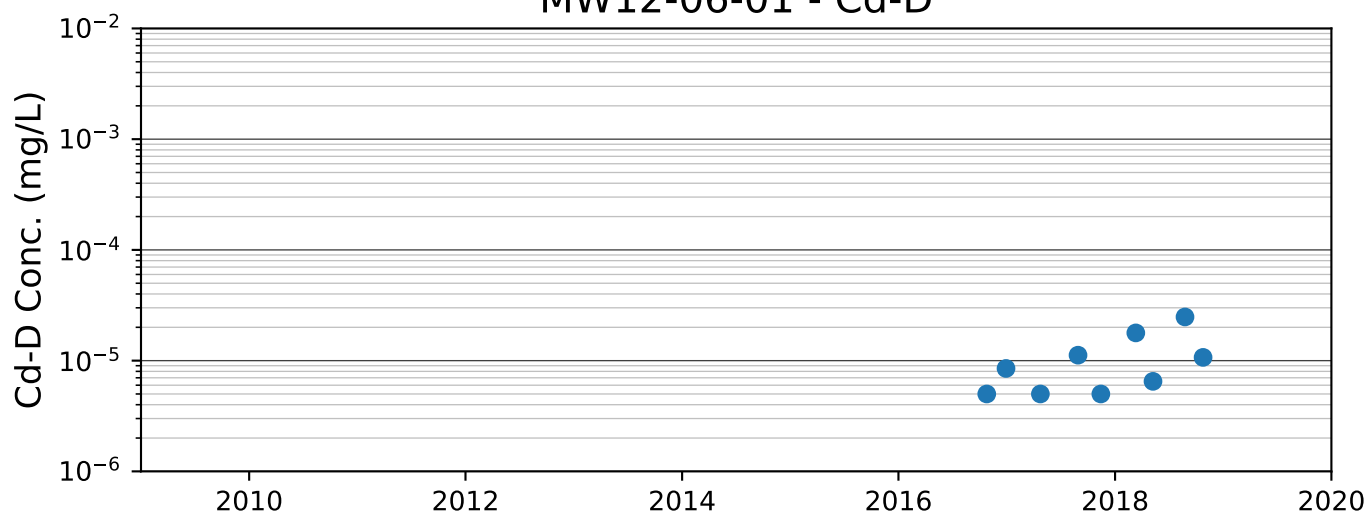
MW12-05-07 - SO4-D



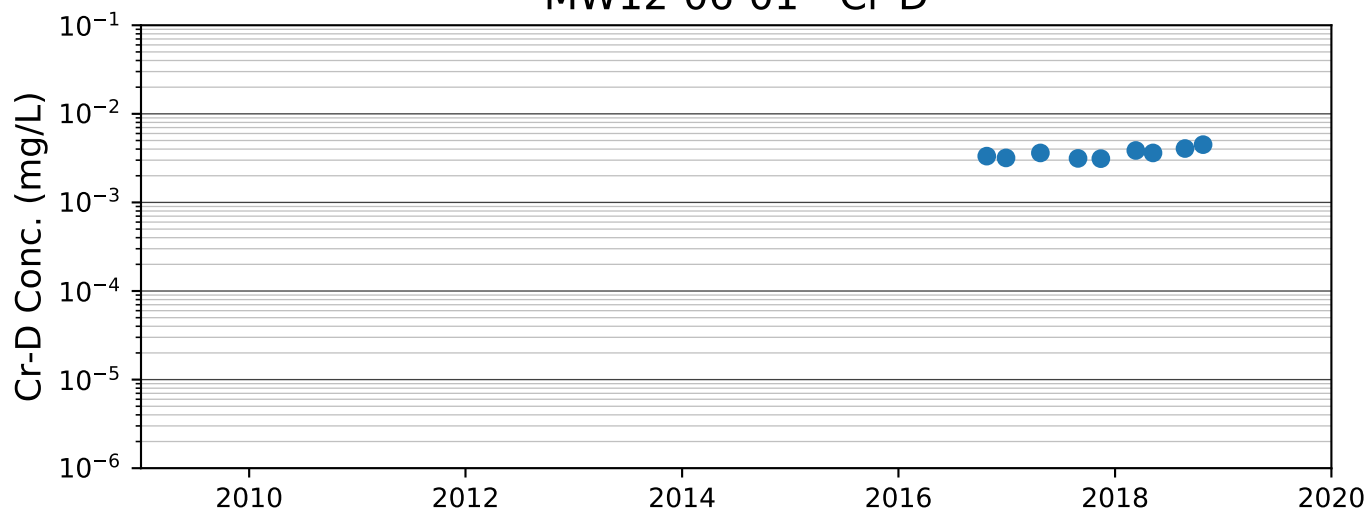
Attachment 2: Groundwater Monitoring Data for All CoCs



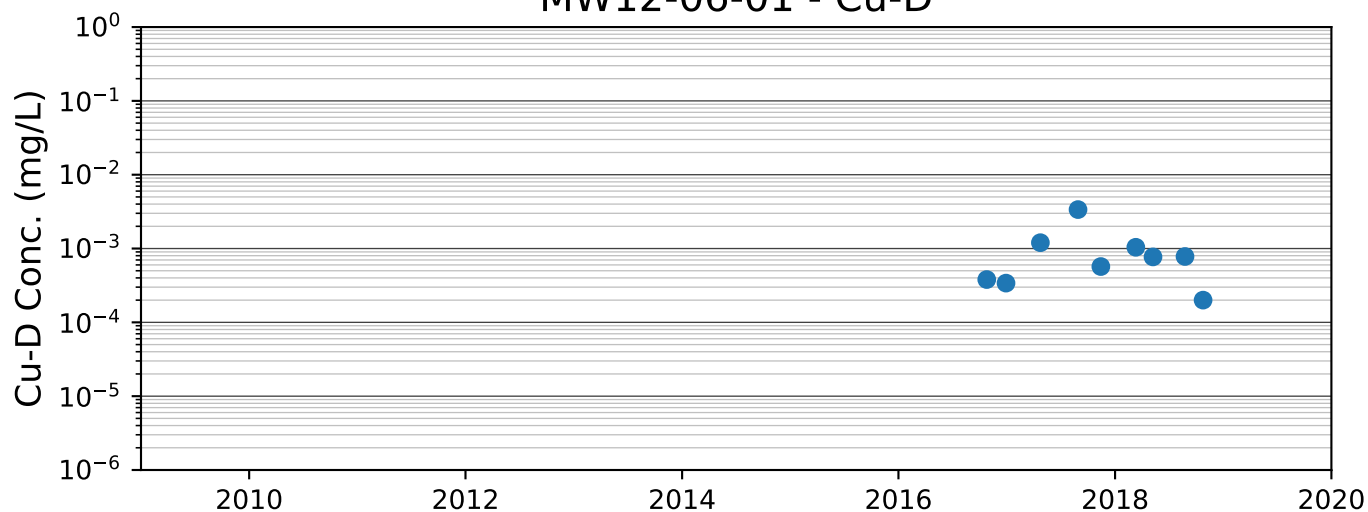
MW12-06-01 - Cd-D



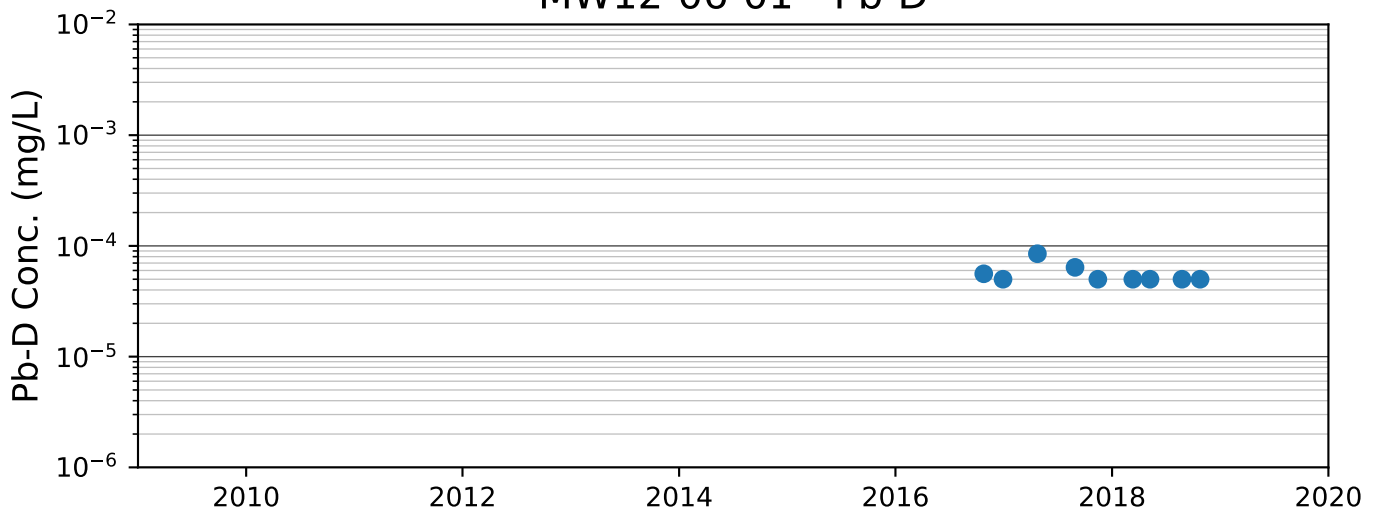
MW12-06-01 - Cr-D



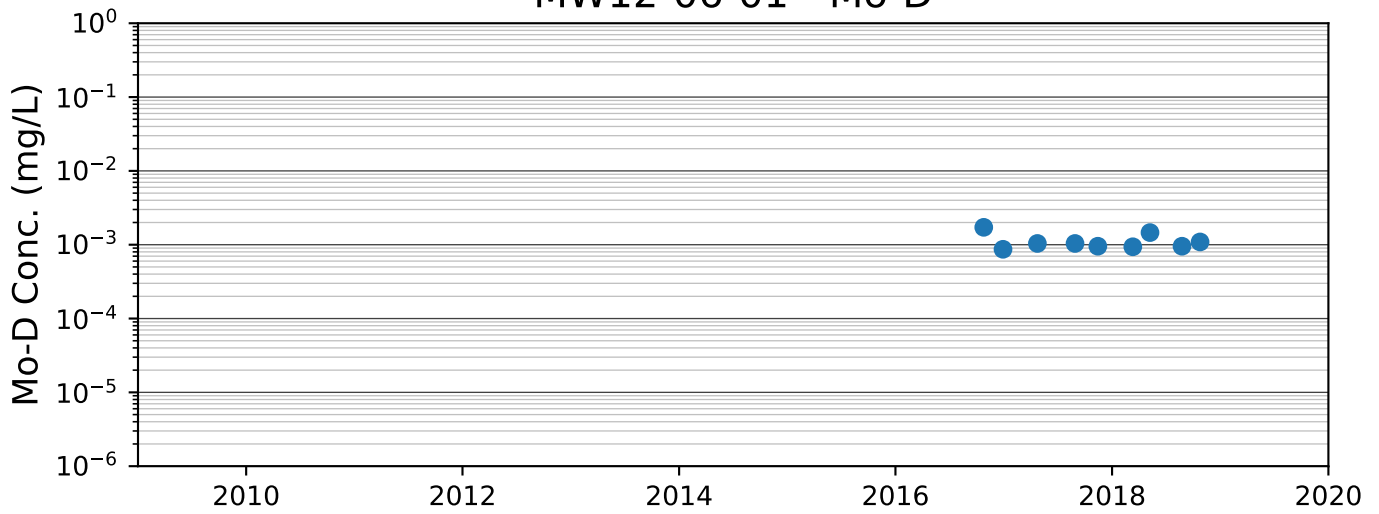
MW12-06-01 - Cu-D



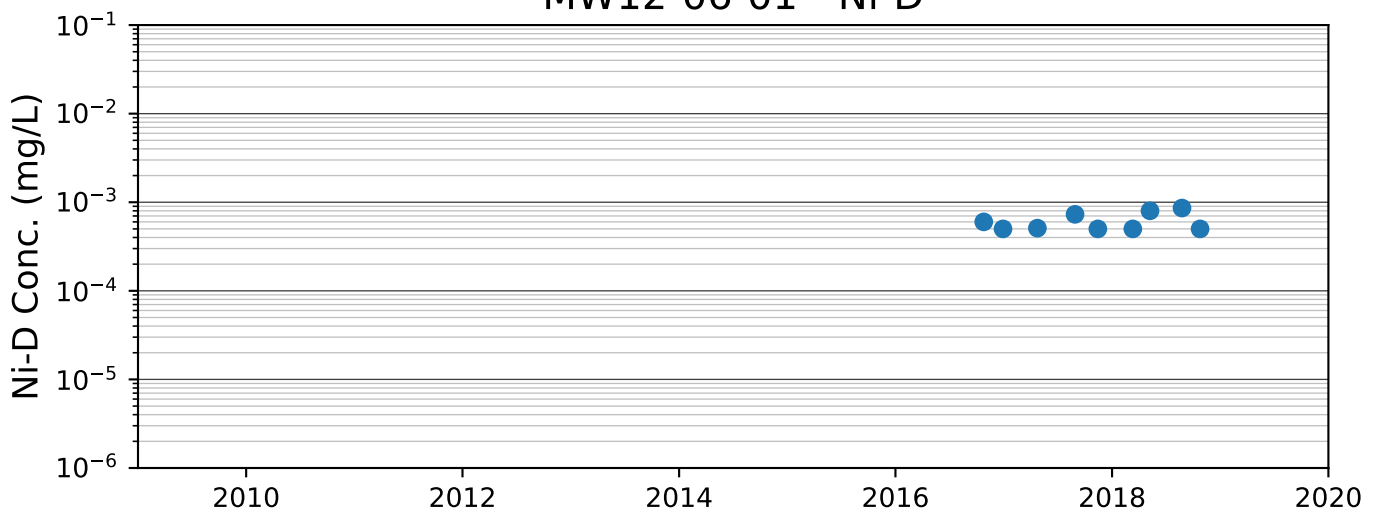
MW12-06-01 - Pb-D



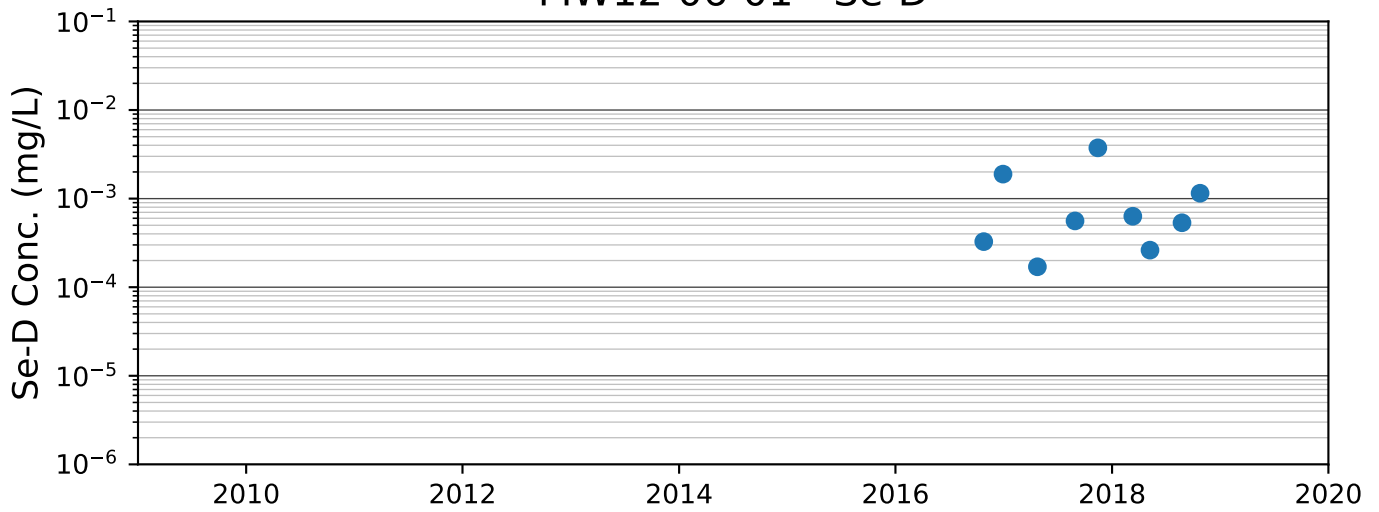
MW12-06-01 - Mo-D



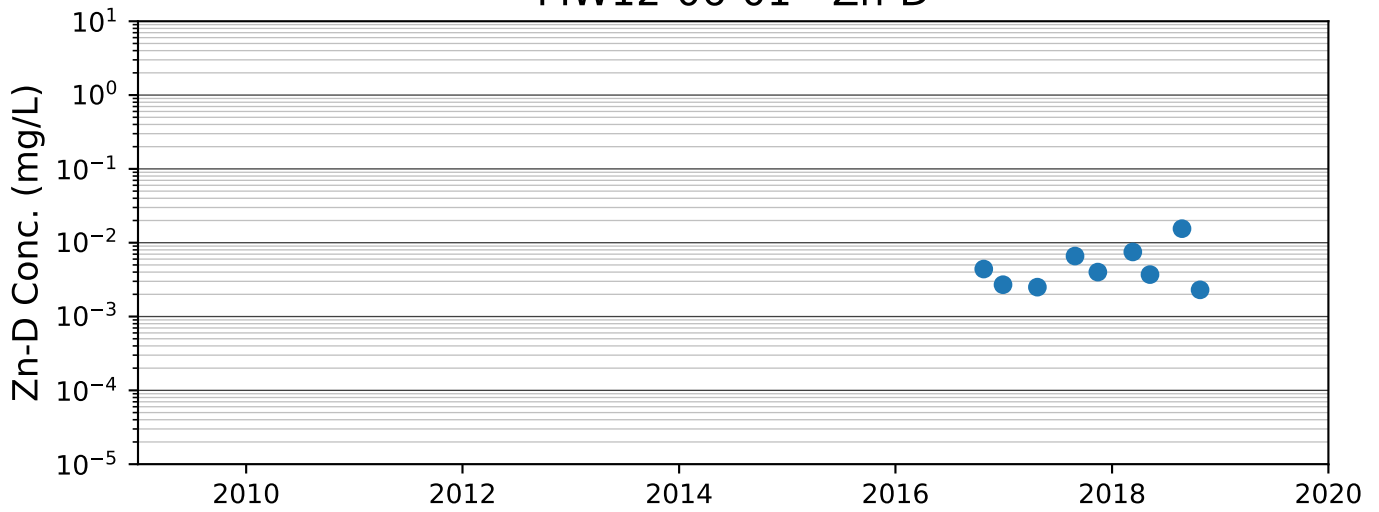
MW12-06-01 - Ni-D



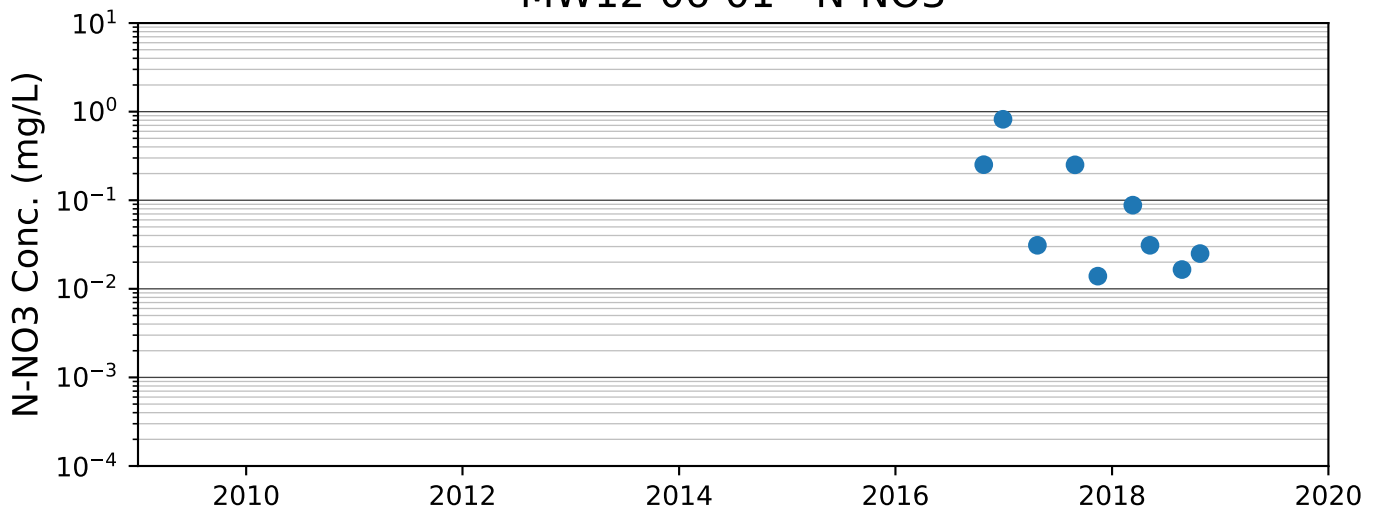
MW12-06-01 - Se-D



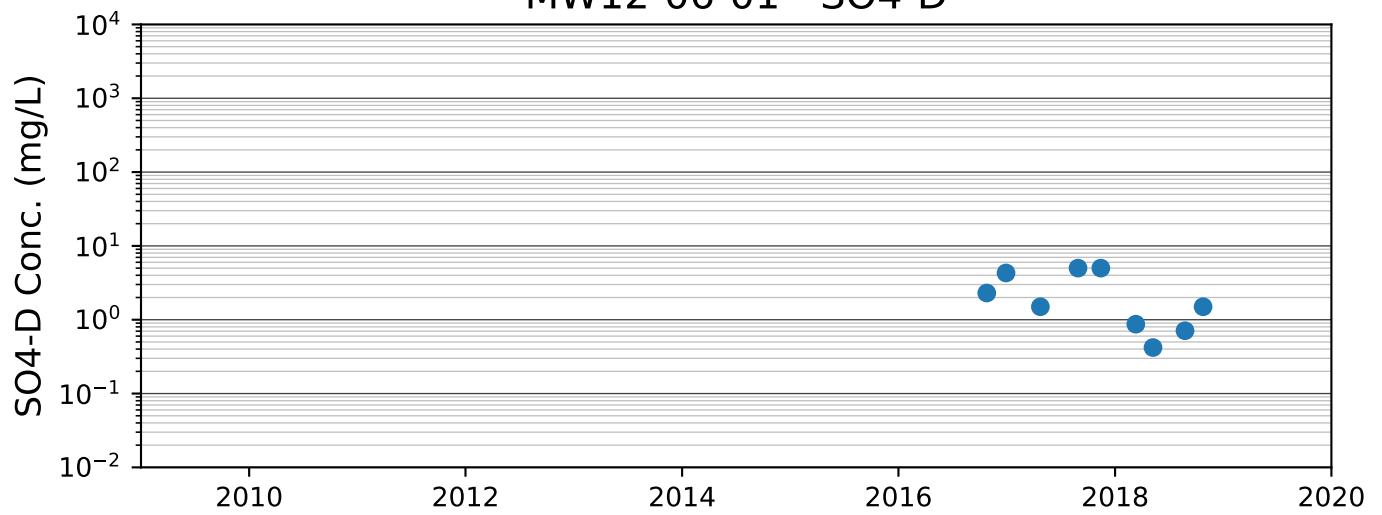
MW12-06-01 - Zn-D



MW12-06-01 - N-NO3

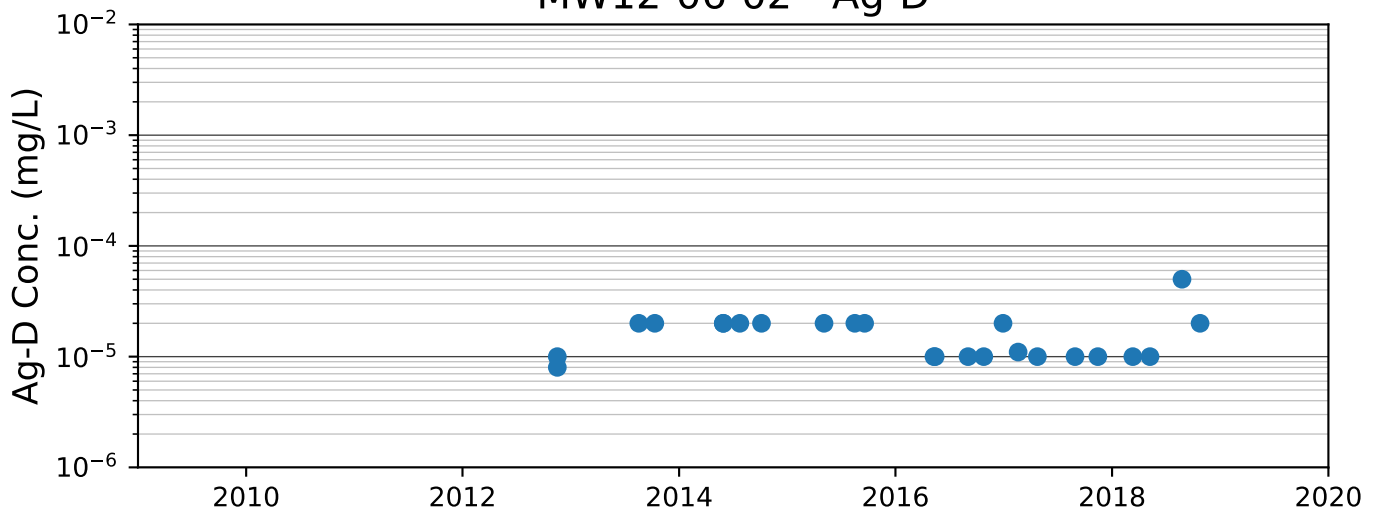


MW12-06-01 - SO4-D

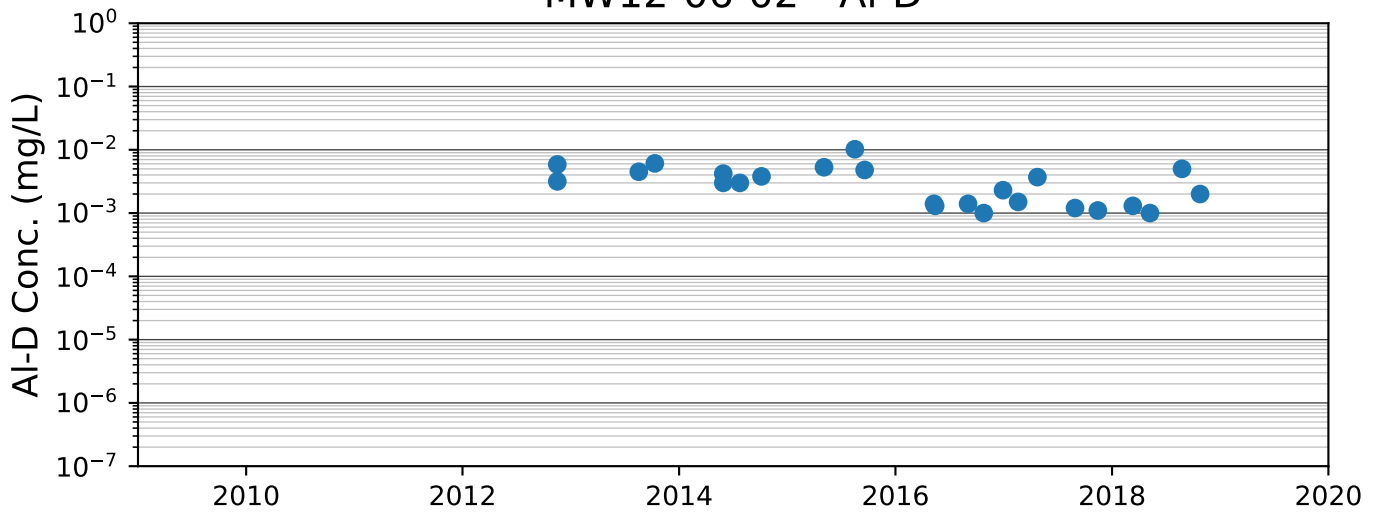


Attachment 2: Groundwater Monitoring Data for All CoCs

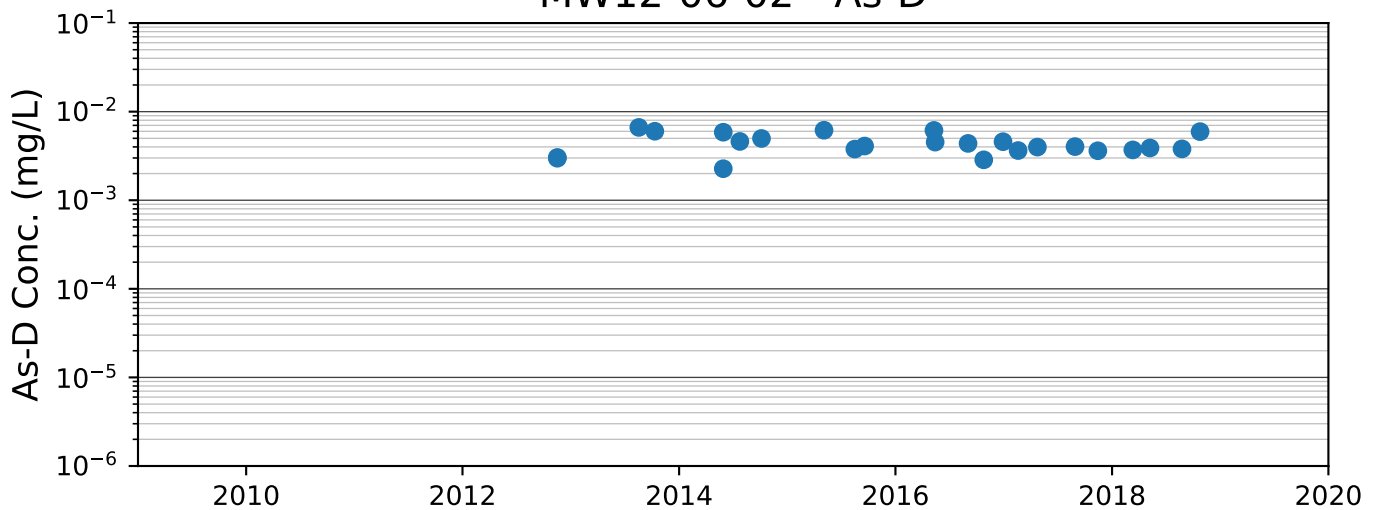
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MW12-06-02 - Al-D

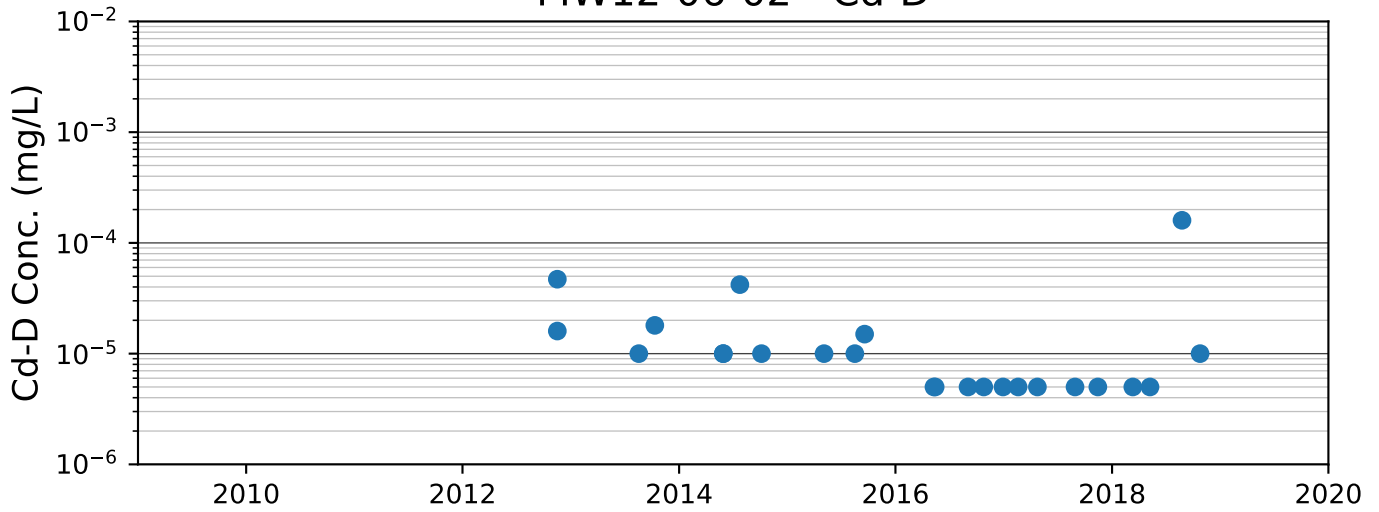


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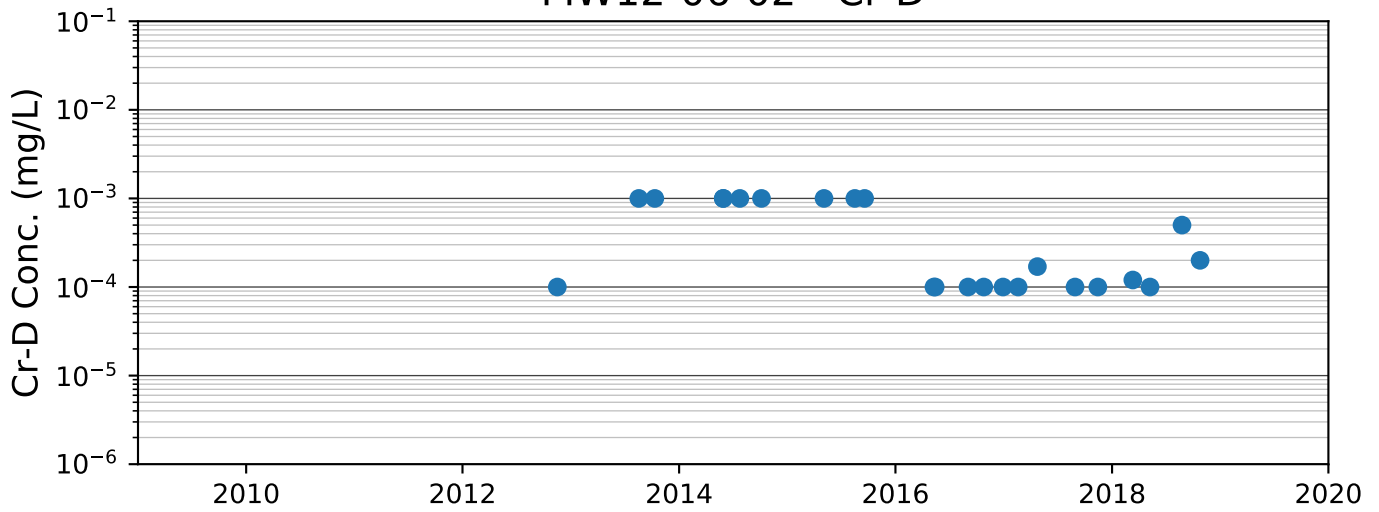


Attachment 2: Groundwater Monitoring Data for All CoCs

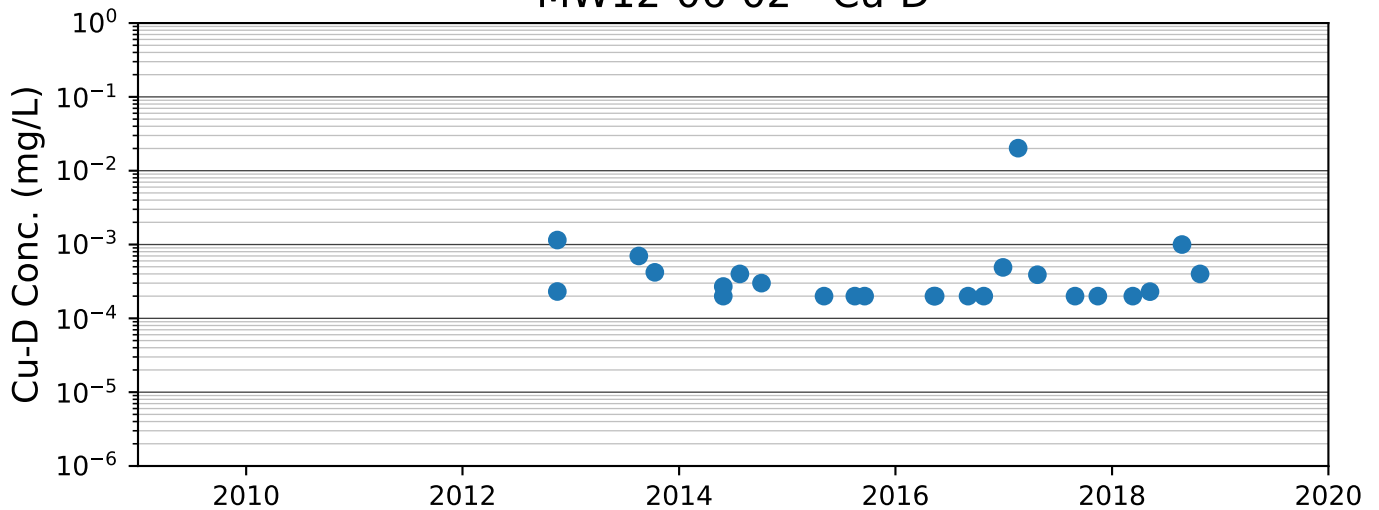
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MW12-06-02 - Cr-D

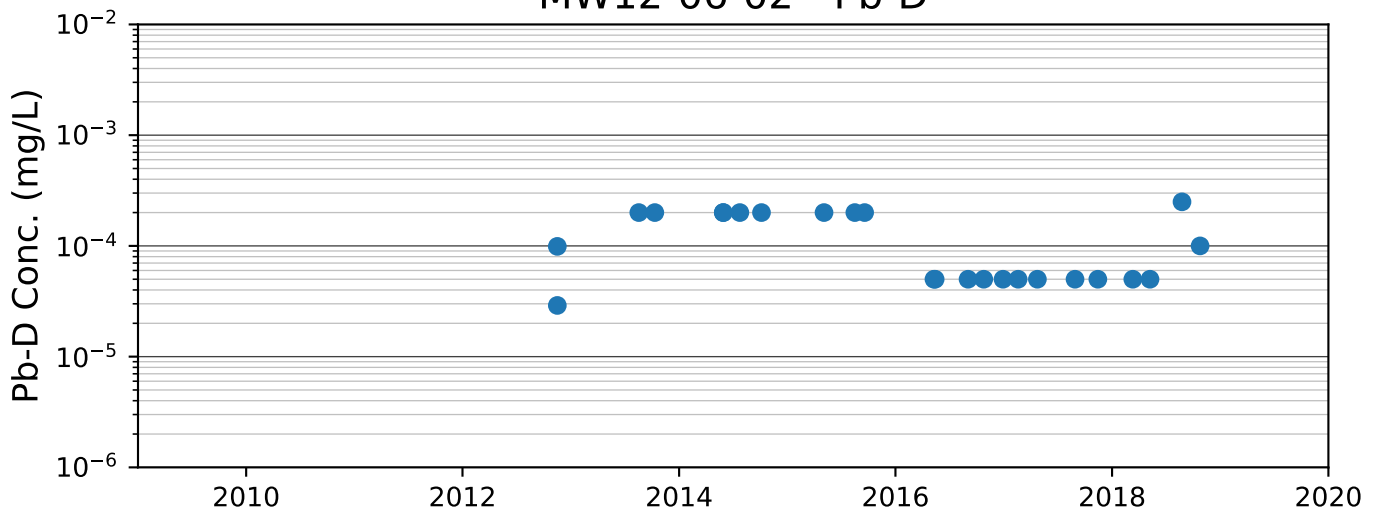


MW12-06-02 - Cu-D

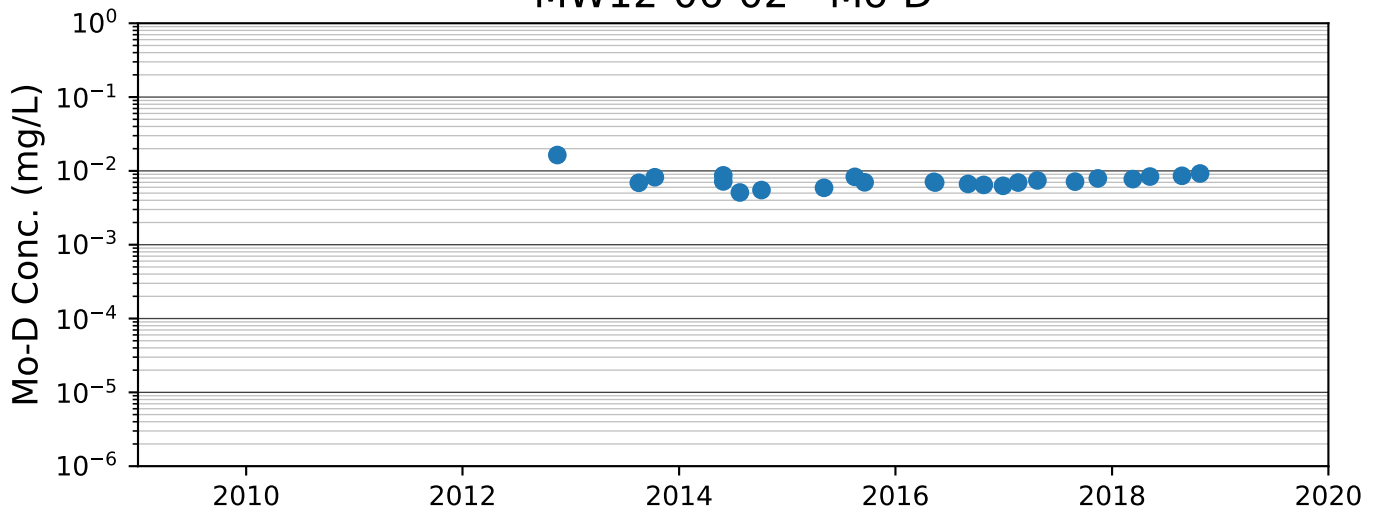


Attachment 2: Groundwater Monitoring Data for All CoCs

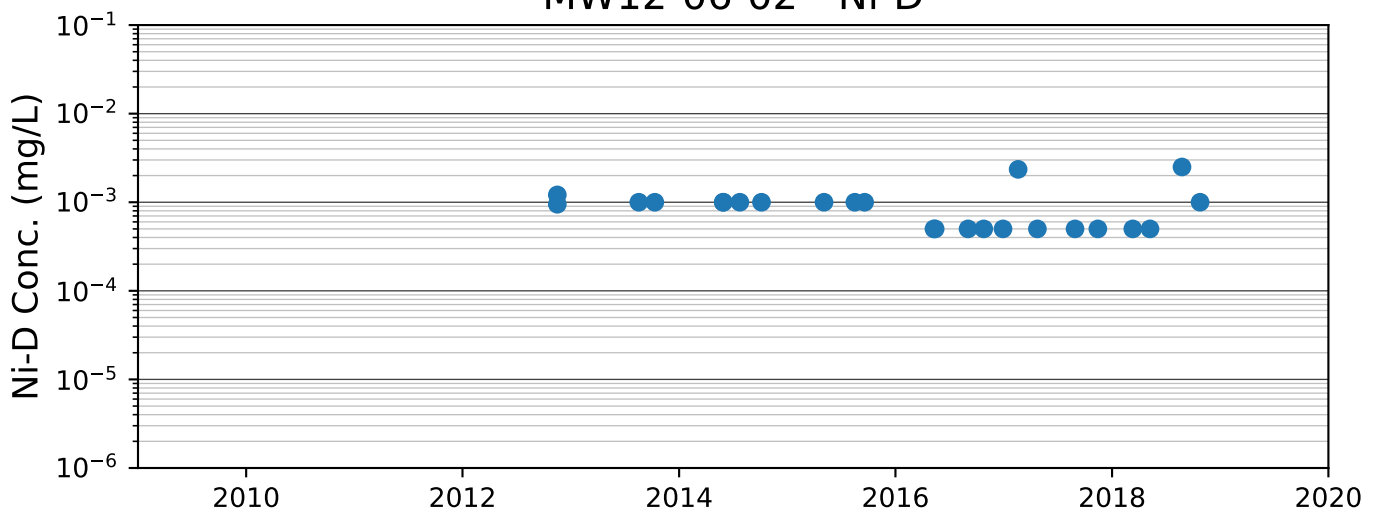
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MW12-06-02 - Mo-D

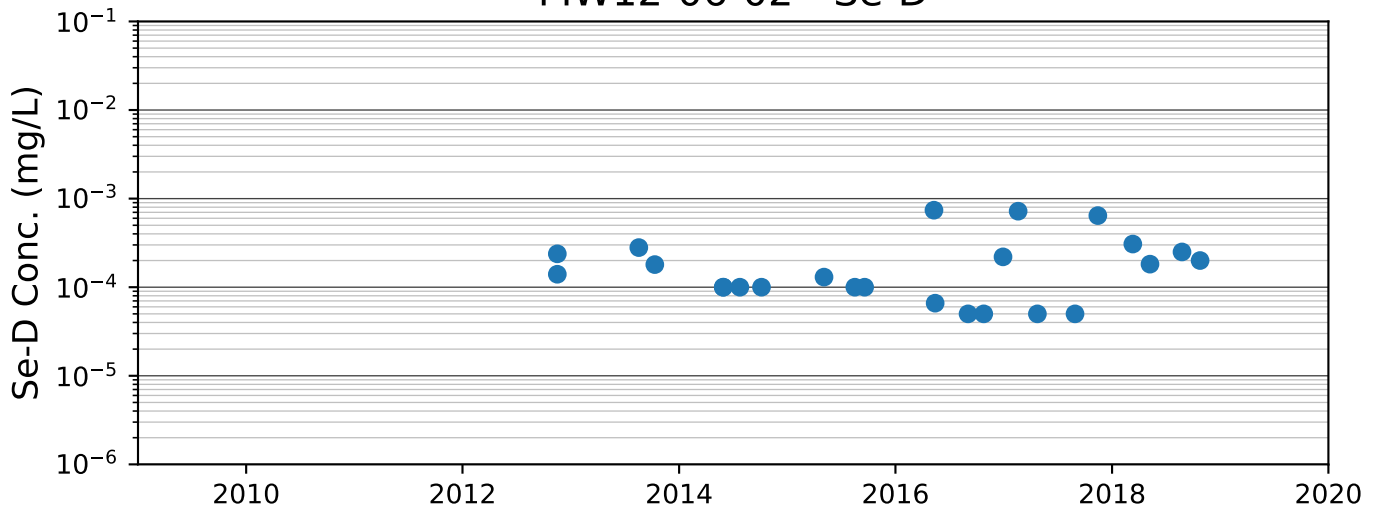


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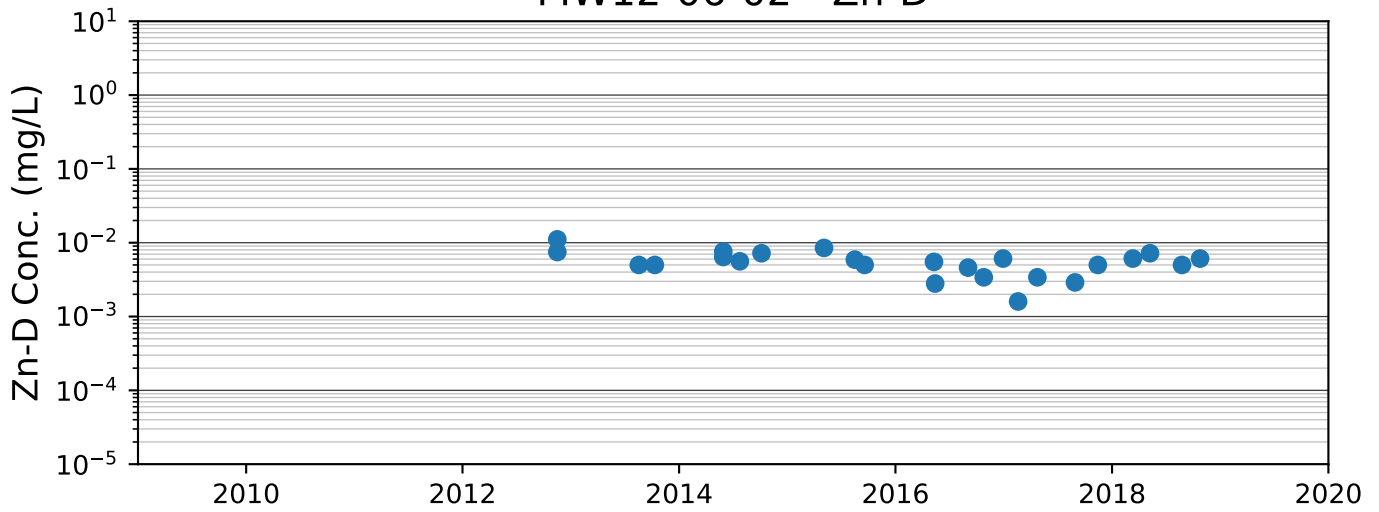


Attachment 2: Groundwater Monitoring Data for All CoCs

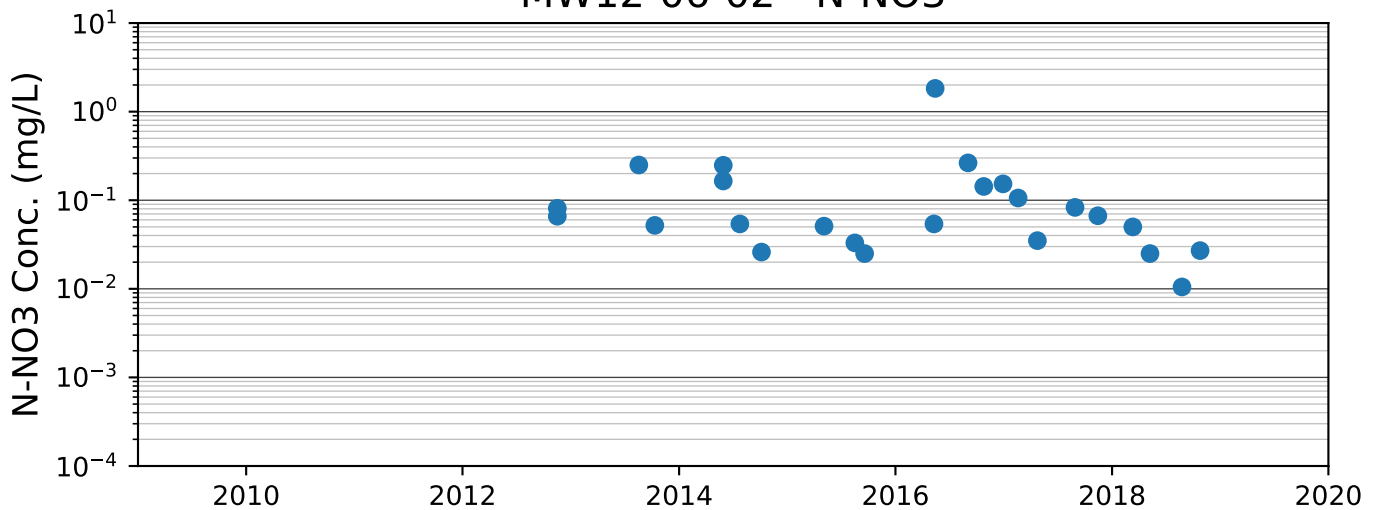
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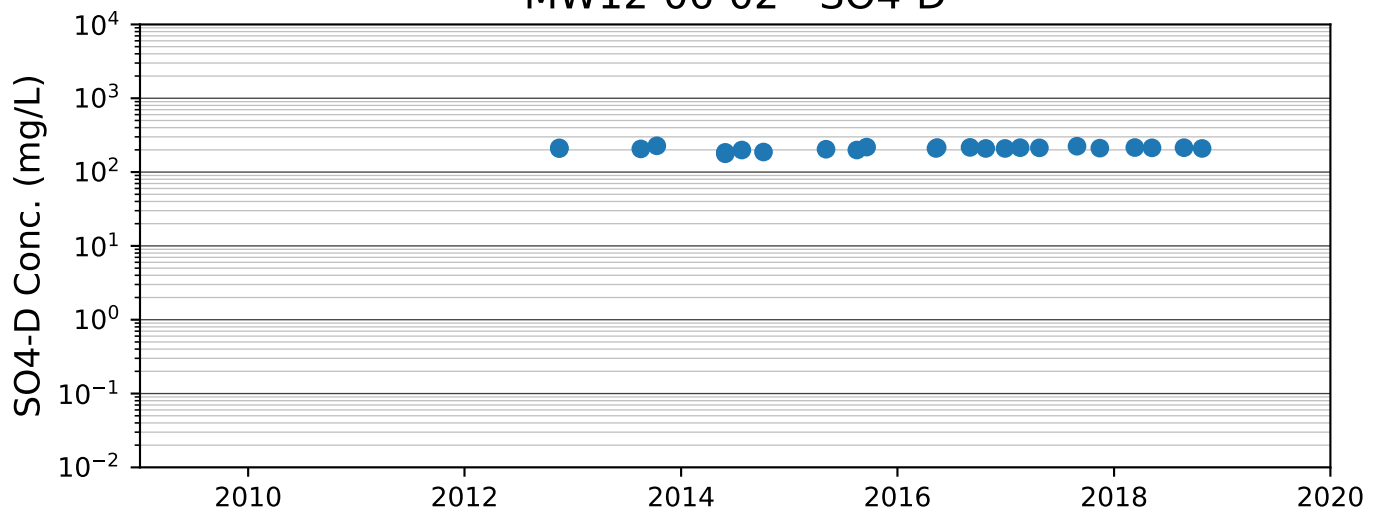
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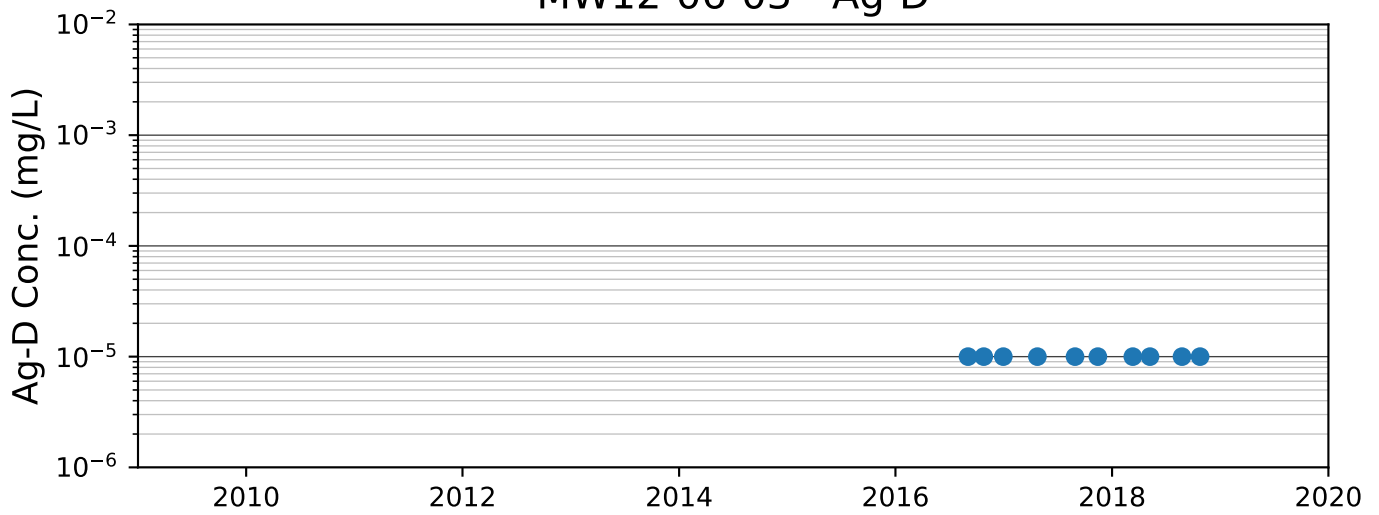
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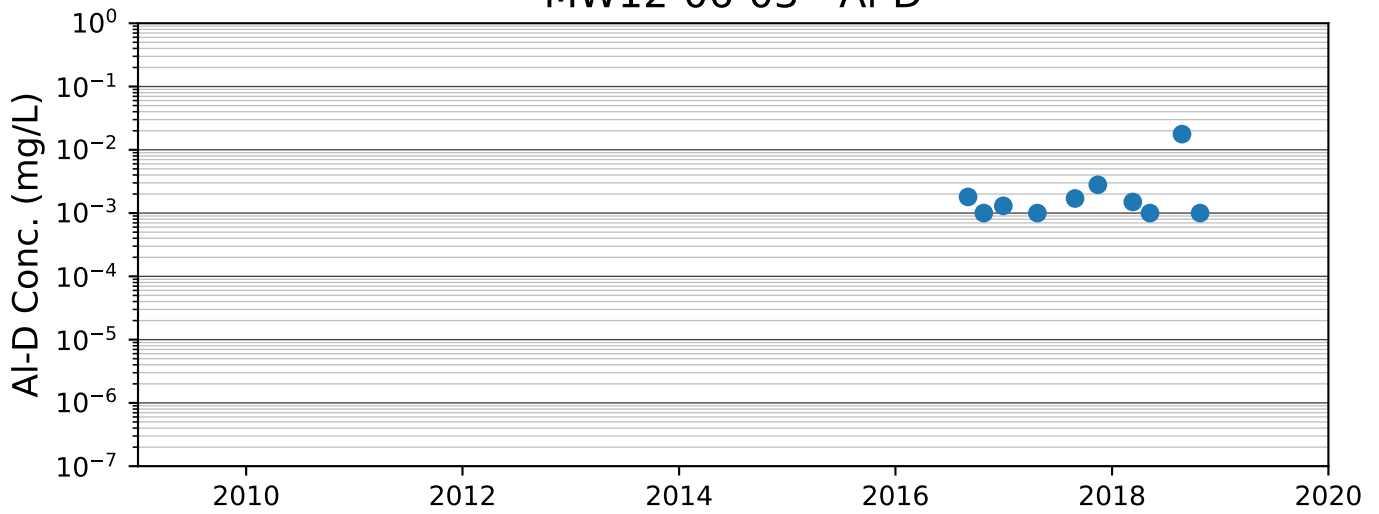
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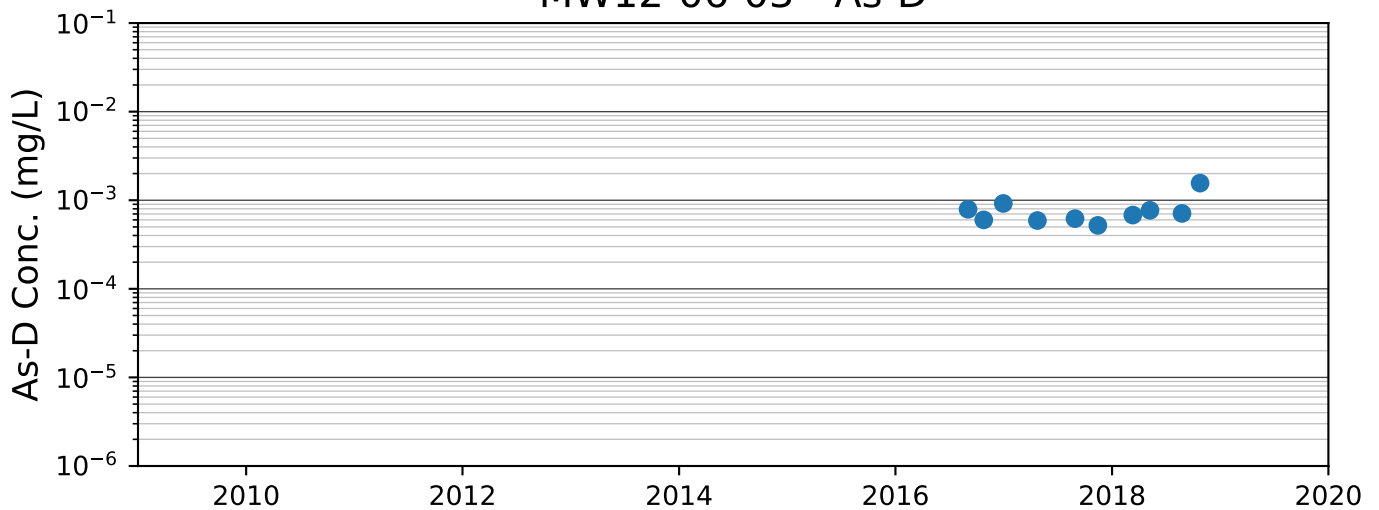
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MW12-06-03 - Al-D

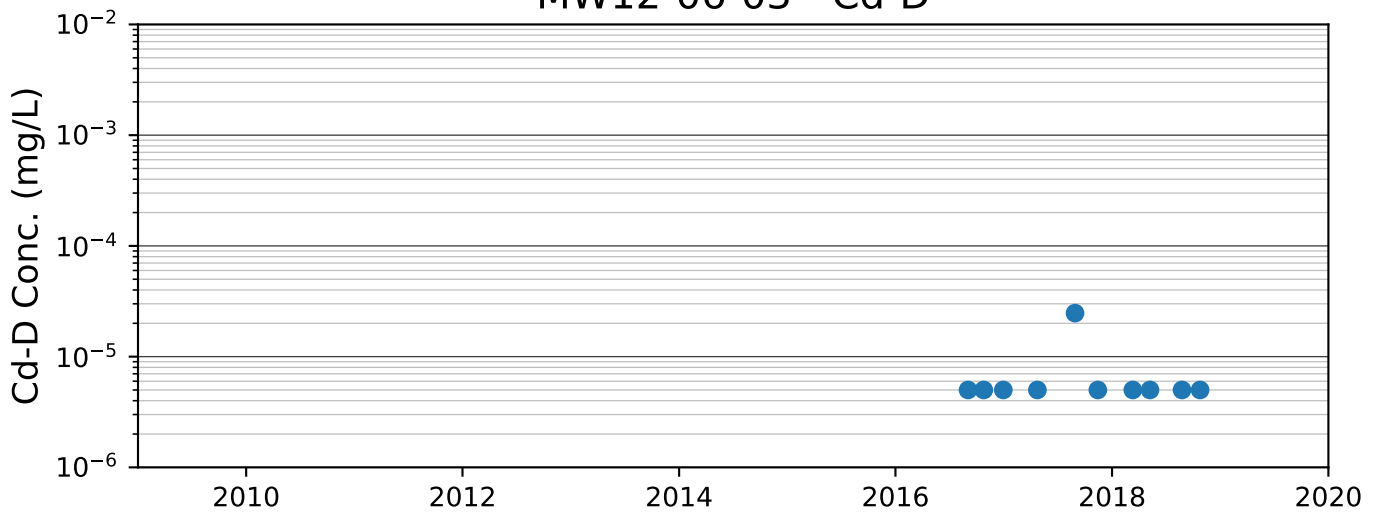


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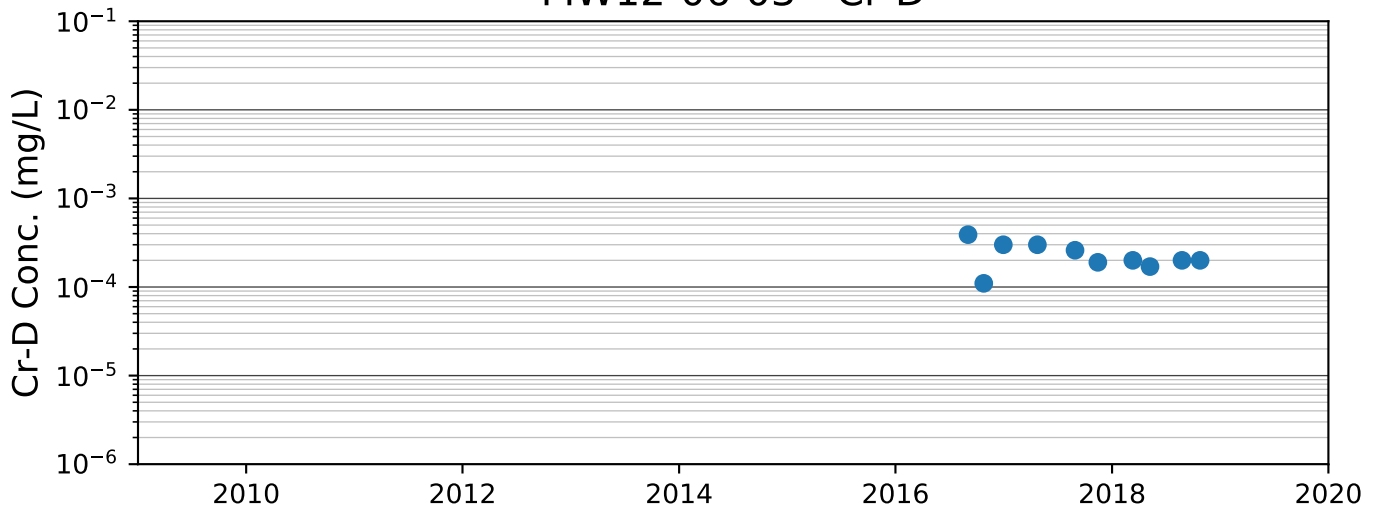


Attachment 2: Groundwater Monitoring Data for All CoCs

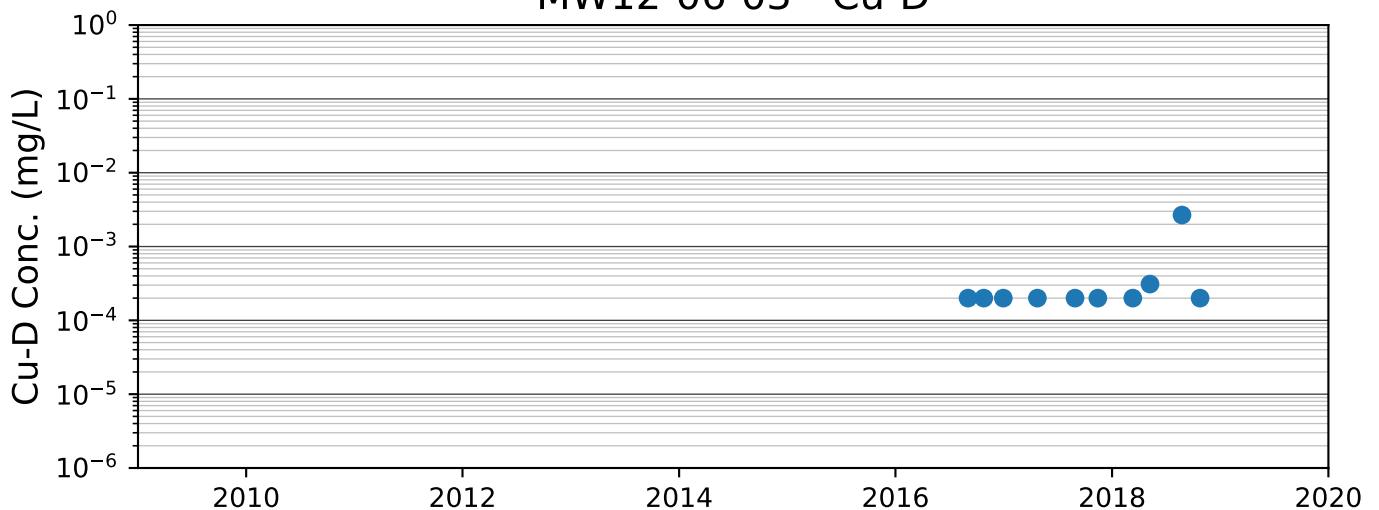
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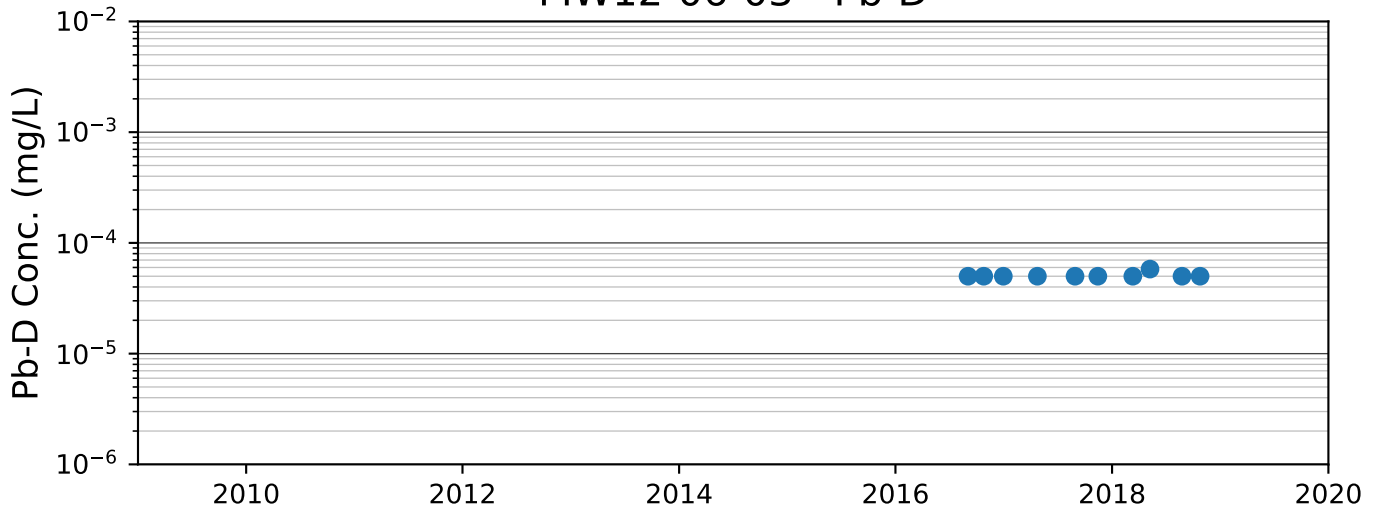
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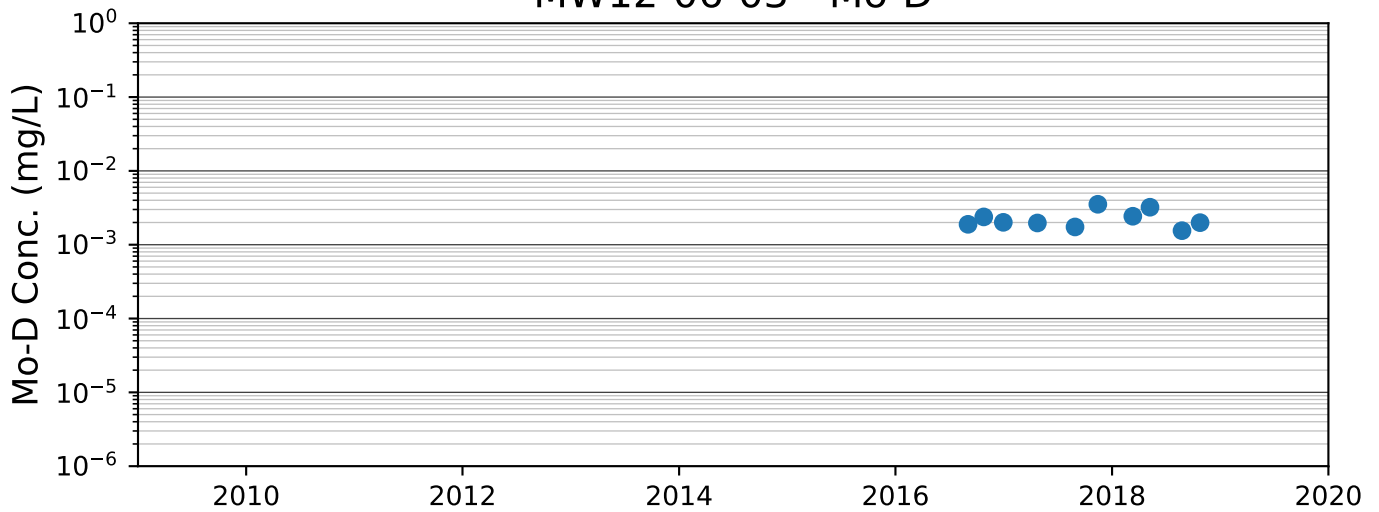
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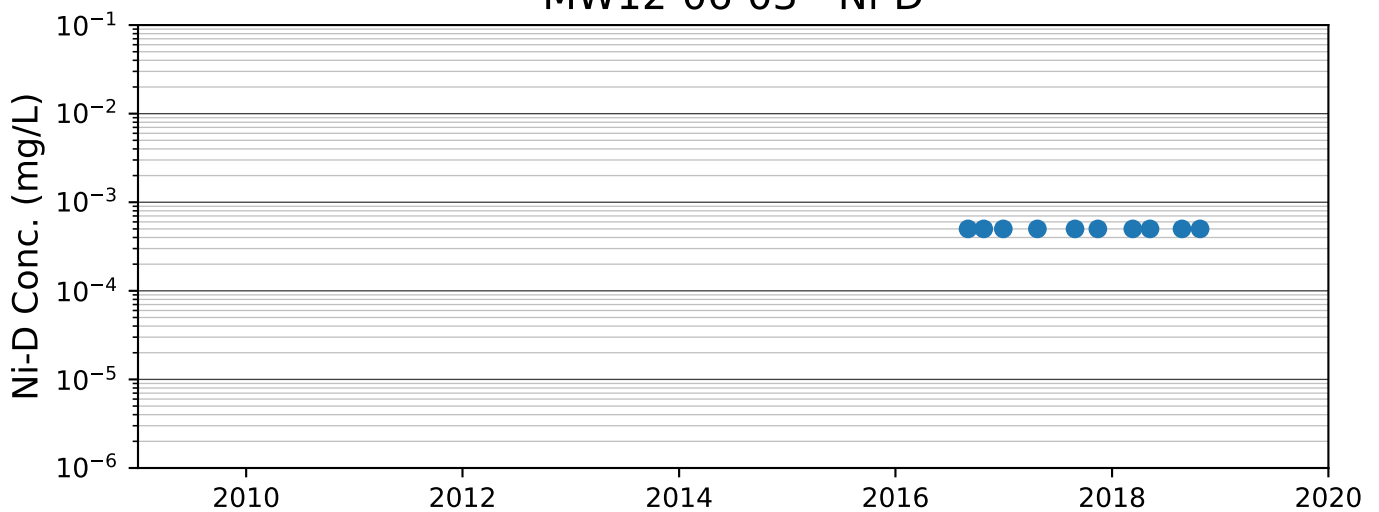
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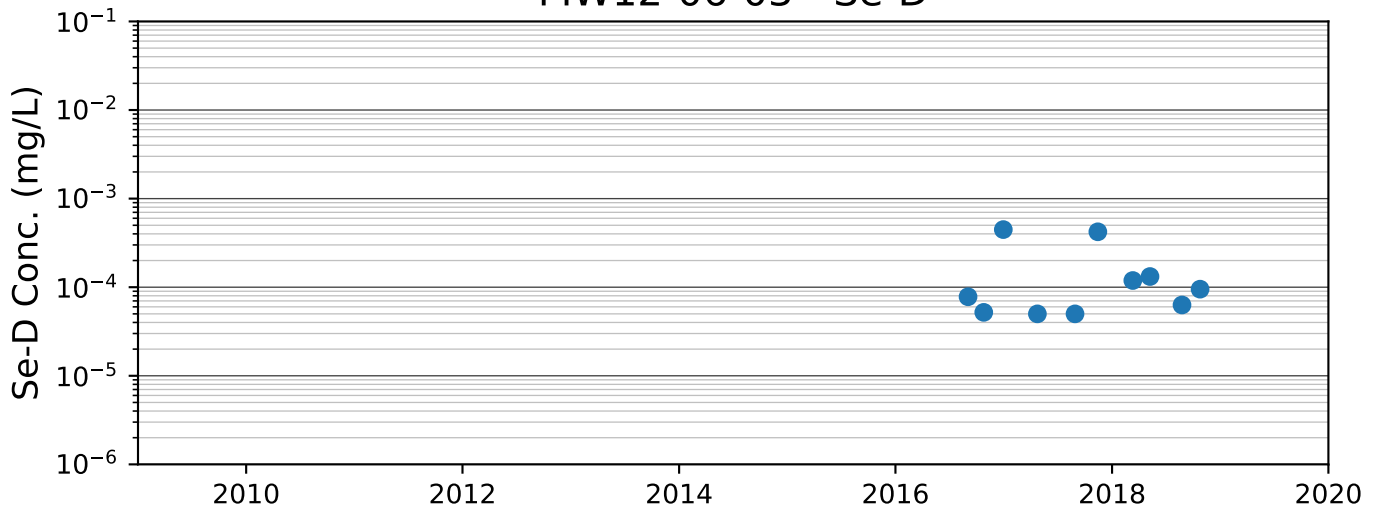
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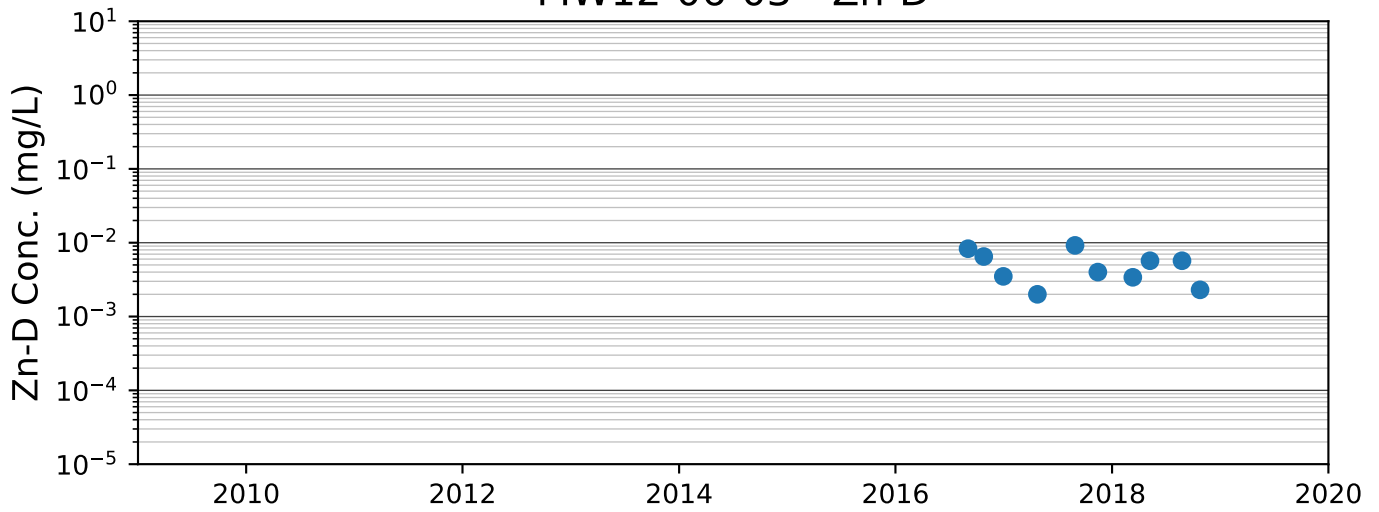
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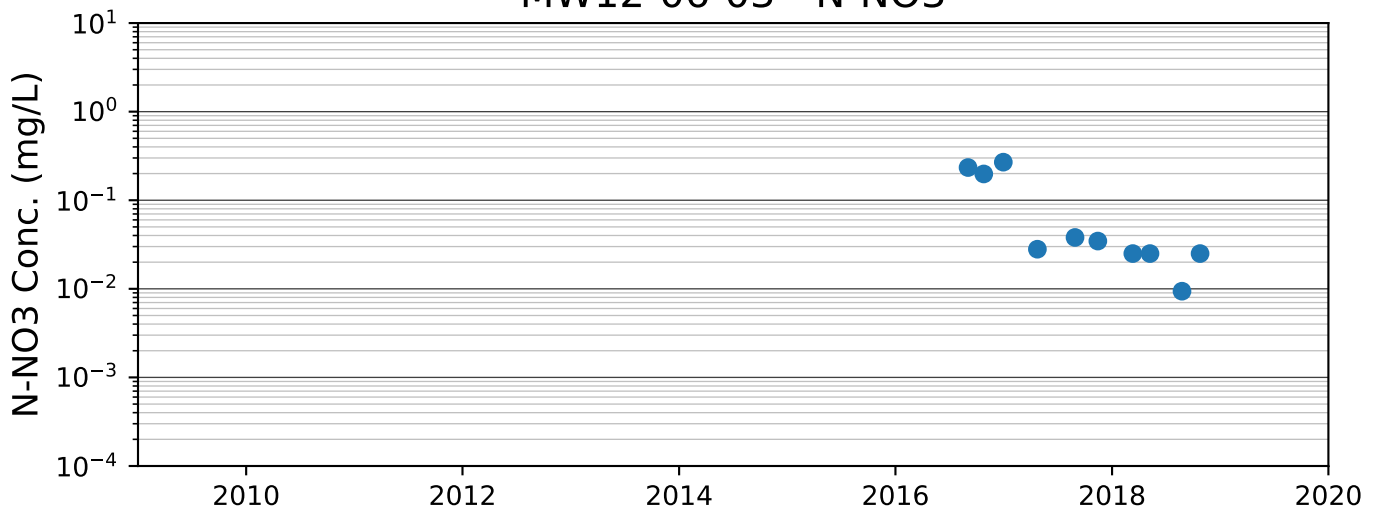
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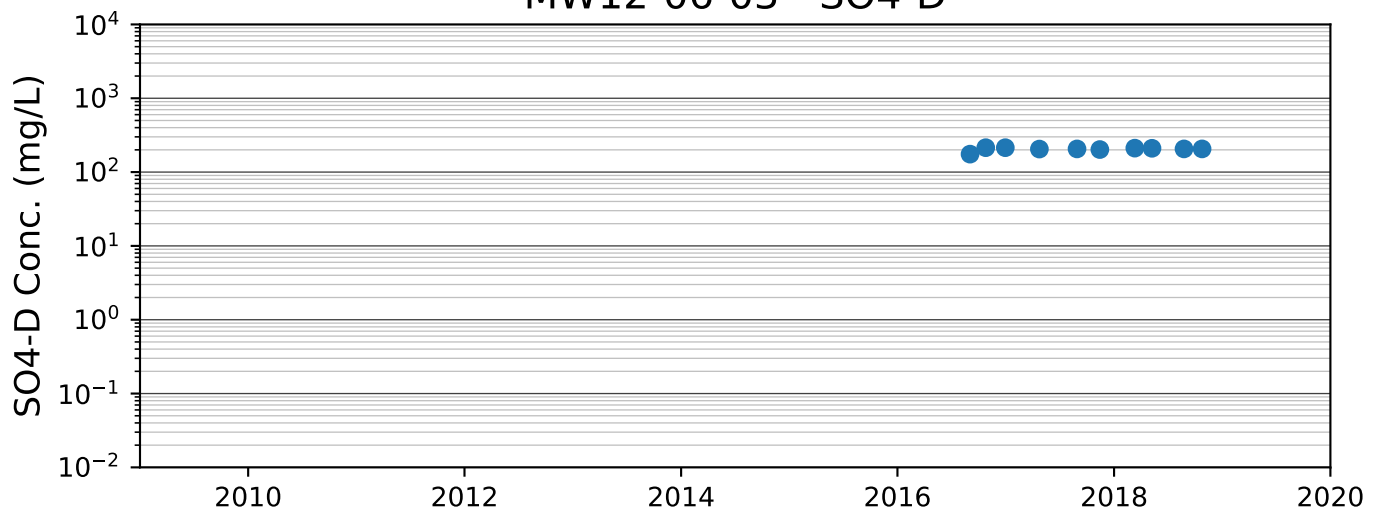
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MW12-06-03 - N-NO3

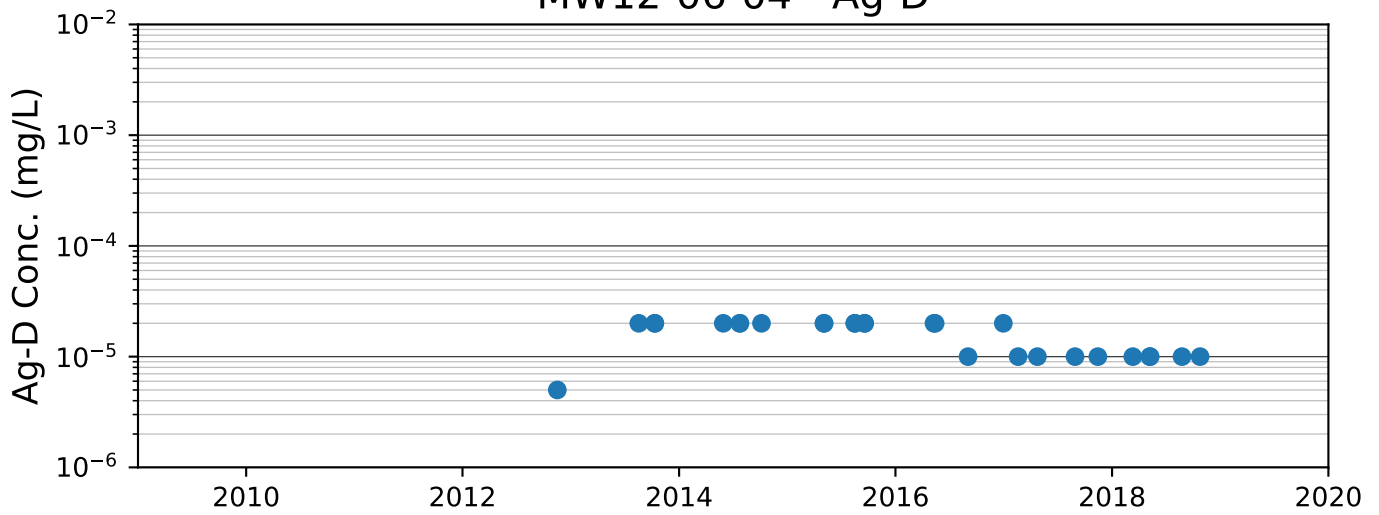


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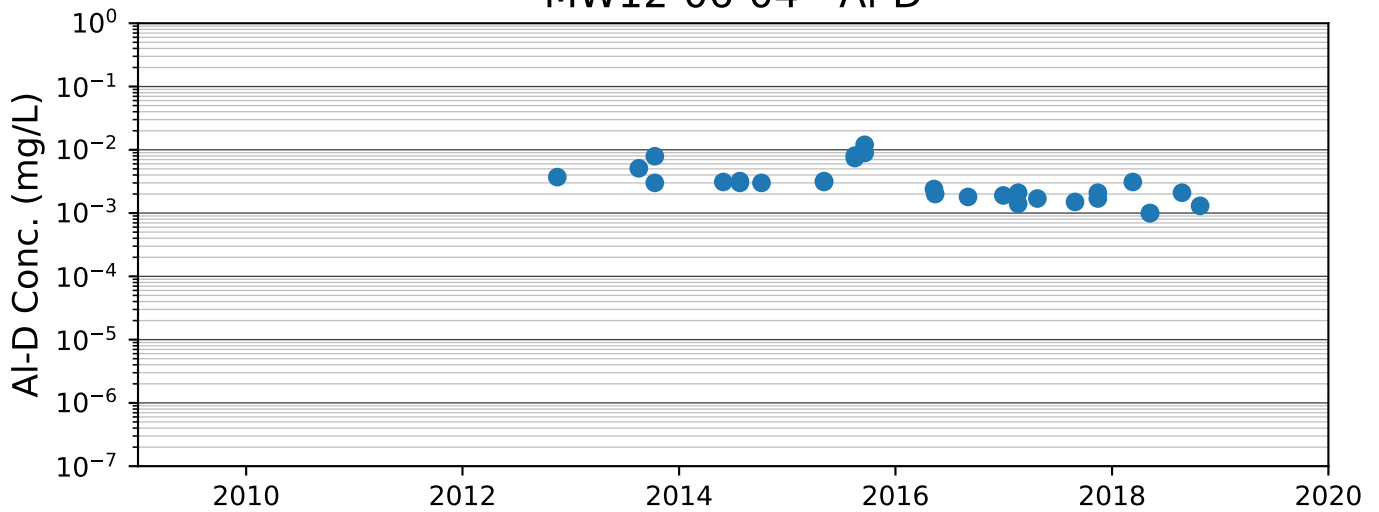


Attachment 2: Groundwater Monitoring Data for All CoCs

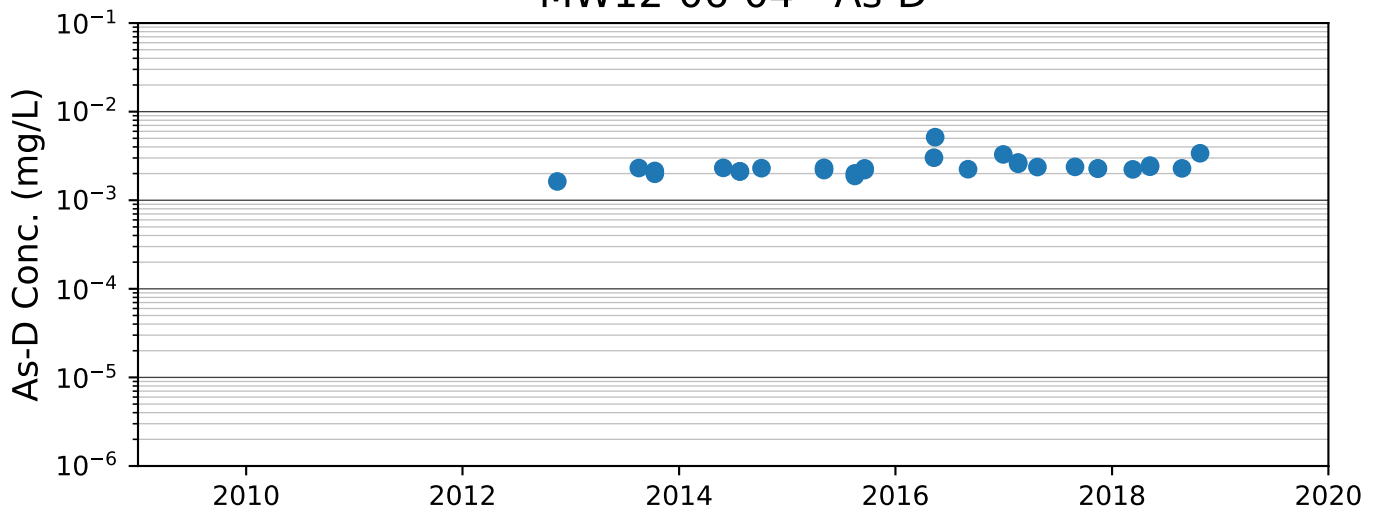
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MW12-06-04 - Al-D

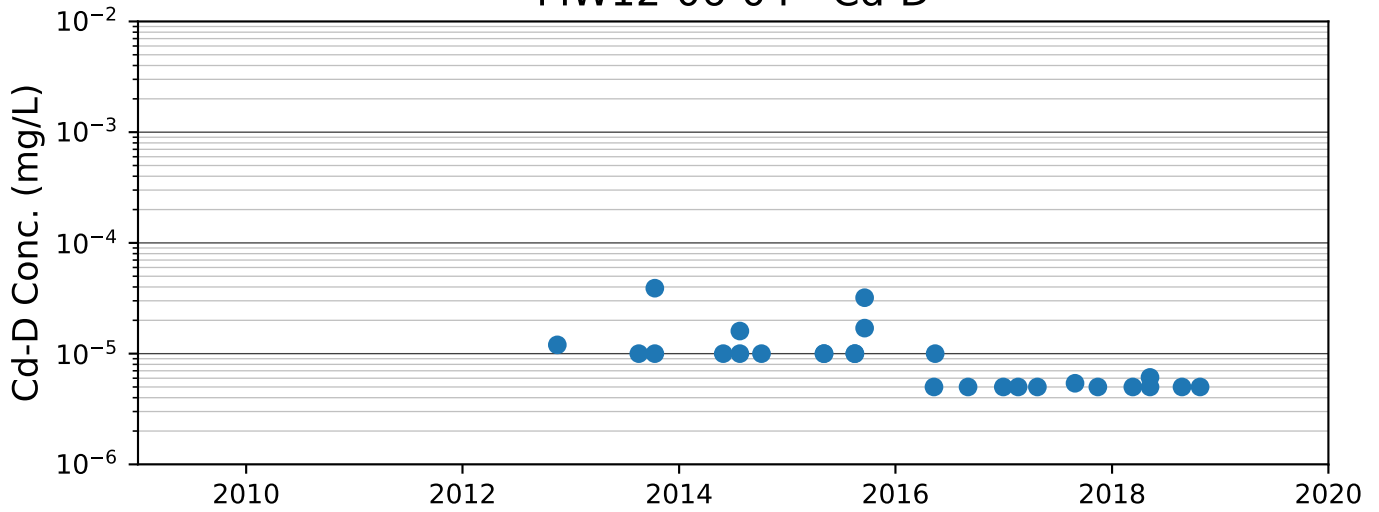


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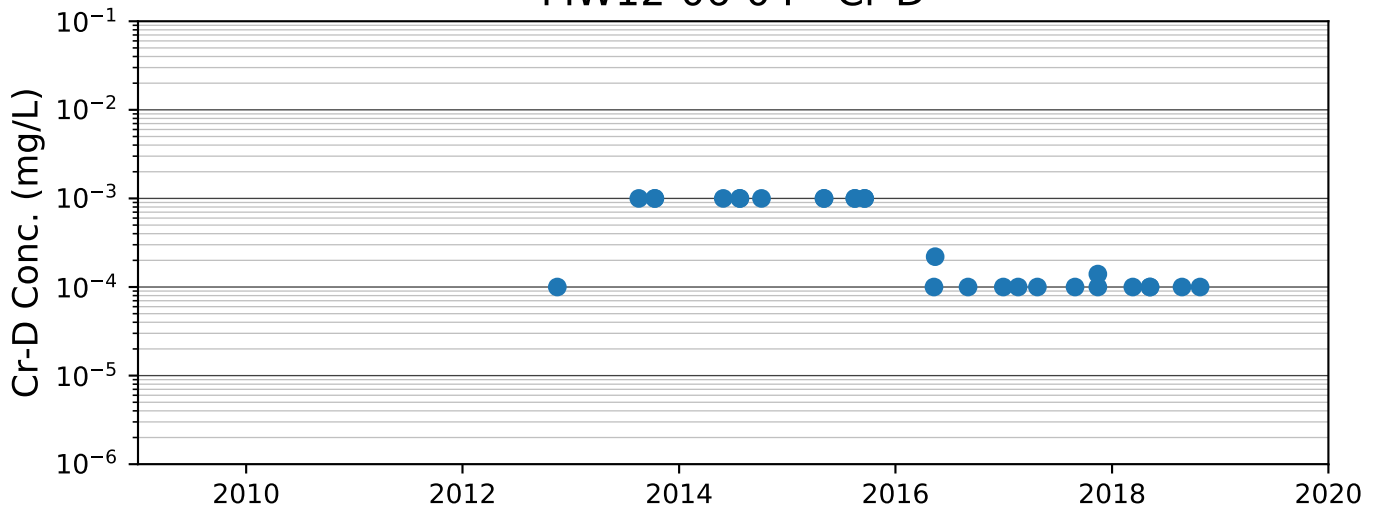


Attachment 2: Groundwater Monitoring Data for All CoCs

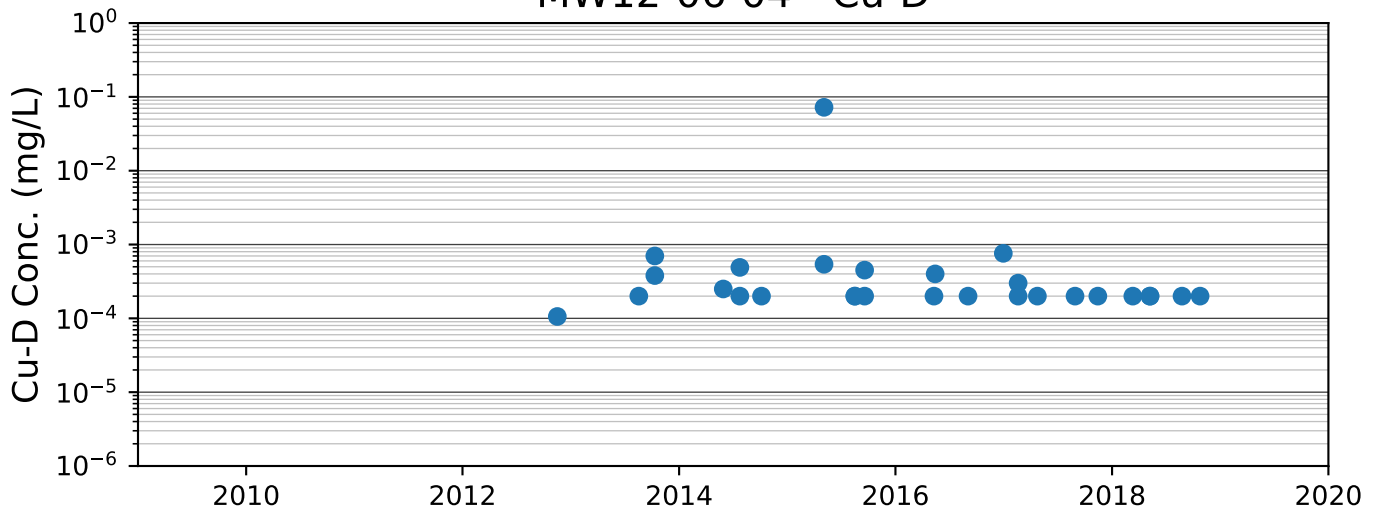
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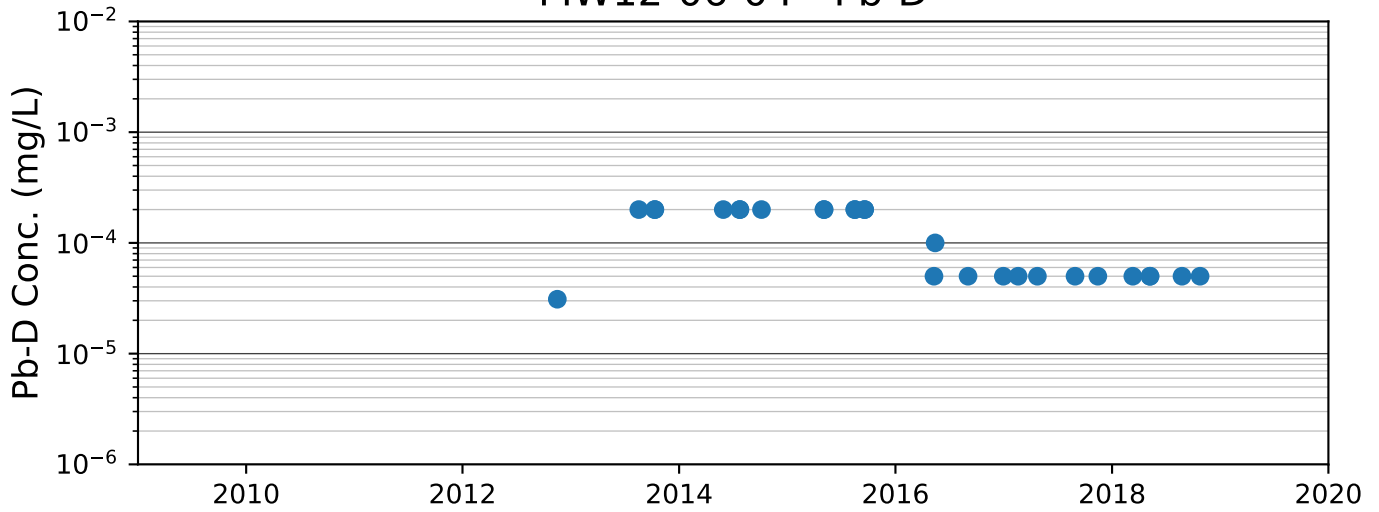


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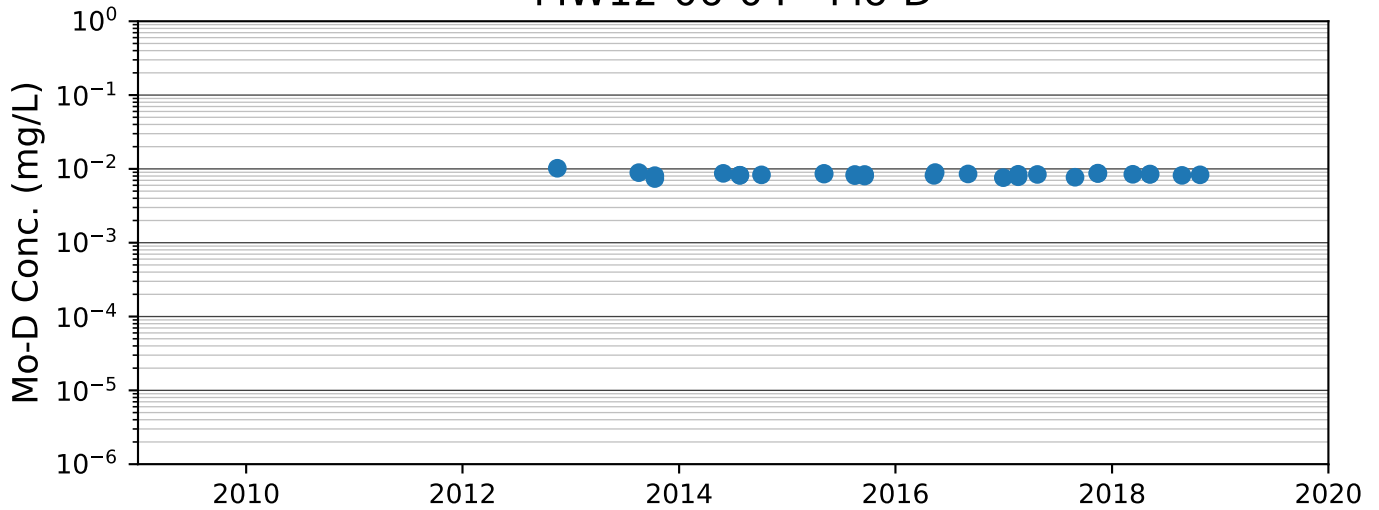


Attachment 2: Groundwater Monitoring Data for All CoCs

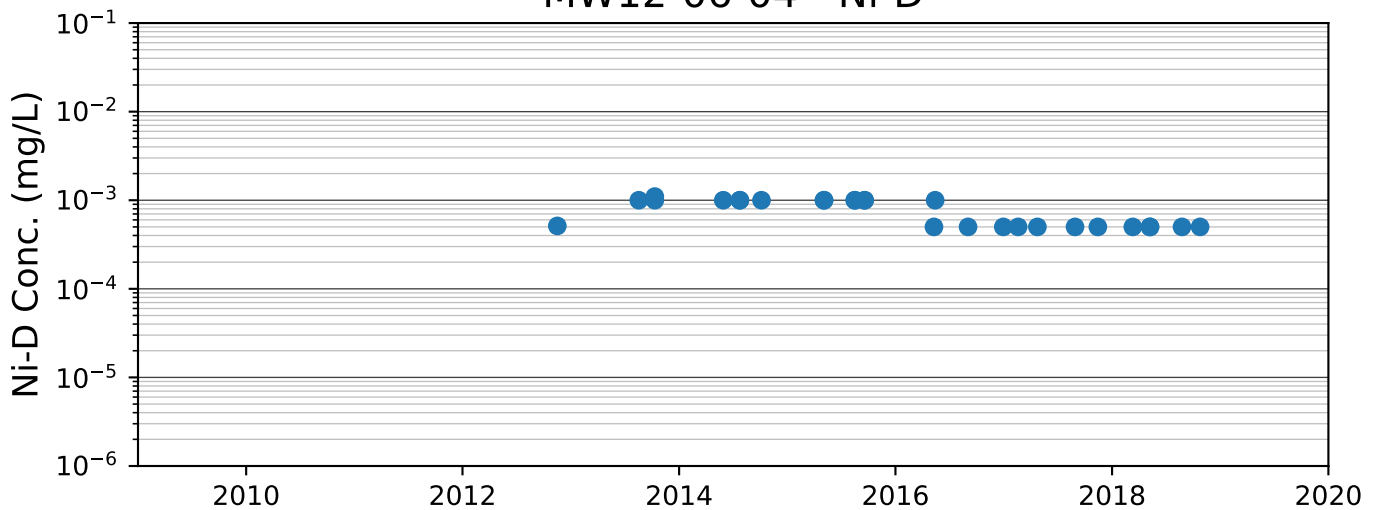
MW12-06-04 - Pb-D



MW12-06-04 - Mo-D

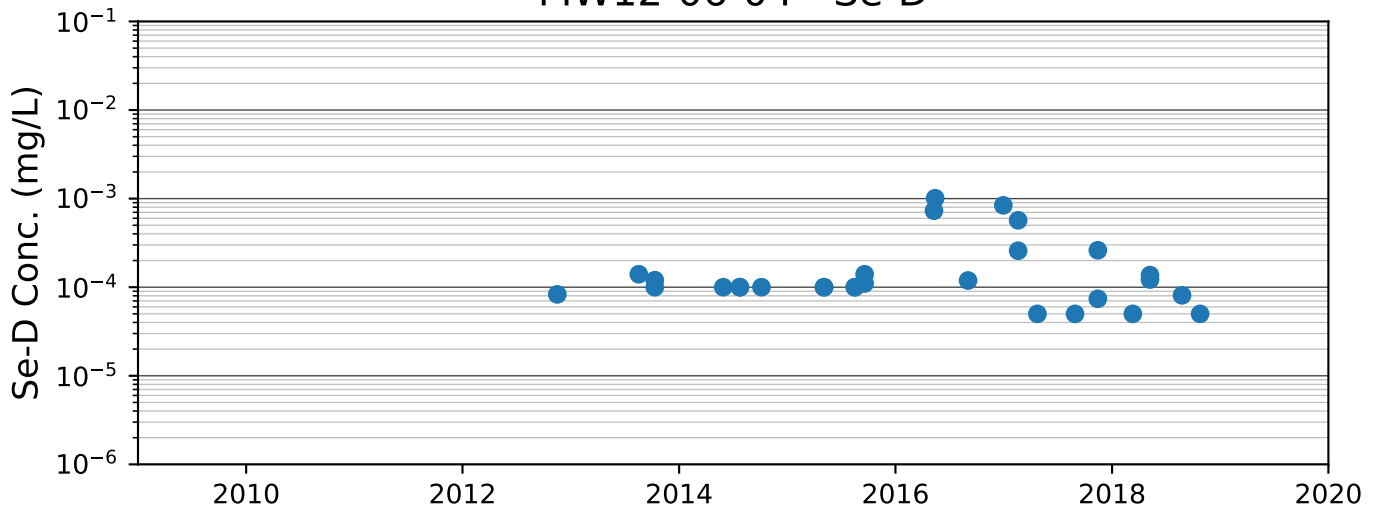


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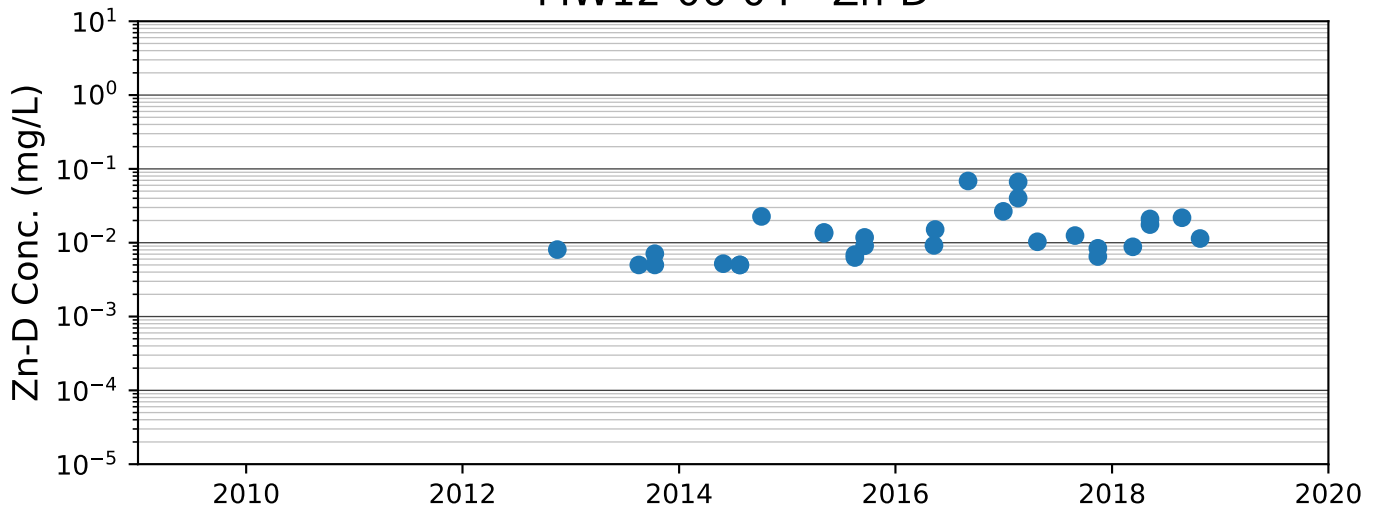


Attachment 2: Groundwater Monitoring Data for All CoCs

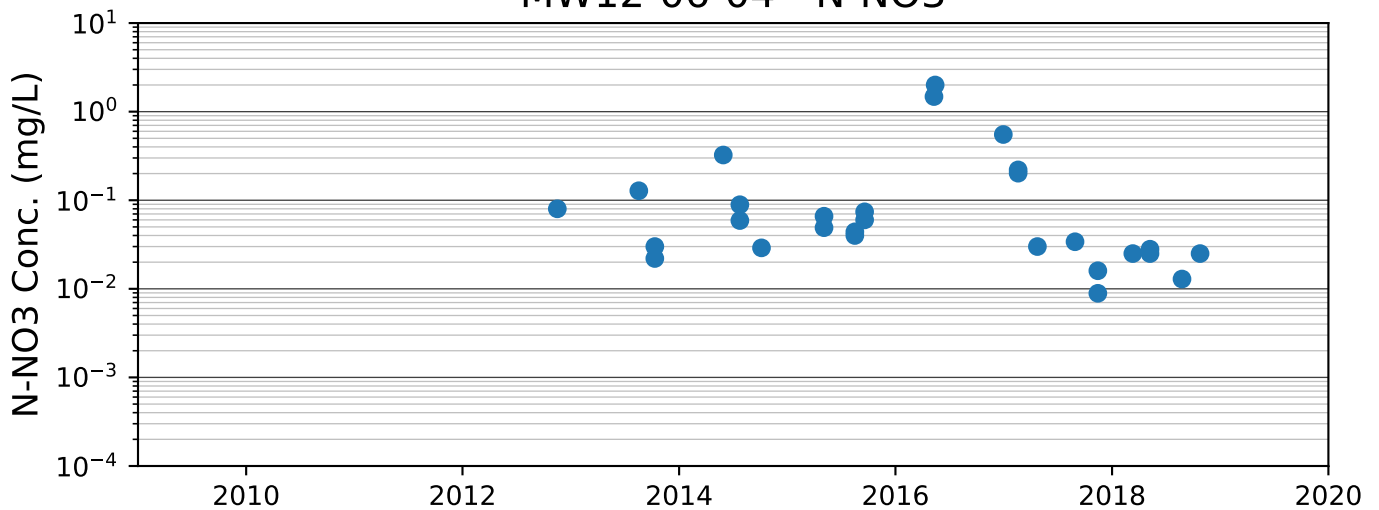
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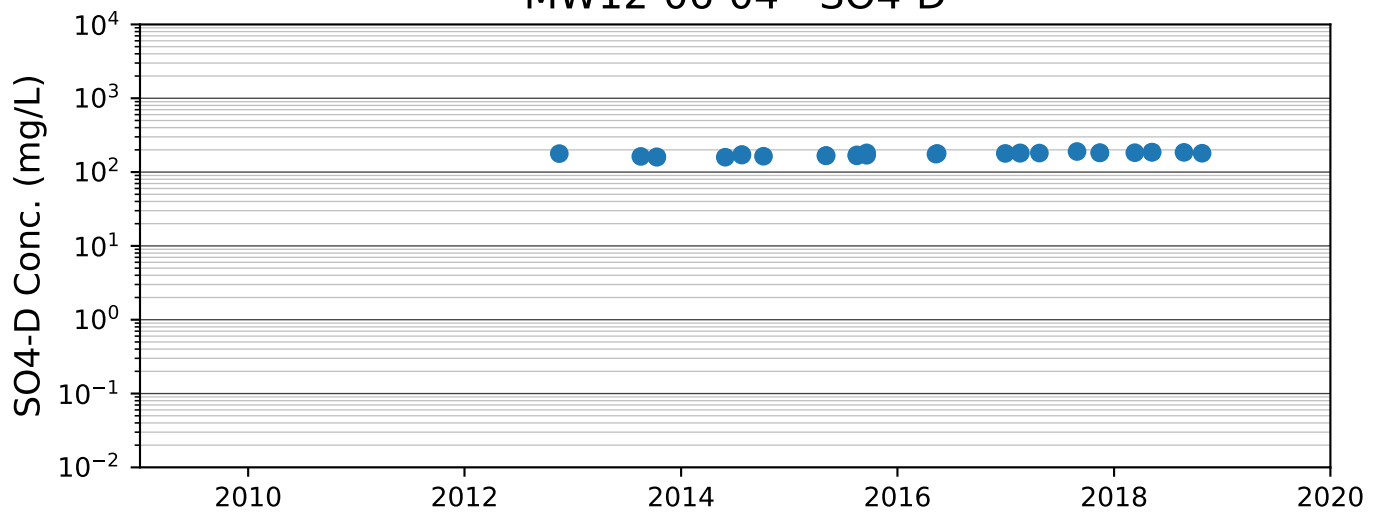
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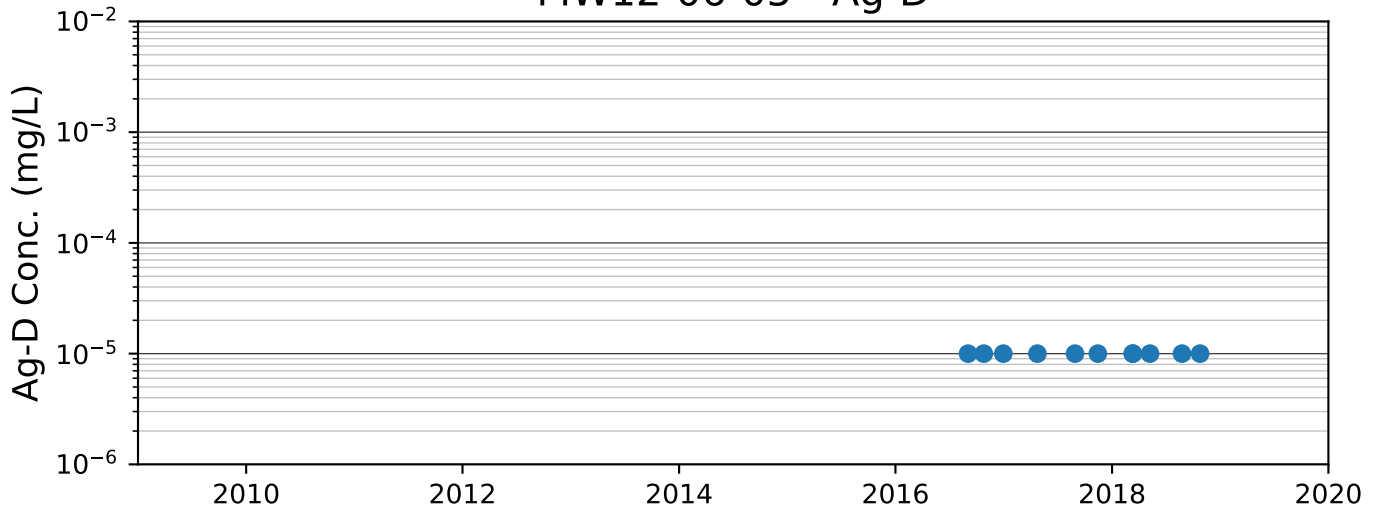
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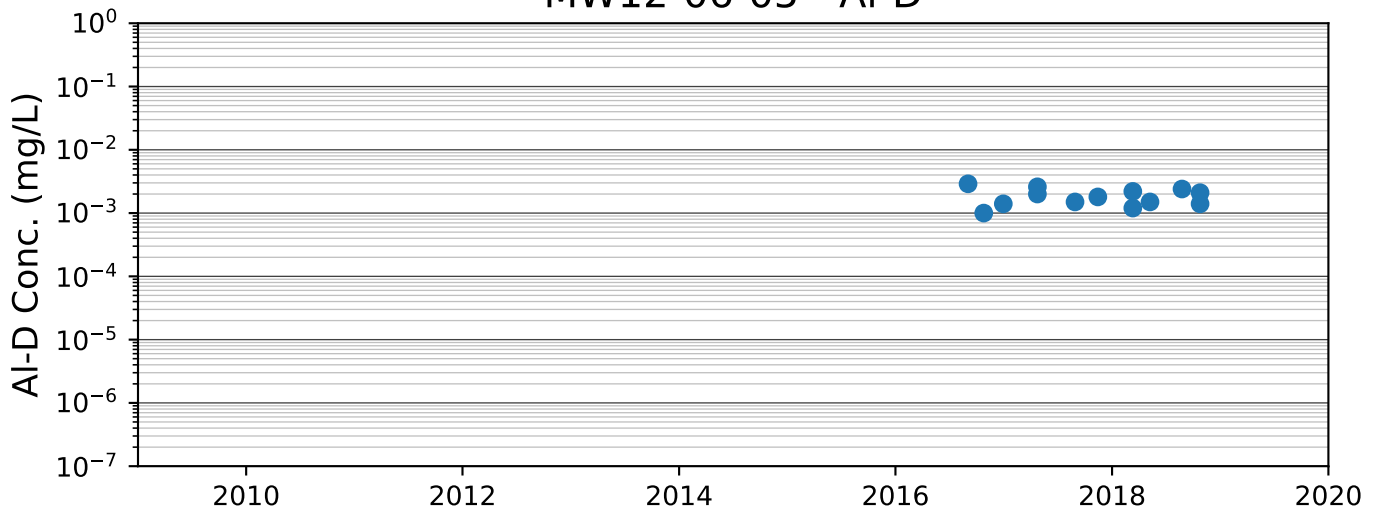
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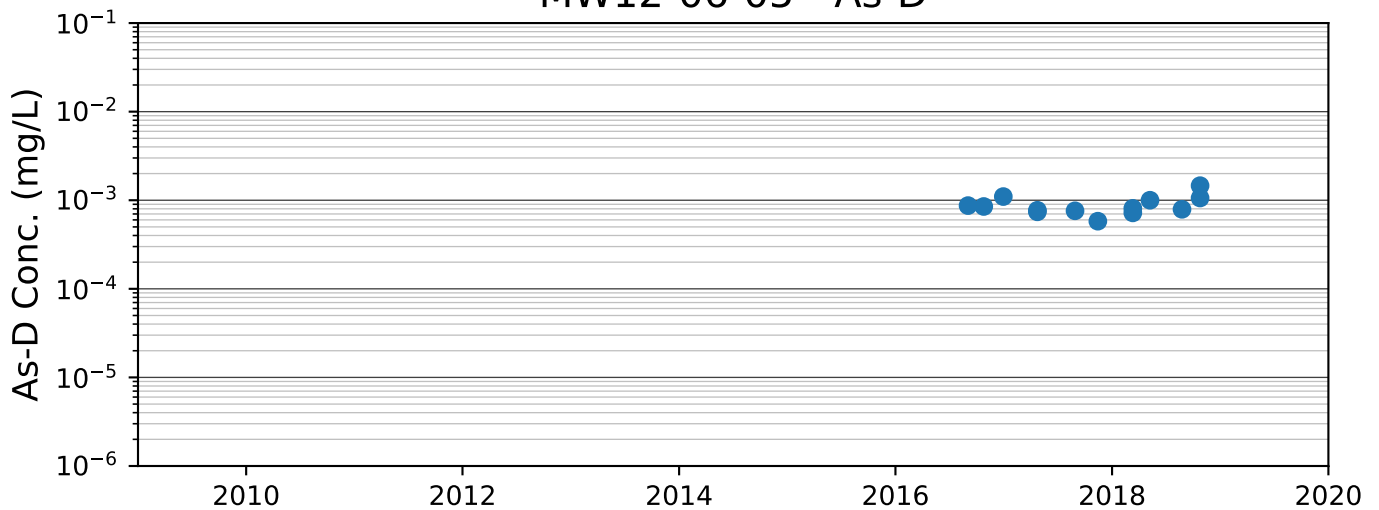
MW12-06-05 - Ag-D



MW12-06-05 - Al-D

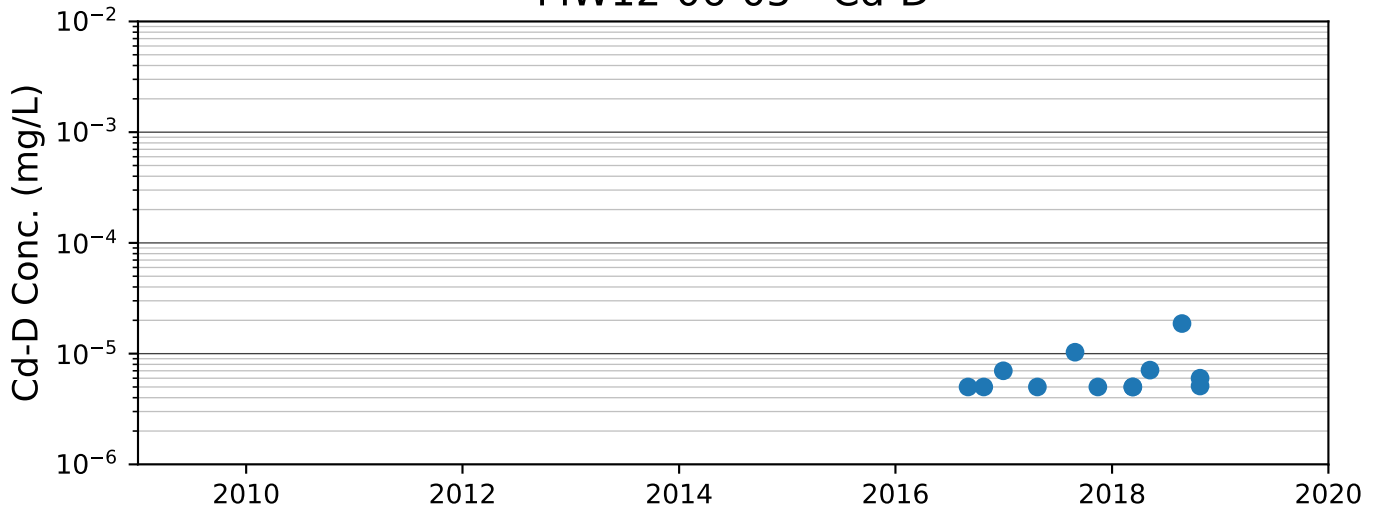


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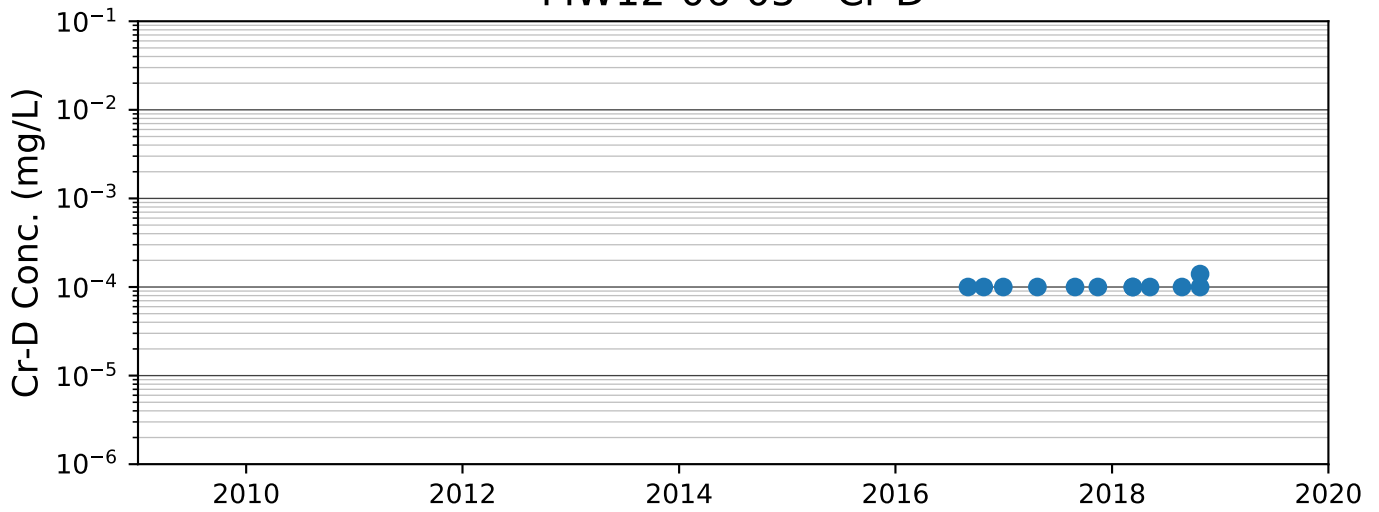


Attachment 2: Groundwater Monitoring Data for All CoCs

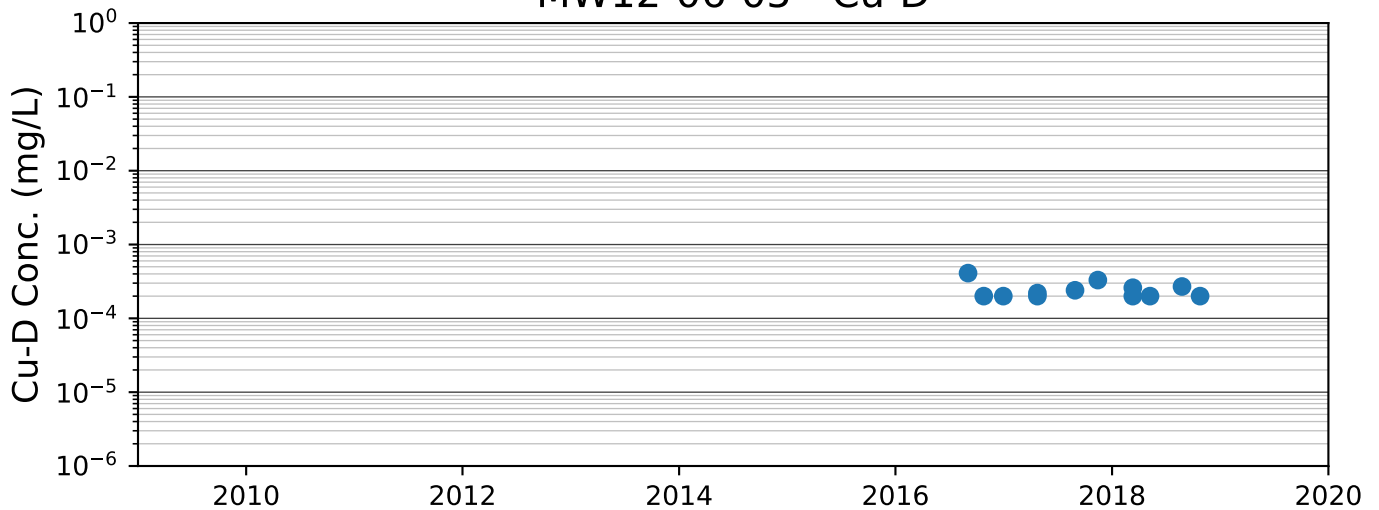
MW12-06-05 - Cd-D



MW12-06-05 - Cr-D

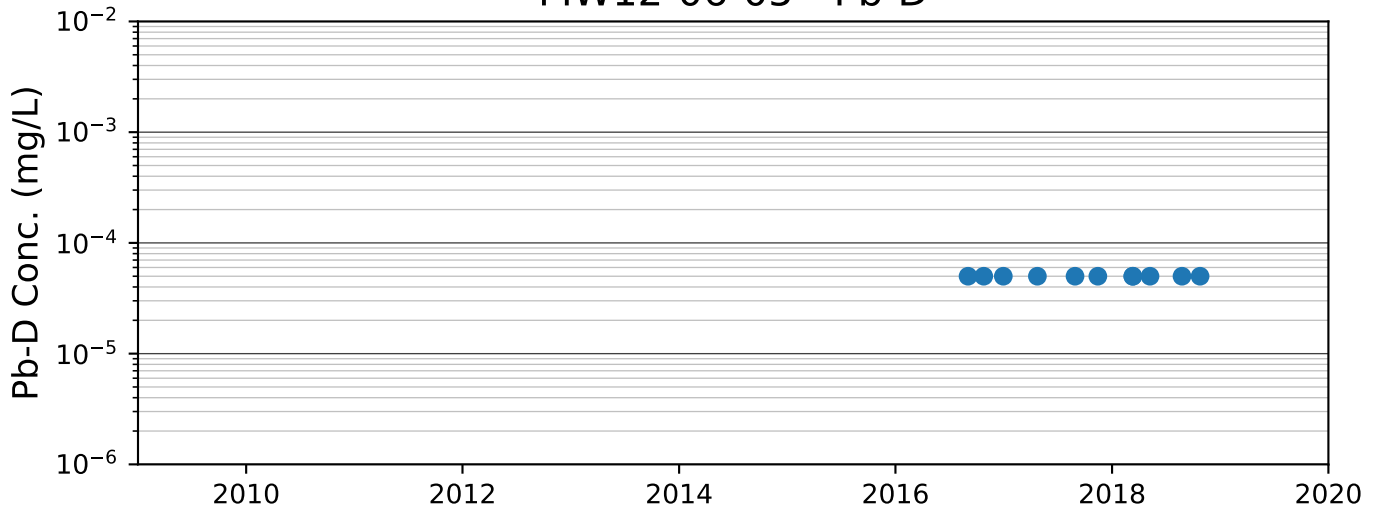


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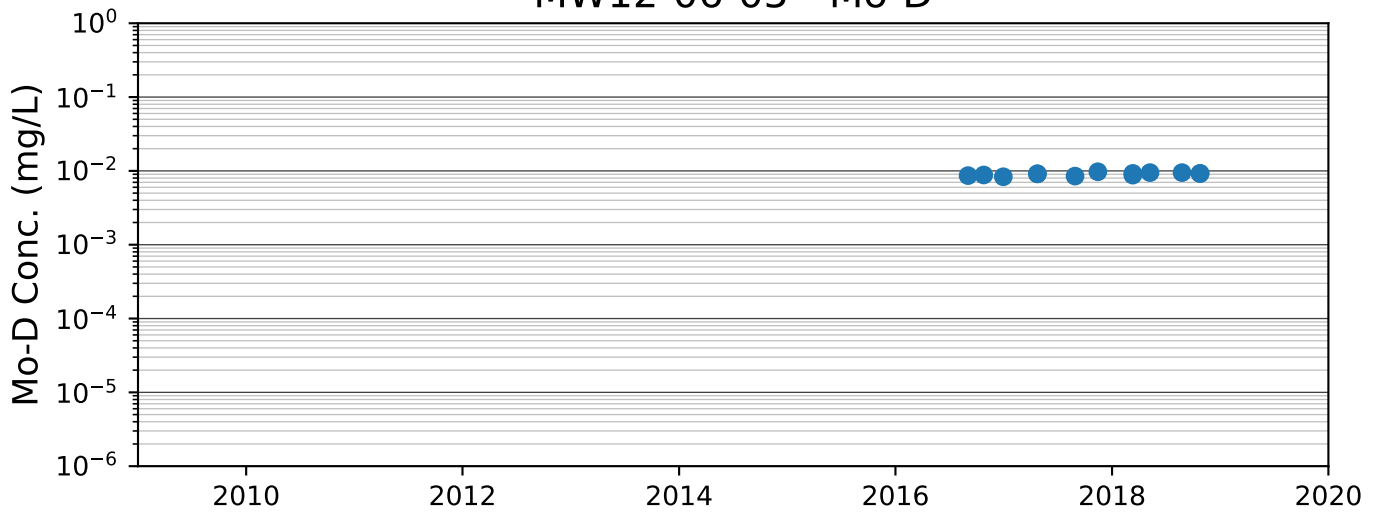


Attachment 2: Groundwater Monitoring Data for All CoCs

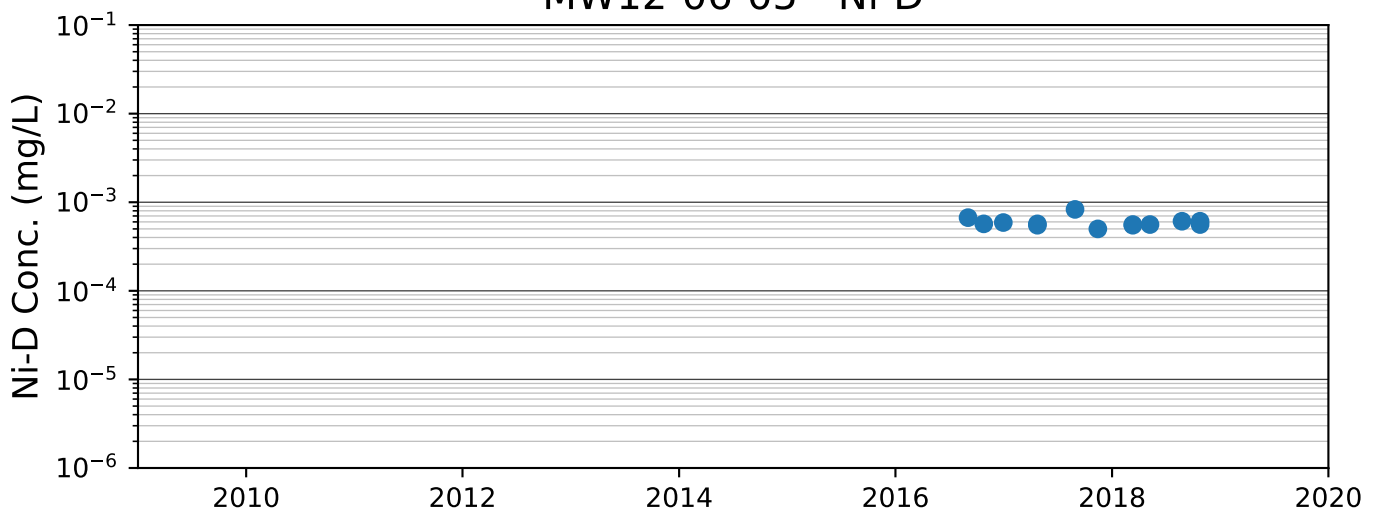
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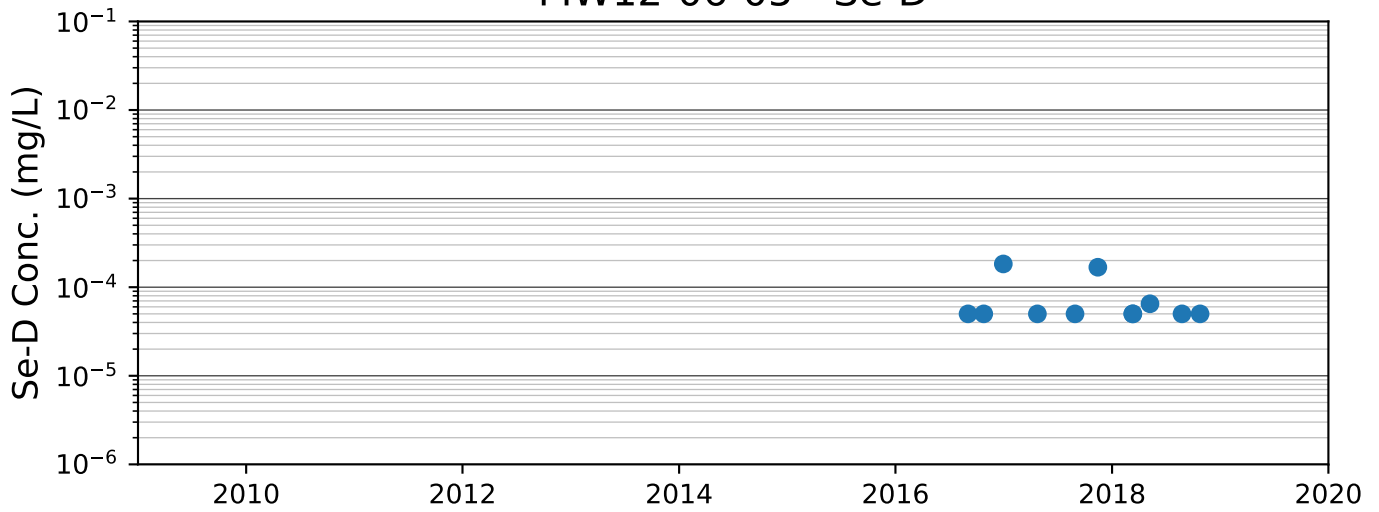
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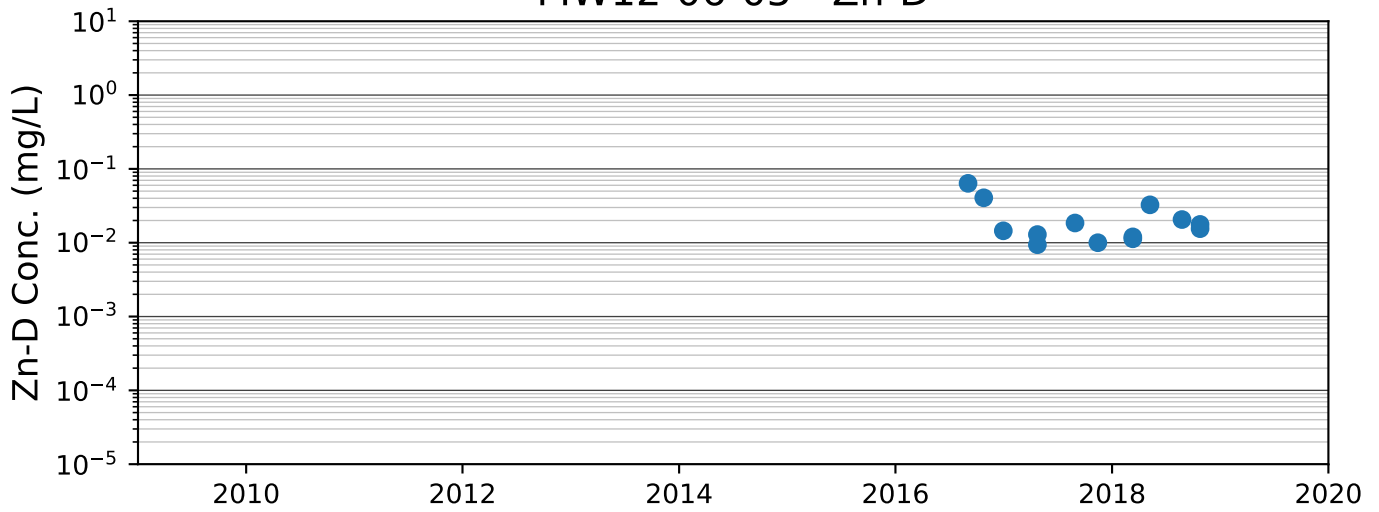
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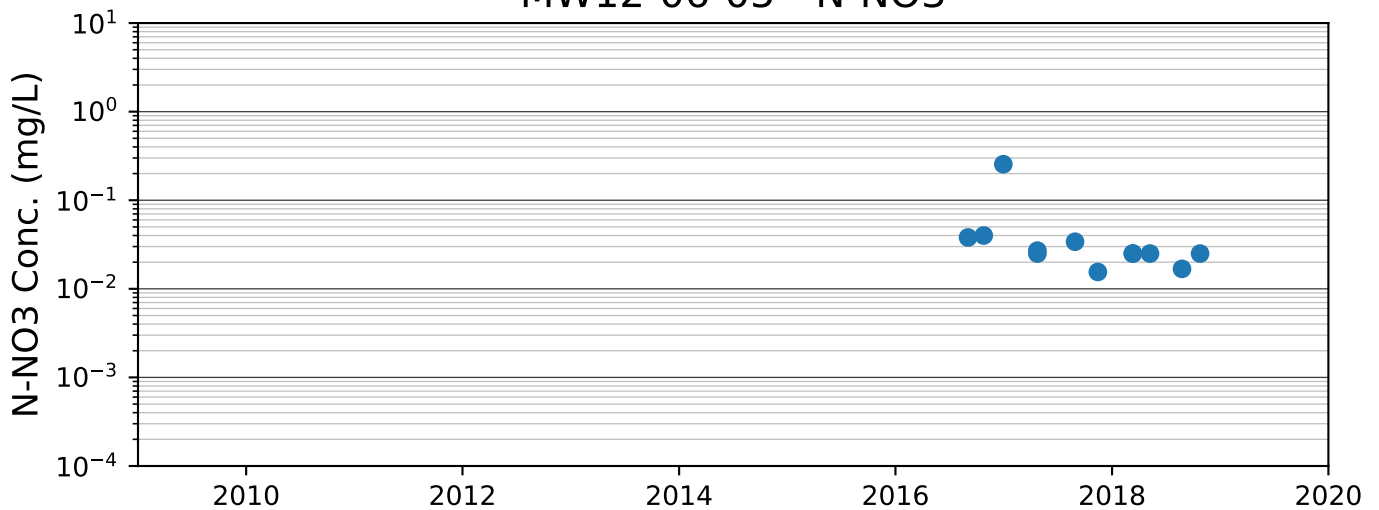
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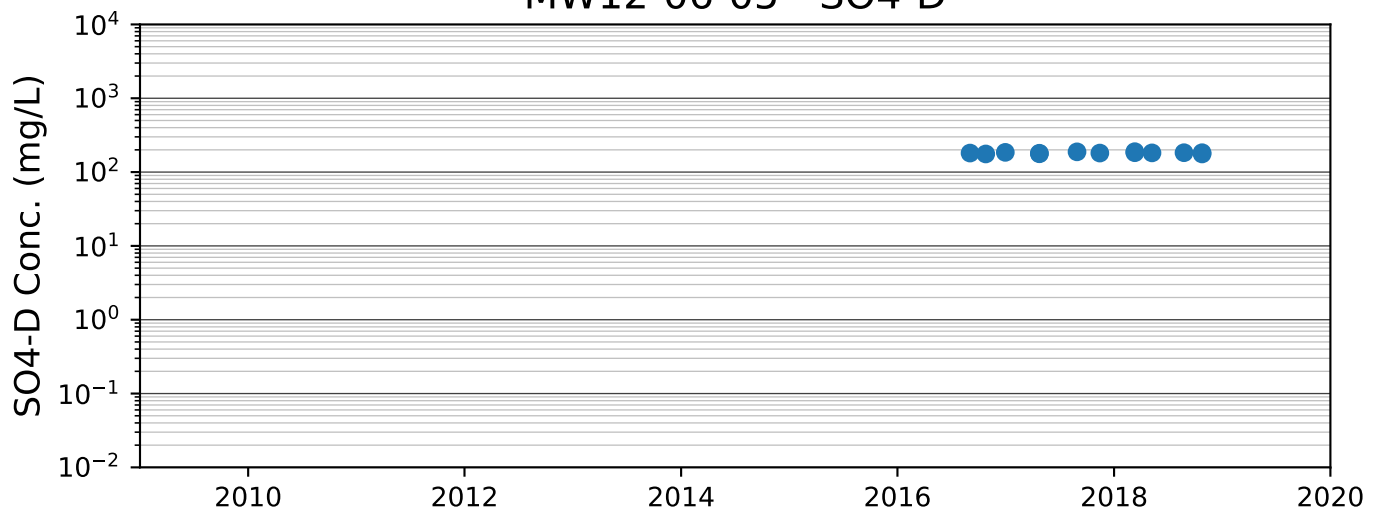
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MW12-06-05 - N-NO3

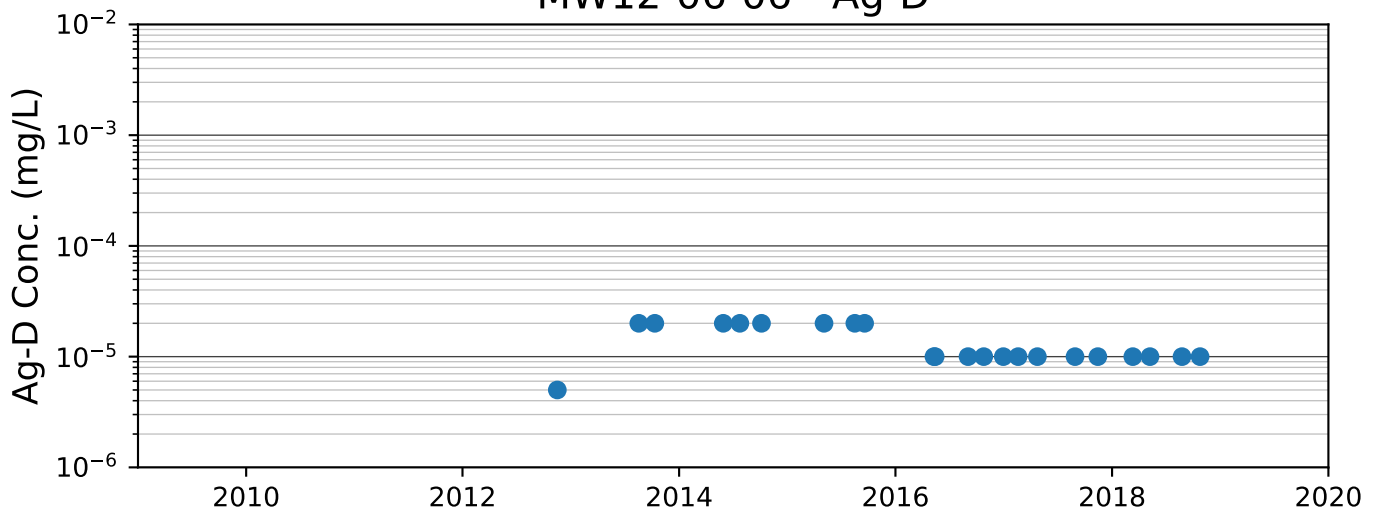


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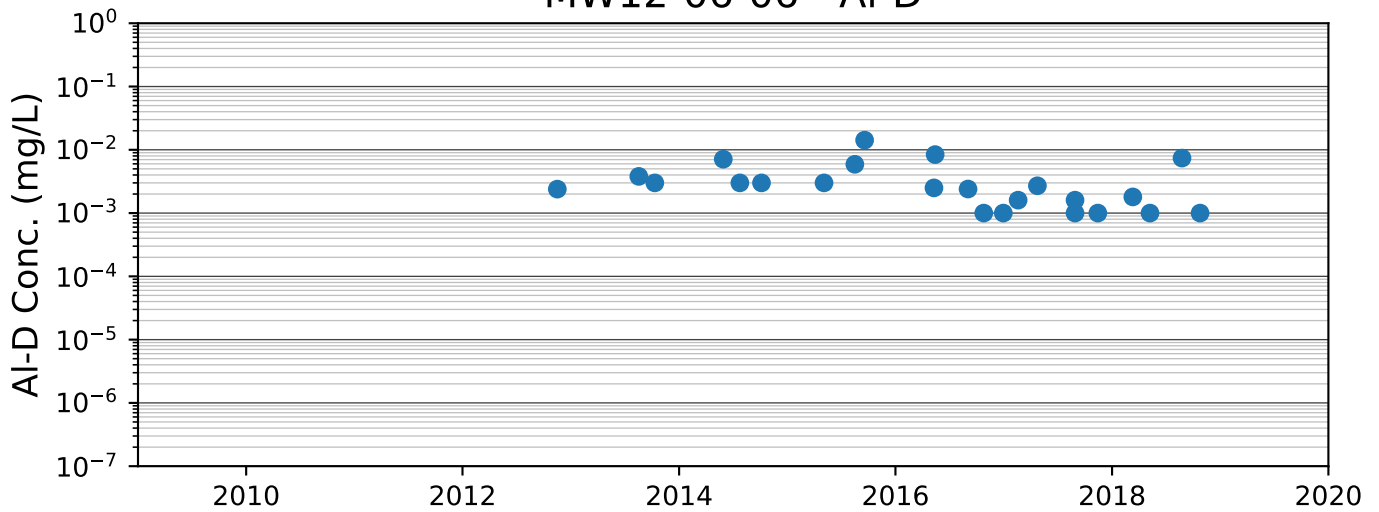


Attachment 2: Groundwater Monitoring Data for All CoCs

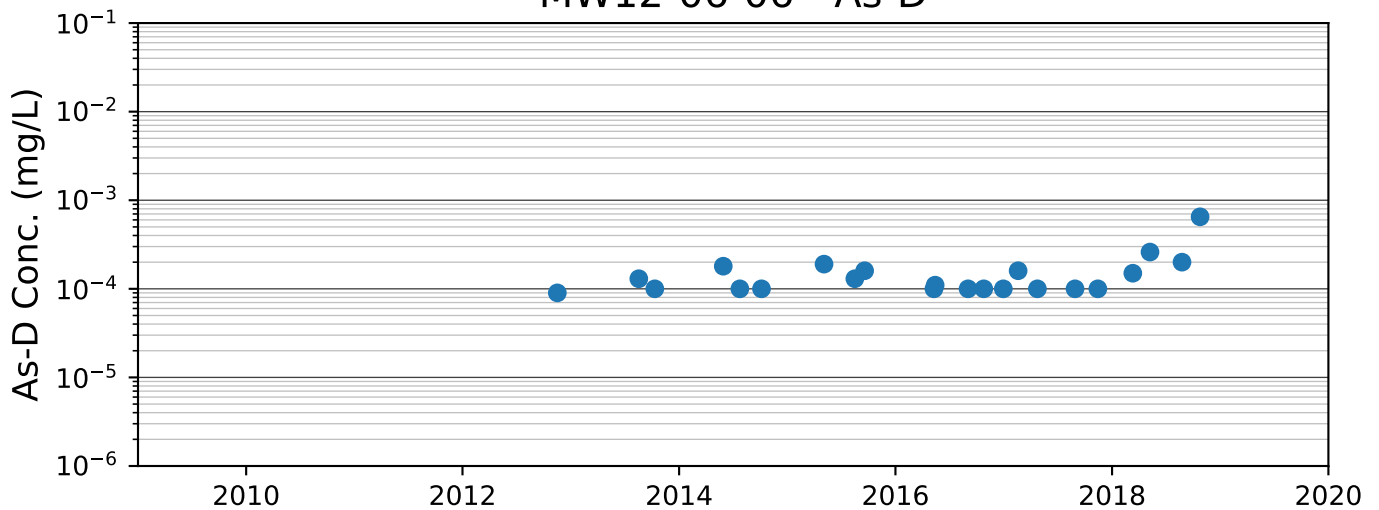
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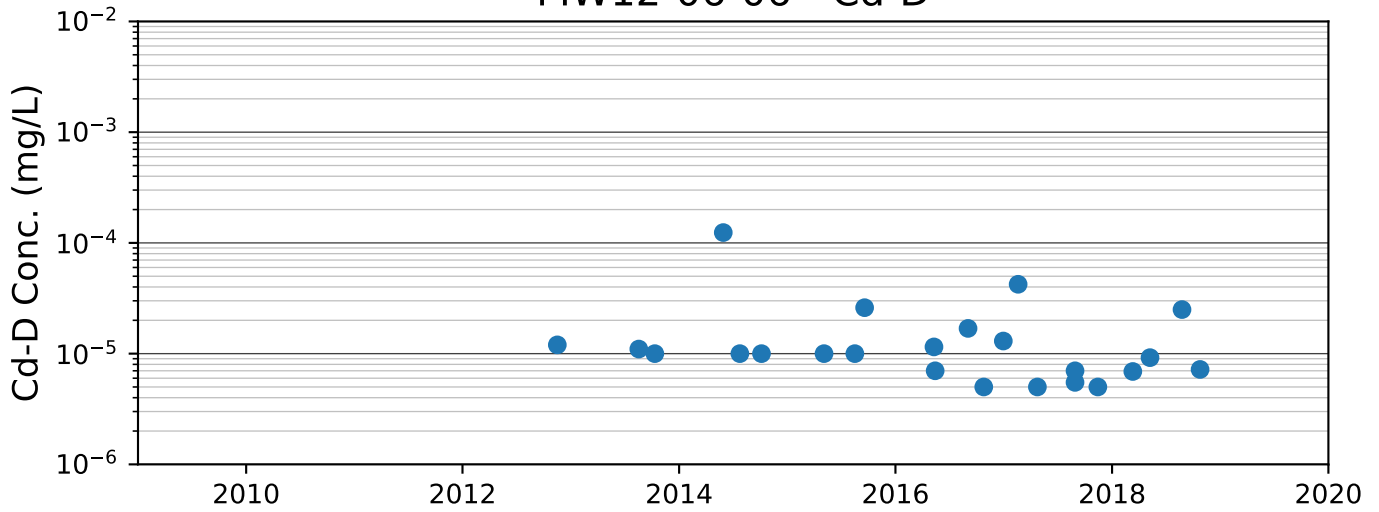


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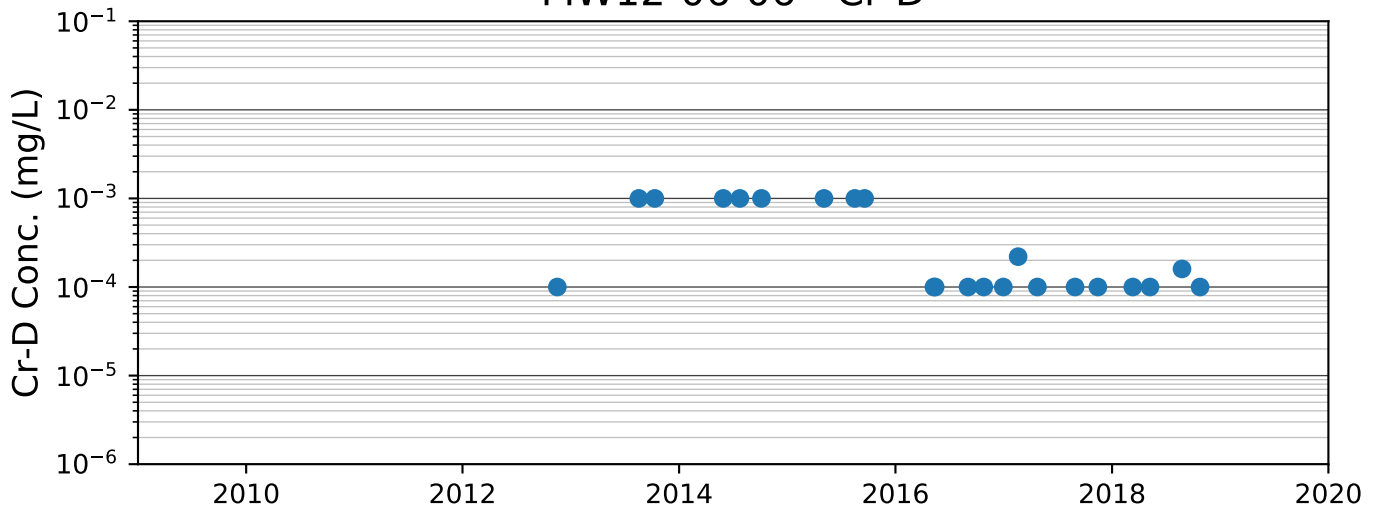


Attachment 2: Groundwater Monitoring Data for All CoCs

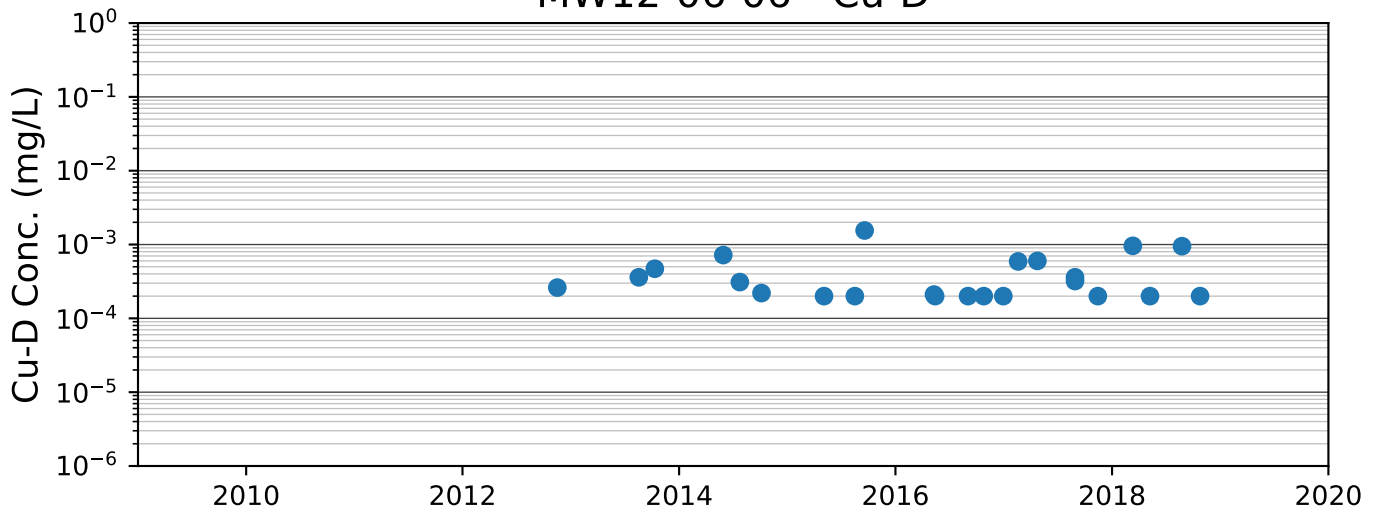
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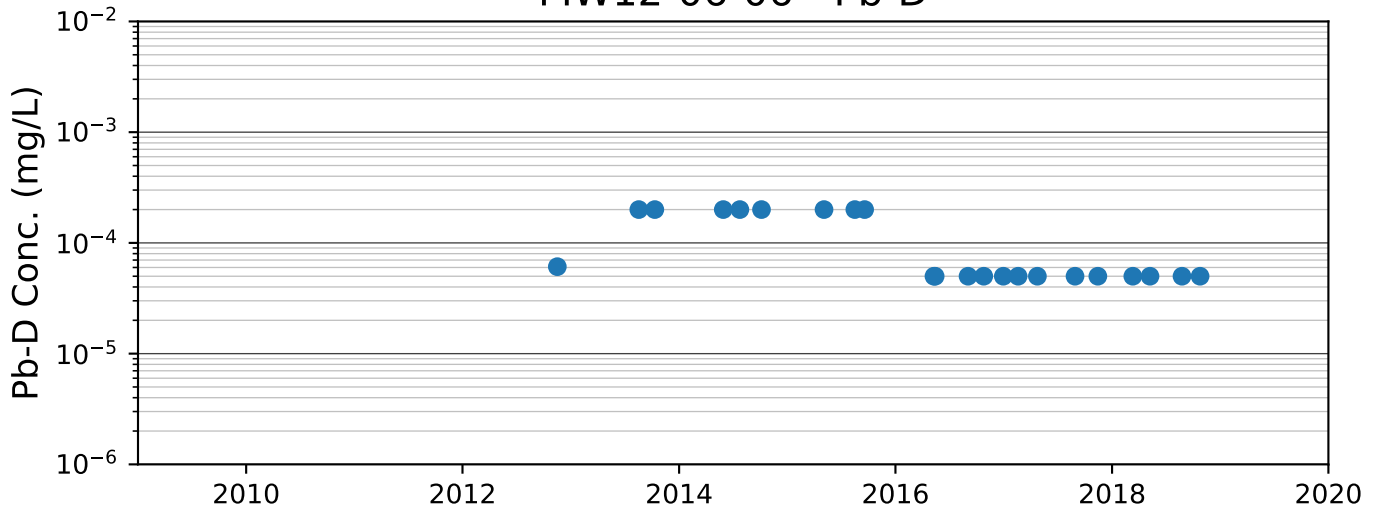
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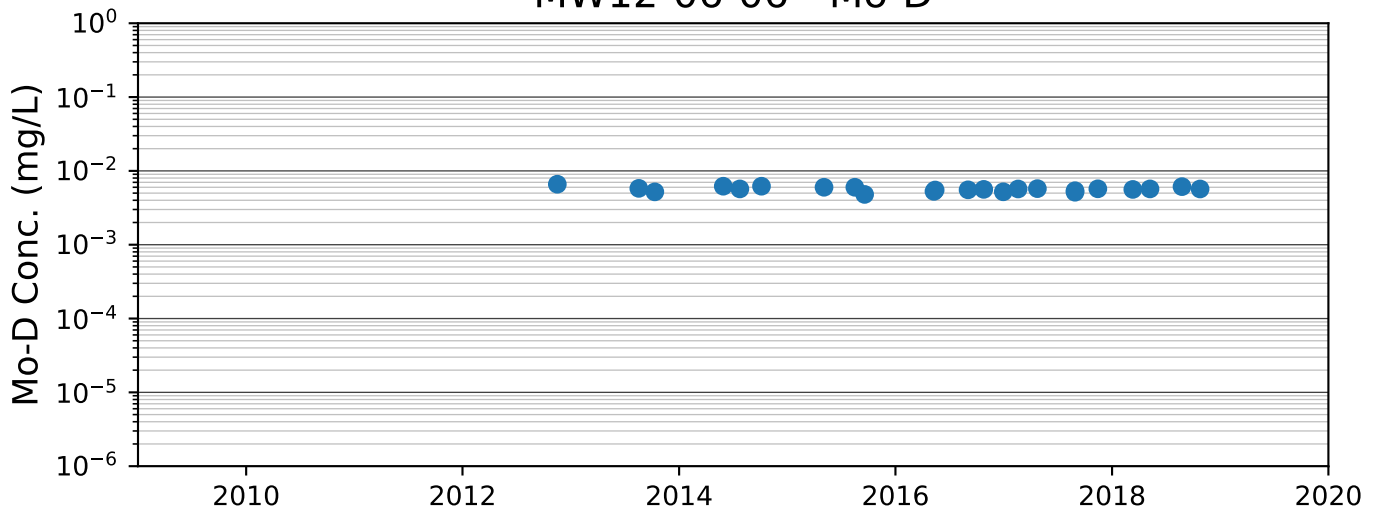
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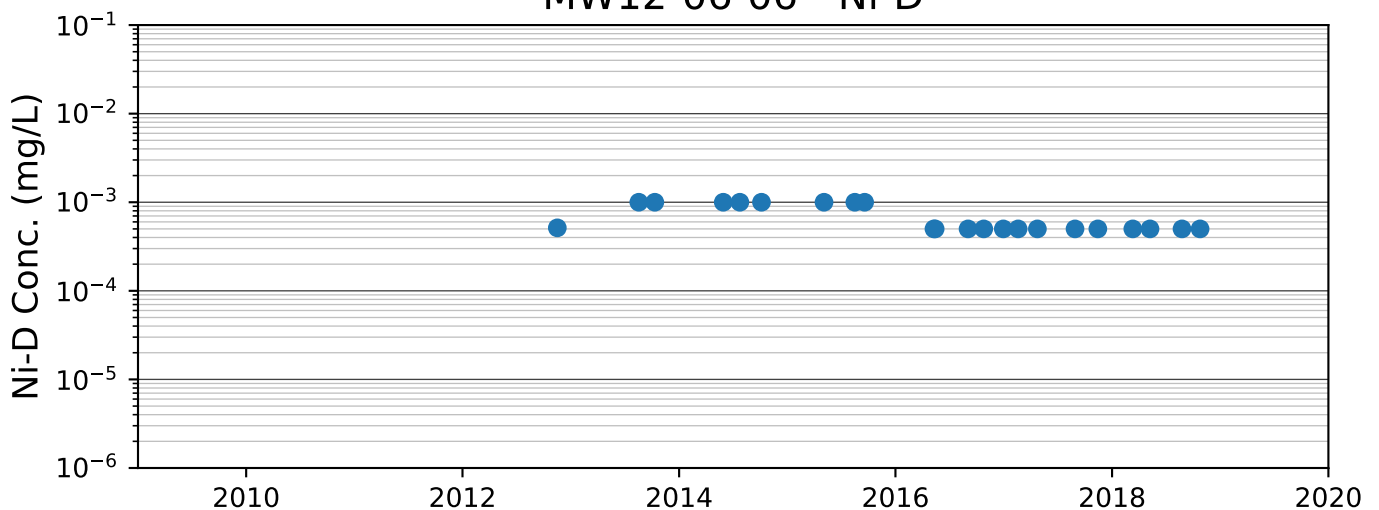
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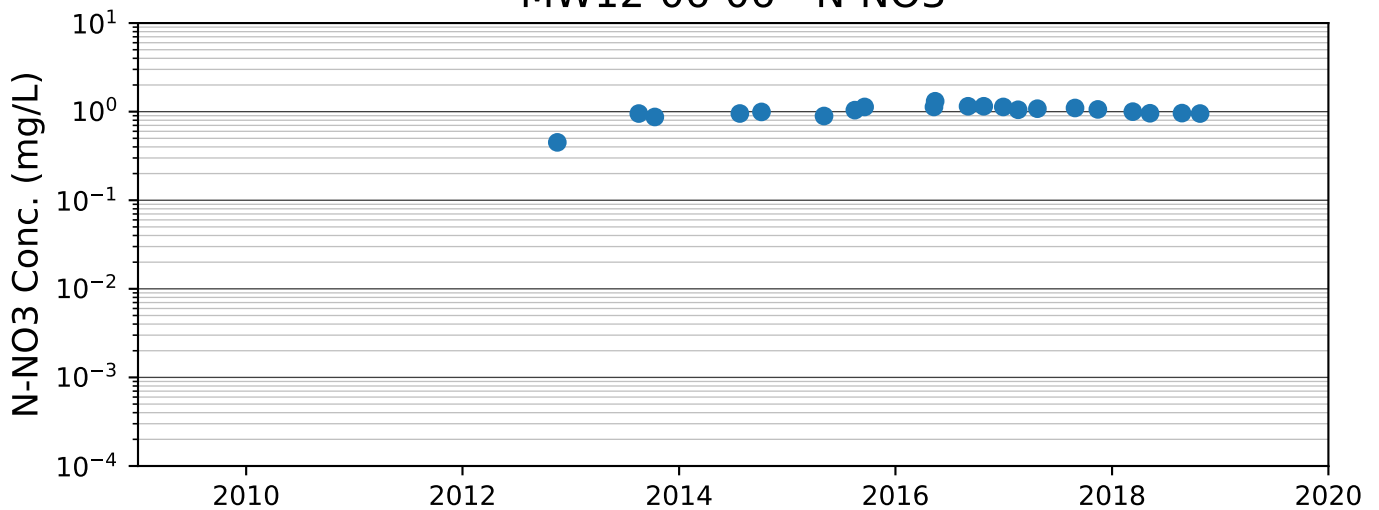
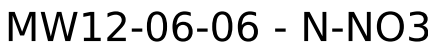
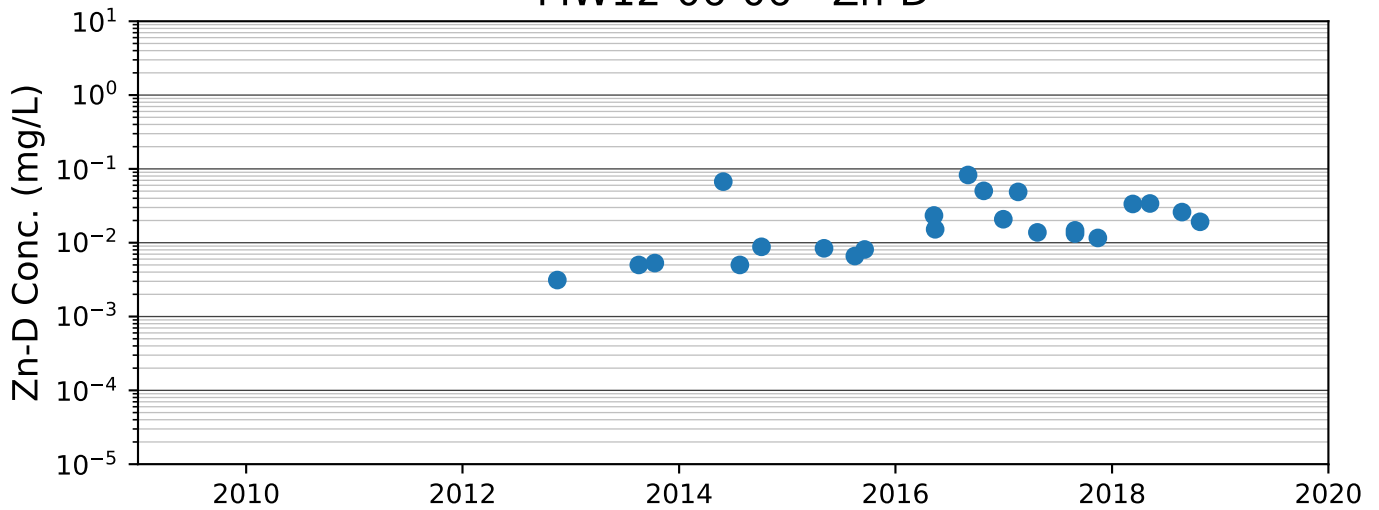
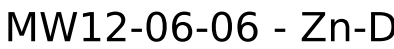
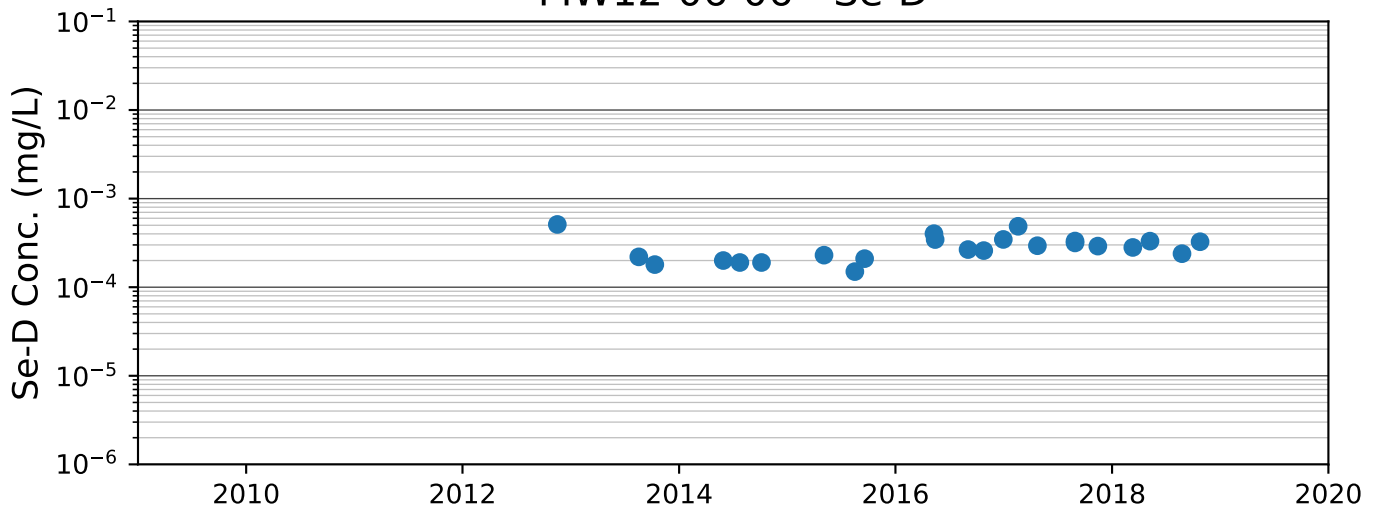
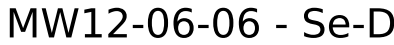
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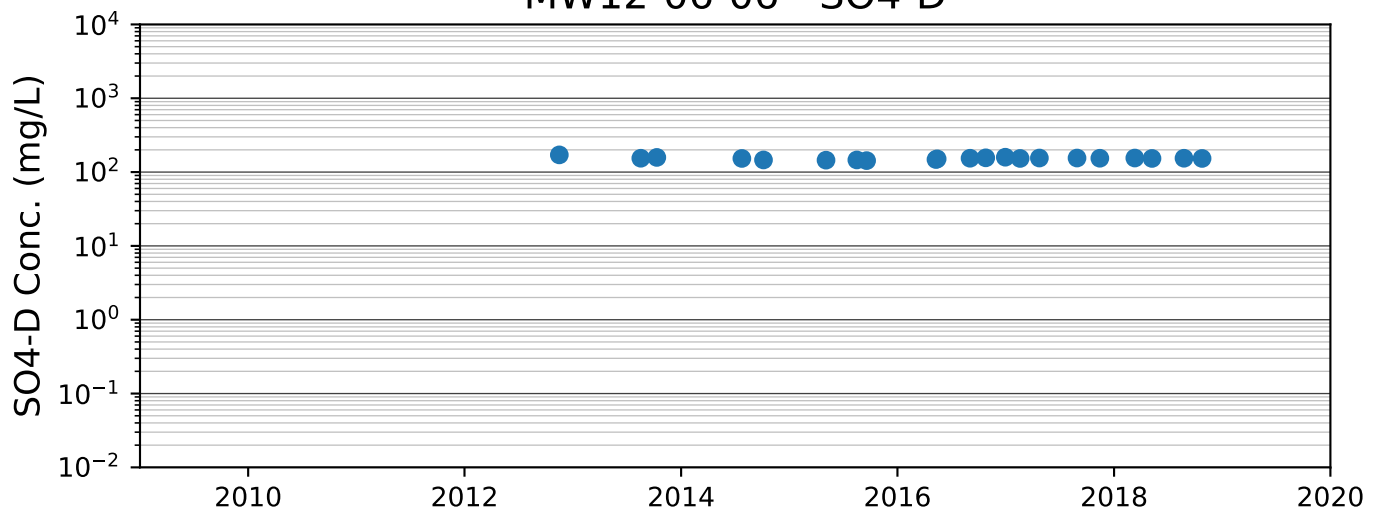
MW12-06-06 - Ni-D



Attachment 2: Groundwater Monitoring Data for All CoCs



MW12-06-06 - SO4-D



Appendix J – MDMER Effluent Monitoring and Environmental Effects Monitoring Water Quality 2018 Submissions

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Canada

Canada



Environment Canada

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[Français](#)[Home](#)[Contact Us](#)[Help](#)[Search](#)[canada.gc.ca](#)**User Information**

Site User

User: PYmmSCC469**Region:** Pacific-Yukon**Regulation:** MMER[Home](#)[Del. Sub. & pH Data](#)[Bioassay Data](#)[EEM](#)[Annual Report](#)[Submission](#)[Regulatory Data - Quarterly Report](#)[EEM - Annual Report](#)[Regulatory Data - Annual Report](#)[Queries & Downloads](#)[Graphs & Tables](#)[Company Information](#)[Password Change](#)[Comments: Submit](#)[Publications](#)[RISS Web Service](#)[Logout](#)**Data Submitted**

Your data has been successfully submitted.

Facility Name: Minto Explorations Limited - Minto Mine (Pelly Crossing, YT)**Date and Time Submitted (GMT):** 2019-03-16 14:54:38**Tracking ID:** PYmmSCC469-2019-03-16-14-54-38-21931**Reporting Period:** 2018**This is the official receipt of your submission.****You may wish to print and retain this receipt for your records.**

Signature: _____

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View Annual Report

Facility: Minto Explorations Limited - Minto Mine (Pelly Crossing, YT)
Final Discharge Point: Mi.W3 - Runoff Main Water Dam
Reporting Period: 2018
Facility Name on Submission:
Submission Tracking ID:

Facility Information

Mine Name: Minto Explorations Limited - Minto Mine (Pelly Crossing, YT)
Mine Operator: Minto Explorations Limited
Address: P.O. Box 11
 Whitehorse, YT
 Y1A5X9
Telephone: 604-759-4634
E-mail: minto_environment@mintomine.com

Location of Final Discharge Point

Name: Mi.W3 - Runoff Main Water Dam
Latitude: 62° 37' 32" N
Longitude: 137° 12' 11" W

Monthly Mean Concentrations, pH Range and Volume of Effluent (Generated)

Month	As (mg/L)	Cu (mg/L)	CN (mg/L)	Pb (mg/L)	Ni (mg/L)	Zn (mg/L)	TSS (mg/L)	Ra 226 (Bq/L)	Lowest pH	Highest pH	Effluent Volume (m ³)
January	0.000238	0.002228	NMR	0.000037	0.00085	0.0015	3.48	NMR	8.03	8.3	7936
February	0.00025	0.00496	NMR	0.000079	0.000723	0.006775	3.325	0.0096	7.9	8.11	6171
March	0.000238	0.006453	NMR	0.000034	0.000628	0.011025	3.65	NMR	8.08	8.34	6448
April	0.000265	0.003888	NMR	0.000025	0.000715	0.004175	3	NMR	8.15	8.5	6360
May	0.000402	0.021082	NMR	0.000031	0.001622	0.0015	4.18	NMR	8.2	8.53	33232
June	0.0004	0.015625	NMR	0.000035	0.001235	0.0015	3.4	0.00345	8.35	8.52	32100
July	0.000304	0.008632	NMR	0.000031	0.001014	0.0015	3.24	NMR	8.08	8.44	15803
August	0.0003	0.006725	NMR	0.000025	0.001023	0.0015	3	0.014	8.14	8.34	6696
September	0.00026	0.003233	NMR	0.000025	0.001	0.0015	3	NMR	8.16	8.42	7905
October	0.00029	0.005702	NMR	0.000047	0.001052	0.00358	3.7	NMR	8.07	8.25	8928
November	0.00025	0.005335	NMR	0.000033	0.000908	0.003425	4	NMR	8.05	8.4	6652
December	0.000255	0.002653	NMR	0.000025	0.000863	0.0015	3.05	NMR	7.77	8.32	5356

Results of Acute Lethality Tests and Daphnia magna Monitoring Tests (Generated)

Date Sample Collected	Results for Rainbow Trout Acute Lethality Tests (mean percentage mortality in 100% effluent test concentration)	Results for Daphnia magna Monitoring Tests (mean percentage mortality in 100% effluent test concentration)
2018-02-20	0	0
2018-06-12	0	0
2018-08-07	0	0
2018-10-02	0	0

Non-Compliance Information



Minto Explorations Ltd.
ATTN: Minto Environment
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 21-FEB-18
Report Date: 14-MAR-18 11:43 (MT)
Version: FINAL

Client Phone: 604-759-0860

Certificate of Analysis

Lab Work Order #: L2059190
Project P.O. #: 229101
Job Reference:
C of C Numbers: 2018-02-21 B
Legal Site Desc:

Comments: Please note, the Nautilus report for Rainbow trout 96-h LC50 and Daphnia magna 48-h LC50 can be found at the end of the attachment

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID						
Grouping	Analyte					

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
---------------	--------	------------------	--------------------

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
----------------------------	---------------------

Chain of Custody Numbers:

2018-02-21 B

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Acute Toxicity Test Results

Sample L2059190-1 W3,
collected February 20, 2018

Final Report

March 13, 2018

Submitted to: **ALS Environmental**
Burnaby, BC

SAMPLE INFORMATION

Sample ID	Dates				Receipt temp/.
	Collected	Received	Rainbow trout test initiation	<i>Daphnia magna</i> test initiation	
L2059190-1 W3	20-Feb-18 at N/A	22-Feb-18 at 1610h	23-Feb-18 at 1520h	22-Feb-18 at 1700h	10.3°C

N/A = Not available

TESTS

- Rainbow trout 96-h LC50 test
- *Daphnia magna* 48-h LC50 test

RESULTS

Toxicity test results

Sample ID	LC50 (% v/v)	
	Rainbow trout	<i>Daphnia magna</i>
L2059190-1 W3	> 100	> 100

QA/QC

QA/QC summary	Rainbow trout	<i>Daphnia magna</i>
Reference toxicant LC50 (95% CL)	135.7 (95.4 – 184.6) µg/L Zn ¹	5.9 (4.8 – 7.3) g/L NaCl ²
Reference toxicant historical mean (2 SD range)	92.8 (55.5 – 155.3) µg/L Zn	6.1 (4.2 – 8.8) g/L NaCl
Reference toxicant CV	29%	20%
Organism health history	Acceptable	Acceptable
Protocol deviations	None	None
Water quality range deviations	None	None
Control performance	Acceptable	Acceptable
Test performance	Valid	Valid

¹ Test date: February 16, 2018; ² Test Date: February 9, 2018, LC = Lethal Concentration, CL = Confidence Limits, SD = Standard Deviation, CV = Coefficient of Variation



Report By:
Kania Lywe, B.Sc.
Laboratory Biologist



Reviewed By:
Julianna Kalocai, M.Sc., R.P.Bio
QA Manager

This report has been prepared by Nautilus Environmental Company Inc. based on data and/or samples provided by our client and the results of this study are for their sole benefit. Any reliance on the data by a third party is at the sole and exclusive risk of that party. The results presented here relate only to the samples tested.

APPENDIX A – Summary of test conditions

Table 1. Summary of test conditions: 96-h rainbow trout (*Oncorhynchus mykiss*) LC50 test.

Test species	<i>Oncorhynchus mykiss</i>
Organism source	Hatchery
Organism age	Juvenile
Test type	Static
Test duration	96 hours
Test vessel	20-L glass aquarium
Test volume	10 to 20 L (depending on size of fish)
Test solution depth	≥15 cm
Test concentrations	Five concentrations, plus laboratory control
Test replicates	1 per treatment
Number of organisms	10 per replicate
Control/dilution water	Dechlorinated Metro Vancouver municipal tapwater
Test solution renewal	None
Test temperature	15 ± 1°C
Feeding	None
Light intensity	100 to 500 lux
Photoperiod	16 hours light / 8 hours dark
Aeration	6.5 ± 1 mL/min/L
Test measurements	Temperature, dissolved oxygen and pH measured daily; salinity measured in the undiluted sample at test initiation; conductivity measured at test initiation and termination; survival checked daily
Test protocol	Environment Canada (2000), EPS 1/RM/13, with 2007 & 2016 amendments
Statistical software	CETIS Version 1.8.7
Test endpoints	Survival (96-hour LC50)
Test acceptability criterion for controls	Survival ≥90%
Reference toxicant	Zinc (added as ZnSO ₄)

Table 2. Summary of test conditions: 48-h *Daphnia magna* LC50 test.

Test species	<i>Daphnia magna</i>
Organism source	In-house culture
Organism age	<24-hour old neonates
Test type	Static
Test duration	48 hours
Test vessel	250-mL glass beaker
Test volume	200 mL
Test solution depth	6 cm
Test concentrations	Five concentrations, plus laboratory control
Test replicates	1 per treatment
Number of organisms	10 per replicate
Control/dilution water	Moderately-hard reconstituted water + 2.5 µg/L Se
Test solution renewal	None
Test temperature	20 ± 2°C
Feeding	None
Light intensity	400 to 800 lux
Photoperiod	16 hours light / 8 hours dark
Aeration	None
Test measurements	Temperature, dissolved oxygen and pH measured daily; salinity, hardness and alkalinity measured in the undiluted sample at test initiation; conductivity measured at test initiation and termination; survival checked daily
Test protocol	Environment Canada (2000), EPS 1/RM/14, with 2016 amendments
Statistical software	CETIS Version 1.8.7
Test endpoints	Survival (48-hour LC50)
Test acceptability criterion for controls	Survival ≥90%
Reference toxicant	Sodium chloride (NaCl)

APPENDIX B – Toxicity test data

Rainbow Trout Summary Sheet

Client: ALS

Start Date/Time: Feb 23/18 @ 1520h

Work Order No.: 180268

Test Species: Oncorhynchus mykiss

Sample Information:

Sample ID: L2059190-1 W3

Sample Date: Feb 20/18

Date Received: Feb 22/18

Sample Volume: 2x20L

Other: -

Test Validity Criteria:

≥ 90% control survival

WQ Ranges:

T (°C) = 15 ± 1; DO (mg/L) = 7.0 to 10.3; pH = 5.5 to 8.5

Dilution Water:

Type: Dechlorinated Municipal Tap Water

Hardness (mg/L CaCO₃): 11

Alkalinity (mg/L CaCO₃): 10

Test Organism Information:

Batch No.: 0112186

Source: Vancouver Island Trout Hatchery

No. Fish/Volume (L): 10/10L

Loading Density (g/L): 0.26 ± 0.31

Mean Length ± SD (mm): 30 ± 2

Mean Weight ± SD (g): 0.31 ± 0.06

Range: 27 - 32

Range: 0.22 - 0.40

Zinc Reference Toxicant Results:

Reference Toxicant ID: RTZn107

Stock Solution ID: 17Zn05

Date Initiated: February 16, 2018

96-h LC50 (95% CL): 135.7 (95.4 - 184.6) µg/L Zn

Reference Toxicant Mean and Historical Range: 92.8 (55.5 - 155.3) µg/L Zn

Reference Toxicant CV (%): 29

Test Results: The 96-hour LC50 is estimated to be >100% (40).

Reviewed by: JGU

Date reviewed: Mar. 12/18

96-Hour Rainbow Trout Toxicity Test Data Sheet

Client/Project#: ALS Environmental
Sample I.D. L2059190-1 W3
W.O. # 180268
RBT Batch #: 011218b
Date Collected/Time: 20 Feb 18 @ not available
Date Setup/Time: 23 Feb 18 @ 1320 ~ 1520
CER #: 2
Sample Setup By: RC

Number Fish/Volume: 10 / 10 L
7-d % Mortality: 0.12
Total Pre-aeration Time (mins): 30
Aeration rate adjusted to 6.5 ± 1 mL/min/L? (Y/N): Y

Thermometer: Cel 2
D.O. meter/probe: 2 / D2
Cond./Salinity meter/probe: 2 / CP2
pH meter/probe: 2 / P2

Undiluted Sample WQ			
Parameters	Initial WQ	Adjustment	30 min WQ
Temp °C	14.0	/	14.0
D.O. (mg/L)	10.0		10.2
pH	7.5		7.6
Cond. (µS/cm)	~ 583		582
Salinity (ppt)	0.3		0.3

Concentration	# Survivors							Temperature (°C)					Dissolved Oxygen (mg/L)					pH					Conductivity (µS/cm)	
(% v/v)	1	2	4	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	96
Ctrl				10	10	10	10	14.0	14.0	14.5	14.0	15.0	10.3	10.3	9.6	9.8	9.3	7.1	7.0	6.9	6.9	7.0	35	41
6.25				10	10	10	10	14.0	14.0	14.5	14.0	15.0	10.3	10.3	9.7	9.7	9.4	7.1	7.0	7.0	6.9	7.0	53	58
12.5				10	10	10	10	14.0	14.0	14.5	14.0	15.0	10.3	10.3	9.7	9.8	9.4	7.3	7.4	7.2	7.3	7.4	116	121
25				10	10	10	10	14.0	14.0	14.5	14.0	15.0	10.3	10.3	9.6	9.8	9.3	7.3	7.7	7.6	7.6	7.9	176	182
50				10	10	10	10	14.0	14.0	14.5	14.0	15.0	10.2	10.2	9.7	9.8	9.2	7.8	8.1	7.9	8.1	8.2	301	314
100				10	10	10	10	14.0	14.0	14.5	14.0	15.0	10.2	10.2	9.6	9.7	9.2	7.6	8.4	8.2	8.5	8.6	582	574
Initials				RC	A	M	RC	M	M	A	M	RC	M	RC	M	M	M	RC	M	A	M	RC	RC	RC

Sample Description/Comments: Clear, light yellow liquid, no odour, no particulates

Fish Description at 96 h All fish appear normal Number of Stressed Fish at 96 h 0

Other Observations: _____

Reviewed by: JCH Date Reviewed: March 9/18

Daphnia magna Summary Sheet

Client: ALS
Work Order No.: 180269

Start Date/Time: Feb 22/18 @ 1700h
Test Species: Daphnia magna
Set up by: YHL

Sample Information:

Sample ID: L2059190-1 W3
Sample Date: Feb 20/18
Date Received: Feb 22/18
Sample Volume: 2x20L

Test Validity Criteria:

≥ 90% mean control survival and/or mobility and ≤ 2 daphnids exhibit immobility and/or mortality in any single control replicate.

WQ Ranges:

T (°C) = 20 ± 2; DO (mg/L) = 3.6 to 9.4; pH = 6 to 8.5

Test Organism Information:

Broodstock No.: 03018A
Age of young (Day 0): <24 h
Avg No. young per brood in previous 7 d: 19
Mortality (%) in previous 7 d: 0
Days to first brood: 8

NaCl Reference Toxicant Results:

Reference Toxicant ID: DmDc6
Stock Solution ID: 18Na01
Date Initiated: Feb 9/18
48-h LC50 (95% CL): 5.9 (4.8 - 7.3) g/L NaCl

Reference Toxicant Mean and Historical Range: 6.1 (4.2 - 8.8) g/L NaCl
Reference Toxicant CV (%): 20

Test Results: The 48-hour LC50 is estimated to be >100% (w/w)

Reviewed by: JGM

Date reviewed: March 9/18

Freshwater Acute 48 Hour Toxicity Test Data Sheet

Client: ALS
 Sample ID: L2059190-4 W3
 Work Order No.: 180267

Start Date/Time: February 22, 2018 @ 1700h
 CER #: 5
 No. Organisms/volume: 10/200mL
 Test Organism: D. magna
 Set up by: Vm

Thermometer: CER#5 pH meter/probe: 3 / 3 DO meter/probe: 3 / 3 Cond./Salinity meter/probe: 3 / 3

Concentration (% v/v)	Number of Live Organisms Rep	24		No. Immobilized 48	Temperature (°C)			Dissolved oxygen (mg/L)			pH			Conductivity (µS/cm)	
		48			0	24	48	0	24	48	0	24	48	0	48
Control	A	10	10	0	19.0	19.0	19.0	8.6	8.5	8.9	7.6	7.6	7.9	352	358
	B														
	C														
	D														
6.25	A	10	10	0	19.0	19.0	19.0	8.6	8.6	8.8	7.6	7.6	7.9	369	375
	B														
	C														
	D														
12.5	A	10	10	0	19.0	19.0	19.0	8.7	8.6	8.8	7.5	7.6	7.9	381	383
	B														
	C														
	D														
25	A	10	10	0	19.0	19.0	19.0	8.7	8.6	8.8	7.3	7.6	7.8	408	409
	B														
	C														
	D														
50	A	10	10	0	19.0	19.0	19.0	8.8	8.6	8.8	7.1	7.5	7.8	471	475
	B														
	C														
	D														
100	A	10	10	0	19.0	19.0	19.0	9.2	8.6	8.9	6.8	7.4	7.6	584	578
	B														
	C														
	D														
Technician Initials	Vm	A			Vm	Vm		Vm	Vm		Vm	Vm		Vm	A

	Hardness*	Alkalinity*
Concentration	*(mg/L as CaCO ₃)	
Control (MHW)	100	72
Highest conc.	280	350
Hardness adjusted	-	-

	Initial WQ	Adjustment	Adjusted WQ
Temp (°C)	19.0		
DO (mg/L)	9.2		
pH	6.8		
Cond (µS/cm)	584		
Salinity (ppt)	0.3		

Comments: _____ Mortality: Heartbeat checked under microscope NO

Sample Description: Clear, colourless liquid, no odour, no particulates

Batch#: 013018A 7-d previous # young/brood: 19 Previous 7-d Mortality (%): 0 Day of 1st Brood: 8

Reviewed by: JGH Date reviewed: March 9/18

APPENDIX C – Chain-of-custody form



L2059190

VANCOUVER

Subcontract Request Form

Subcontract To:

NAUTILUS ENVIRONMENTAL

8664 COMMERCE COURT
BURNABY, BC V5A 4N7

NOTES: Please reference on final report and invoice: PO# L2059190
ALS requires QC data to be provided with your final results.

Please see enclosed 1 sample(s) in 20 Container(s)

SAMPLE NUMBER	ANALYTICAL REQUIRED	DATE SAMPLED	Priority Flag
		DUE DATE	
L2059190-1 W3		2/20/2018	
	Daphnia Magna LC50 (48 Hour) - Nautilus (DAPHNIA-LC50-48HR-NL 1)	3/1/2018	
	Trout Bioassay LC50 (96 Hour) - Nautilus (TROUT-LC50-96HR-NL 1)	3/1/2018	

Subcontract Info Contact: Walter Lin (604) 253-4188
Analysis and reporting info contact: Shane Stack
8081 LOUGHEED HWY
SUITE 100
BURNABY, BC V5A 1W9
Phone: (604) 253-4188

NEW Reporting Contacts:
1. Account Manager Listed Below
2. ALSEVDataSublet@ALSGlobal.com (PDF / EXCEL)
3. ALSE.CASDG@ALSGlobal.com (EDD/Database Formats)

Email: Shane.Stack@alsglobal.com

Please email confirmation of receipt to: **Shane.Stack@alsglobal.com**

Shipped By: me Date Shipped: Feb 22 2018
Received By: Nautilus Date Received: Feb 22/18 @ 16:10
Verified By: NY - Nari Yamamoto Date Verified: _____
Temperature: 10.3°C
2x 20L

Sample Integrity Issues: _____

wo # 180268 - Rbt LC50
180269 - D. Magna LC50

(Minto)

**L2059190**

VANCOUVER

Subcontract Request Form**Subcontract To:****NAUTILUS ENVIRONMENTAL**8664 COMMERCE COURT
BURNABY, BC V5A 4N7**NOTES:** Please reference on final report and invoice: PO# L2059190
ALS requires QC data to be provided with your final results.Please see enclosed 1 sample(s) in 2 Container(s)

SAMPLE NUMBER	ANALYTICAL REQUIRED	DATE SAMPLED	Priority Flag
		DUE DATE	
L2059190-1 W3		2/20/2018	
	Daphnia Magna LC50 (48 Hour) - Nautilus (DAPHNIA-LC50-48HR-NL 1)	3/1/2018	
	Trout Bioassay LC50 (96 Hour) - Nautilus (TROUT-LC50-96HR-NL 1)	3/1/2018	

Subcontract Info Contact: Walter Lin (604) 253-4188

Analysis and reporting info contact: Shane Stack
8081 LOUGHEED HWY
SUITE 100
BURNABY, BC V5A 1W9

Phone: (604) 253-4188

***NEW* Reporting Contacts:**

1. Account Manager Listed Below
2. ALSEVDataSublet@ALSGlobal.com (PDF / EXCEL)
3. ALSE.CASDG@ALSGlobal.com (EDD/Database Formats)

Email: Shane.Stack@alsglobal.com

Please email confirmation of receipt to: Shane.Stack@alsglobal.com

Shipped By: _____ Date Shipped: _____

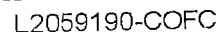
Received By: Nautilus Date Received: Feb 23/18 @ 12:10.Verified By: NY- Nair Yamamoto Date Verified: _____Temperature: 5.2 °CSample Integrity Issues: 2x 1L - remaining containers.

Tested from 20L jugs, received
Feb 22/18 @ 16:10.
wo # 180269 - D. Magna LC50.
180268 - RBT LC50

END OF REPORT



Canada Toll Free: 1 800 668 9878



COC Number: 2018-02-21 B

Page 1 of 1

[illegible]

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

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OCTOBER 2015 / 63



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 13-JUN-18
Report Date: 10-JUL-18 17:39 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2111715
Project P.O. #: 229096 (WUL)
Job Reference:
C of C Numbers: 2018-06-13 C
Legal Site Desc:

Comments: Please note, this report contains only Nautilus Environmental reports (at the end of the attachment).

This report was combined with the L2111718 submission.

Shane Stack
Account Manager

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ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID						
Grouping	Analyte					

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
---------------	--------	------------------	--------------------

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
----------------------------	---------------------

Chain of Custody Numbers:

2018-06-13 C

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

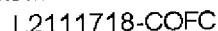
Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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OCTOBER 2015 FROM

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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Toxicity Testing for W2 and W50

Collected June 12, 2018

Final Report

July 10, 2018

Submitted to: **ALS Environmental**
Burnaby, BC

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3.0 Results	3
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List of Appendices

APPENDIX A – *Ceriodaphnia dubia* Toxicity Test Data
APPENDIX B – Chain-of-Custody Form

SIGNATURE PAGE

Report By:
Kania Lywe, B.Sc.
Laboratory Biologist



Reviewed By:
Armando Tang, R.P. Bio
Senior Reviewer

This report has been prepared by Nautilus Environmental Company Inc. based on data and/or samples provided by our client and the results of this study are for their sole benefit. Any reliance on the data by a third party is at the sole and exclusive risk of that party. The results presented here relate only to the sample tested.

SUMMARY

Sample Information and Test Type

Sample ID	L2111715-1 W2 and L2111715-3 W50
Sample collection date	June 12, 2018
Sample receipt date	June 15, 2018
Sample receipt temperature	7.6°C
Test types	<i>Ceriodaphnia dubia</i> survival and reproduction

Summary of Results

Endpoint	L2111715-1 W2 (% v/v)	L2111715-3 W50 (% v/v)
<i>Ceriodaphnia dubia</i>		
Survival LC50	> 100	> 100
Reproduction IC25	> 100	> 100
Reproduction IC50	> 100	> 100

LC = Lethal Concentration, IC = Inhibition Concentration

1.0 INTRODUCTION

Nautilus Environmental Company Inc. conducted a sub-lethal toxicity test for ALS Environmental on samples identified as L2111715-1 W2 and L2111715-3 W50. The samples were collected on June 12, 2018 and delivered to the Nautilus Environmental laboratory in Burnaby, BC on June 15, 2018. The samples were transported in six to seven 1-L containers for both samples and additional one 20-L container for L2111715-3 W50. The samples were received at a temperature of 7.6°C and were stored in the dark at $4 \pm 2^\circ\text{C}$ prior to testing.

This report describes the results of the toxicity tests using *Ceriodaphnia dubia*. Copies of raw laboratory data sheets and statistical analyses are provided in Appendix A. The chain-of-custody form is provided in Appendix B.

2.0 METHODS

Methods for the toxicity test are summarized in Table 1. Testing using *C. dubia* was conducted according to procedures described by Environment Canada (2007). Statistical analyses for all the tests were performed using CETIS (Tidepool Scientific Software, 2013).

Table 1. Summary of test conditions: *Ceriodaphnia dubia* survival and reproduction test.

Test species	<i>Ceriodaphnia dubia</i>
Organism source	In-house culture
Organism age	<24 hour old neonates, produced within a 12 hour window
Test type	Static-renewal
Test duration	7 ± 1 day
Test vessel	20-mL glass test tube
Test volume	15 mL
Test solution depth	10 cm
Test concentrations	Seven concentrations, plus laboratory control
Test replicates	10 per treatment
Number of organisms	1 per replicate
Control/dilution water	20% Perrier water and 80% deionized water + 5 µg/L Se and 2 µg/L vitamin B12
Test solution renewal	Daily (100% renewal)
Test temperature	25 ± 1°C
Feeding	Daily with <i>Pseudokirchneriella subcapitata</i> and YCT (3:1 ratio)
Light intensity	100 to 600 lux at water surface
Photoperiod	16 hours light / 8 hours dark
Aeration	None
Test measurements	Temperature, dissolved oxygen, pH and conductivity measured daily; hardness and alkalinity of undiluted sample measured at test initiation; survival and reproduction checked daily
Test protocol	Environment Canada (2007), EPS 1/RM/21
Statistical software	CETIS Version 1.8.7
Test endpoints	Survival and reproduction ≥80% survival; ≥15 young per surviving control producing three broods; ≥60% of controls producing three or more broods; no ephippia present
Test acceptability criteria for controls	
Reference toxicant	Sodium chloride (NaCl)

3.0 RESULTS

Results of the toxicity tests are summarized in Table 2. There were no adverse effects observed on either survival or reproduction of *C. dubia*, with the LC and IC values greater than >100% (v/v).

Table 2. Results: *Ceriodaphnia dubia* survival and reproduction test.

Concentration (% v/v)	L2111715-1 W2		L2111715-3 W50	
	Survival (%)	Reproduction (Mean $\pm$ SD)	Survival (%)	Reproduction (Mean $\pm$ SD)
Laboratory Control	90	14.2 $\pm$ 7.0 ¹	100	15.5 $\pm$ 4.9
1.56	90	15.0 $\pm$ 5.7	90	16.2 $\pm$ 6.7
3.12	100	16.6 $\pm$ 2.6	100	18.9 $\pm$ 2.7
6.25	100	18.0 $\pm$ 1.8	100	18.2 $\pm$ 2.6
12.5	100	19.4 $\pm$ 3.0	80	16.1 $\pm$ 8.6
25	100	20.3 $\pm$ 1.7	100	22.1 $\pm$ 3.3
50	90	19.1 $\pm$ 7.4	100	20.9 $\pm$ 3.5
100	100	22.8 $\pm$ 2.1	90	18.5 $\pm$ 7.3
Test Endpoint (% v/v)				
LC50	>100	--	>100	--
IC25	--	>100	--	>100
IC50	--	>100	--	>100

SD = Standard Deviation, LC = Lethal Concentration, IC = Inhibition Concentration, ¹ = Reproduction met passing criteria; the mean number of young per surviving female that produced three broods was 17.

4.0 QA/QC

The health histories of the test organisms used in the exposures were acceptable and met the requirements of the Environment Canada protocols. The tests met all control acceptability criteria and water quality parameters remained within ranges specified in the protocols throughout the tests. Uncertainty associated with the tests is best described by the standard deviation around the mean and/or the confidence intervals around the point estimates.

Results of the reference toxicant test conducted during the testing program are summarized in Table 3. Results for this test fell within the ranges for organism performance of the mean and two standard deviations, based on historical results obtained by the laboratory with this test. Thus, the sensitivity of the organisms used in this test was appropriate. The reference toxicant test was performed under the same conditions as those used for the samples.

Table 3. Reference toxicant test results.

Test Species	Endpoint	Historical Mean (2 SD Range)	CV (%)	Test Date
<i>C. dubia</i>	Survival (LC50): 2.0 g/L NaCl	2.0 (1.8 – 2.3) g/L NaCl	7	June 13, 2018
	Reproduction (IC50): 1.0 g/L NaCl	1.3 (0.9 – 1.9) g/L NaCl	23	

SD = Standard Deviation, CV = Coefficient of Variation, LC = Lethal Concentration, IC = Inhibition Concentration

5.0 REFERENCES

Environment Canada. 2007. Biological test method: test of reproduction and survival using the cladoceran *Ceriodaphnia dubia*. Environmental Protection Series. Report EPS 1/RM/21, Second Edition, February 2007. Environment Canada, Method Development and Application Section, Environmental Science and Technology Centre, Science and Technology Branch, Ottawa, ON. 74 pp.

Tidepool Scientific Software. 2013. CETIS comprehensive environmental toxicity information system, version 1.8.7.16 Tidepool Scientific Software, McKinleyville, CA. 275 pp

APPENDIX A – *Ceriodaphnia dubia* Toxicity Test Data

Ceriodaphnia dubia Summary Sheet

Client: ALS
Work Order No.: 130978

Start Date/Time: June 15/18 e 1030h
Set up by: W. GMM

Sample Information:

Sample ID: W2 CUMIS-1 W2
Sample Date: June 12/18
Date Received: June 15/18
Sample Volume: 6X 1L

Test Validity Criteria:

- 1) Mean survival of first generation controls is $\geq 80\%$
- 2) At least 60% of controls have produced three broods within 8 days
- 3) An average of ≥ 15 live young produced per surviving female in the control solutions during the first three broods.
- 4) Invalid if ephippia observed in any control solution at any time.

WQ Ranges:

T ($^{\circ}$ C) = 25 ± 1 ; DO (mg/L) = 3.3 to 8.4 ; pH = 6.0 to 8.5

Test Organism Information:

Broodstock No.: BS060718A LB
Age of young (Day 0): <24-h (within 12-h)
Avg No. young in first 3 broods of previous 7 d: 20
Mortality (%) in previous 7 d: 0
Individual female # used ≥ 8 young on test day: 26, 7, 10, 11, 13-17, 21-30, 32, 33, 35, 36, 37

NaCl Reference Toxicant Results:

Reference Toxicant ID: Cd186
Stock Solution ID: 18Na02 (100g/L NaCl)
Date Initiated: June 13/18

7-d LC50 (95% CL): 2.0(1.7-2.3) g/L NaCl
7-d IC50 (95% CL): 1.0(0.7-1.1) g/L NaCl

7-d LC50 Reference Toxicant Mean and Historical Range: 2.0(1.8-2.3) g/L NaCl CV (%): 7
7-d IC50 Reference Toxicant Mean and Historical Range: 1.3(0.9-1.9) g/L NaCl CV (%): 23

Test Results:

	Survival	Reproduction
LC50 % (v/v) (95% CL)	<u>>100</u>	
IC25 % (v/v) (95% CL)		<u>>100</u>
IC50 % (v/v) (95% CL)		<u>>100</u>

Reviewed by: JGH

Date reviewed: June 29/18

Chronic Freshwater Toxicity Test Initial and Final Water Quality Measurements

Client: ALS (Minto)
Sample ID: W2 12117151 W2
Work Order #: 180978

Start Date & Time: June 15/18 @ 1030h
Stop Date & Time: June 21/18 @ 1600h
CER #: 4
Test Species: Ceriodaphnia dubia

Concentration	Days													
	0	1		2		3		4		5		6		7
	init.	old	new	old	new	old	new	old	new	old	new	old	new	final
Control														
Temperature (°C)	24.0	25.0	24.0	25.0	24.0	25.0	24.5	25.0	24.5	25.0	24.0	25.0		
DO (mg/L)	8.1	8.2	8.0	7.6	8.1	7.8	8.2	7.3	8.1	7.4	7.9	7.3		
pH	7.9	8.0	8.0	7.9	8.1	8.0	8.2	8.1	8.3	8.1	8.3	7.9		
Cond. (µS/cm)	210	209		211		211		211		211		211		
Initials	EMM													

Concentration (150%)	Days													
	0	1		2		3		4		5		6		7
	init.	old	new	old	new	old	new	old	new	old	new	old	new	final
Temperature (°C)	24.0	25.0	24.0	25.0	24.0	25.0	25.0	25.0	24.5	25.0	24.5	25.0		
DO (mg/L)	8.1	8.2	8.0	7.7	8.1	7.8	7.8	7.3	8.0	7.4	7.9	7.3		
pH	8.1	8.0	8.1	8.1	8.1	8.1	8.0	8.0	8.2	8.1	8.3	8.0		
Cond. (µS/cm)	219	210		214		213		214		215		210		
Initials	EMM					AW								

Concentration (125%)	Days													
	0	1		2		3		4		5		6		7
	init.	old	new	old	new	old	new	old	new	old	new	old	new	final
Temperature (°C)	24.0	25.0	24.0	25.0	24.0	25.0	25.0	25.0	24.5	25.0	25.0	25.0		
DO (mg/L)	8.1	8.1	8.0	7.7	8.1	7.8	7.8	7.4	8.0	7.4	7.9	7.3		
pH	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.0	8.2	8.1	8.3	8.9		
Cond. (µS/cm)	227	225		228		227		226		227		223		
Initials	EMM					AW								

Concentration (100%)	Days													
	0	1		2		3		4		5		6		7
	init.	old	new	old	new	old	new	old	new	old	new	old	new	final
Temperature (°C)	24.0	25.0	24.0	25.0	24.0	25.0	25.0	25.0	24.5	25.0	25.0	25.0		
DO (mg/L)	8.0	8.1	8.1	7.6	8.2	7.8	8.8	7.3	8.0	7.4	7.9	7.3		
pH	8.1	8.1	8.1	8.2	8.1	8.2	8.0	8.0	8.0	8.2	8.2	8.0		
Cond. (µS/cm)	321	324		321		327		327		318		324	315	
Initials	EMM					AW								

Thermometer: 4 DO meter/probe: 21, 1 pH meter/probe: 21, 1 Conductivity meter/probe: 21, 1

	Control	100% (100%)	
Hardness*	100	140	
Alkalinity*	4294	144	

* mg/L as CaCO₃

Analysts: KL, EMM, AWB, AW

Reviewed by: JBL

Date reviewed: June 29/18

Sample Description: light yellow, clear, clear, colourless, no particulates, no precipitate

Comments: Broodboard Used: 060718A (2, 6, 7, 10, 11, 13, 14) & 06060718B (21-30, 32, 33, 35, 36, 37)

Chronic Freshwater Toxicity Test C. dubia Reproduction Data

Client: ALS (minto)
Sample ID: W2 1211715-1 W2
Work Order: 180978

Start Date & Time: June 15/18 at 1030h
Stop Date & Time: June 21/18 at 1600h
Set up by: EMM

% (V/V)

Days	Concentration: control												Concentration: 1.56												Concentration: 3.12											
	A	B	C	D	E	F	G	H	I	J	Init	A	B	C	D	E	F	G	H	I	J	Init	A	B	C	D	E	F	G	H	I	J	Init			
1	/	/	/	/	/	/	/	/	/	/	EMM	/	/	/	/	/	/	/	/	/	/	EMM	/	/	/	/	/	/	/	/	/	/	EMM			
2	/	/	/	/	/	/	/	/	/	/	EMM	/	/	/	/	/	/	/	/	/	/	EMM	/	/	/	/	/	/	/	/	/	/	EMM			
3	/	/	/	/	/	/	/	/	/	/	EMM	/	/	/	/	/	/	/	/	/	/	EMM	/	/	/	/	/	/	/	/	/	/	EMM			
4	/	3	2	3	2	4	4	2	4	4	EMM	/	3	3	3	2	/	3	3	3	X	EMM	3	2	3	3	2	3	2	2	2	2	EMM			
5	/	4	6	/	5	5	7	5	6	6	EMM	5	6	6	5	5	5	6	6	6	/	EMM	6	5	6	6	5	6	5	6	5	4	EMM			
6	/	10	11	/	7	7	10	10	9	8	EMM	7	9	10	8	9	10	7	7	10	/	EMM	11	6	9	11	7	10	10	8	8	8	EMM			
7				/																																
8				/																																
Total	0	17	19	3	14	16	21	17	17	18	EMM	12	18	19	16	16	15	16	19	19	EMM	20	13	18	20	14	19	17	16	15	14	EMM				

Days	Concentration: 6.25												Concentration: 12.5												Concentration: 25											
	A	B	C	D	E	F	G	H	I	J	Init	A	B	C	D	E	F	G	H	I	J	Init	A	B	C	D	E	F	G	H	I	J	Init			
1	/	/	/	/	/	/	/	/	/	/	EMM	/	/	/	/	/	/	/	/	/	/	EMM	/	/	/	/	/	/	/	/	/	/	EMM			
2	/	/	/	/	/	/	/	/	/	/	EMM	/	/	/	/	/	/	/	/	/	/	EMM	/	/	/	/	/	/	/	/	/	/	EMM			
3	/	/	/	/	/	/	/	/	/	/	EMM	/	/	/	/	/	/	/	/	/	/	EMM	/	/	/	/	/	/	/	/	/	/	EMM			
4	2	2	3	2	3	3	3	2	2	3	W	2	3	4	4	3	2	2	2	2	2	W	2	4	1	3	3	1	3	1	2	3	W			
5	7	6	6	7	4	5	5	6	5	7	W	6	6	7	7	6	4	6	8	9	8	W	5	7	6	8	8	7	9	7	7	7	W			
6	11	10	12	10	8	9	8	10	10	9	W	7	11	12	10	11	10	10	11	12	7	W	12	10	11	12	10	12	10	13	11	11	W			
7																																				
8																																				
Total	20	18	21	19	15	17	16	18	17	19	W	15	20	23	21	20	14	18	21	23	W	19	21	17	23	21	24	22	20	20	21	W				

Days	Concentration: 50												Concentration: 100												Concentration:											
	A	B	C	D	E	F	G	H	I	J	Init	A	B	C	D	E	F	G	H	I	J	Init	A	B	C	D	E	F	G	H	I	J	Init			
1	/	/	/	/	/	/	/	/	/	/	EMM	/	/	/	/	/	/	/	/	/	/	EMM														
2	/	/	/	/	/	/	/	/	/	/	A	/	/	/	/	/	/	/	/	/	/															
3	/	/	/	/	3	/	/	/	/	X	EMM	/	/	/	/	/	/	/	/	/	/	EMM														
4	/	4	4	2	/	4	3	2	/	/	K	2	4	3	3	3	2	4	4	4	4	EMM														
5	6	8	8	7	7	7	9	9	3	/	w	9	8	9	10	10	9	8	6	6	w															
6	13	11	13	10	12	13	11	11	11	/	w	11	11	14	10	10	14	8	11	12	13	w														
7										/																										
8			w							/																										
Total	19	23	24	19	22	24	23	22	14	15	w	22	23	26	19	23	26	21	23	22	23	w														

Notes: X = mortality.

Sample Description: See WQ sheet

Comments: Total # Young only based on the first 3 Broods. Fourth and subsequent broods not included in total count. ① checked under microscope; no epiphys observed

Reviewed by: JGh

Date reviewed: June 29/18

CETIS Analytical Report

Report Date: 27 Jun-18 18:52 (p 1 of 2)
Test Code: 180978a | 05-2865-6447

Ceriodaphnia 7-d Survival and Reproduction Test

Nautilus Environmental

Analysis ID: 18-4075-3097	Endpoint: 7d Survival Rate	CETIS Version: CETISv1.8.7
Analyzed: 27 Jun-18 18:51	Analysis: Linear Interpolation (ICPIN)	Official Results: Yes
Batch ID: 19-9640-4154	Test Type: Reproduction-Survival (7d)	Analyst: Kania Lywe
Start Date: 15 Jun-18 10:30	Protocol: EC/EPS 1/RM/21	Diluent: 20% Perrier Water
Ending Date: 21 Jun-18 16:00	Species: Ceriodaphnia dubia	Brine:
Duration: 6d 5h	Source: In-House Culture	Age: <24h
Sample ID: 07-9320-4067	Code: 2F475563	Client: ALS
Sample Date: 12 Jun-18 13:30	Material: Water Sample	Project:
Receive Date: 15 Jun-18 09:38	Source: ALS	
Sample Age: 69h (7.6 °C)	Station: L2111715-1 W2	

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	1553803	200	Yes	Two-Point Interpolation

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
EC5	>100	N/A	N/A	<1	NA	NA
EC10	>100	N/A	N/A	<1	NA	NA
EC15	>100	N/A	N/A	<1	NA	NA
EC20	>100	N/A	N/A	<1	NA	NA
EC25	>100	N/A	N/A	<1	NA	NA
EC40	>100	N/A	N/A	<1	NA	NA
EC50	>100	N/A	N/A	<1	NA	NA

7d Survival Rate Summary

Calculated Variate(A/B)

C-%	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
0	Negative Control	10	0.9	0	1	0.1	0.3162	35.14%	0.0%	9	10
1.56		10	0.9	0	1	0.1	0.3162	35.14%	0.0%	9	10
3.12		10	1	1	1	0	0	0.0%	-11.11%	10	10
6.25		10	1	1	1	0	0	0.0%	-11.11%	10	10
12.5		10	1	1	1	0	0	0.0%	-11.11%	10	10
25		10	1	1	1	0	0	0.0%	-11.11%	10	10
50		10	0.9	0	1	0.1	0.3162	35.14%	0.0%	9	10
100		10	1	1	1	0	0	0.0%	-11.11%	10	10

7d Survival Rate Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Negative Control	1	1	1	0	1	1	1	1	1	1
1.56		1	1	1	1	1	1	1	1	1	0
3.12		1	1	1	1	1	1	1	1	1	1
6.25		1	1	1	1	1	1	1	1	1	1
12.5		1	1	1	1	1	1	1	1	1	1
25		1	1	1	1	1	1	1	1	1	1
50		1	1	1	1	1	1	1	1	1	0
100		1	1	1	1	1	1	1	1	1	1

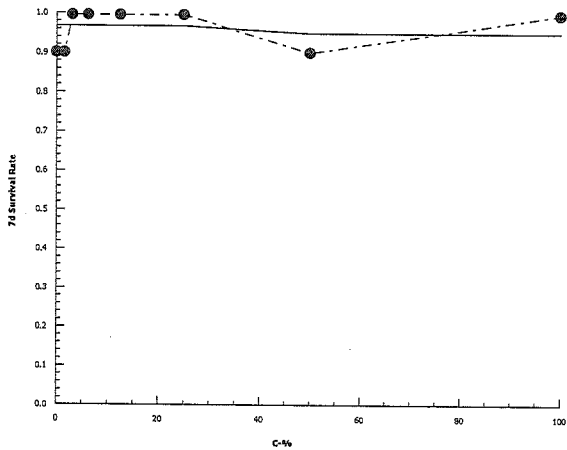
CETIS Analytical Report

Report Date: 27 Jun-18 18:52 (p 2 of 2)
 Test Code: 180978a | 05-2865-6447

Ceriodaphnia 7-d Survival and Reproduction Test				Nautilus Environmental
Analysis ID: 18-4075-3097	Endpoint: 6 d 7d Survival Rate	CETIS Version: CETISv1.8.7		
Analyzed: 27 Jun-18 18:51	Analysis: Linear Interpolation (ICPIN)	Official Results: Yes		

7d Survival Rate Binomials											
C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Negative Control	1/1	1/1	1/1	0/1	1/1	1/1	1/1	1/1	1/1	1/1
1.56		1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	0/1
3.12		1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
6.25		1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
12.5		1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
25		1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
50		1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	0/1
100		1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1

Graphics



CETIS Analytical Report

Report Date: 27 Jun-18 18:52 (p 1 of 2)
Test Code: 180978a | 05-2865-6447

Ceriodaphnia 7-d Survival and Reproduction Test				Nautilus Environmental	
Analysis ID:	16-7826-1129	Endpoint:	Reproduction	CETIS Version:	CETISv1.8.7
Analyzed:	27 Jun-18 18:51	Analysis:	Linear Interpolation (ICPIN)	Official Results:	Yes
Batch ID:	19-9640-4154	Test Type:	Reproduction-Survival (7d)	Analyst:	Kania Lywe
Start Date:	15 Jun-18 10:30	Protocol:	EC/EPS 1/RM/21	Diluent:	20% Perrier Water
Ending Date:	21 Jun-18 16:00	Species:	Ceriodaphnia dubia	Brine:	
Duration:	6d 5h	Source:	In-House Culture	Age:	<24h
Sample ID:	07-9320-4067	Code:	2F475563	Client:	ALS
Sample Date:	12 Jun-18 13:30	Material:	Water Sample	Project:	
Receive Date:	15 Jun-18 09:38	Source:	ALS		
Sample Age:	69h (7.6 °C)	Station:	L2111715-1 W2		

Linear Interpolation Options					
X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	338981	200	Yes	Two-Point Interpolation

Point Estimates						
Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
IC5	>100	N/A	N/A	<1	NA	NA
IC10	>100	N/A	N/A	<1	NA	NA
IC15	>100	N/A	N/A	<1	NA	NA
IC20	>100	N/A	N/A	<1	NA	NA
IC25	>100	N/A	N/A	<1	NA	NA
IC40	>100	N/A	N/A	<1	NA	NA
IC50	>100	N/A	N/A	<1	NA	NA

Reproduction Summary			Calculated Variate						
C-%	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	10	14.2	0	21	2.205	6.973	49.11%	0.0%
1.56		10	15	0	19	1.807	5.715	38.1%	-5.63%
3.12		10	16.6	13	20	0.8192	2.591	15.61%	-16.9%
6.25		10	18	15	21	0.5774	1.826	10.14%	-26.76%
12.5		10	19.4	14	23	0.9568	3.026	15.6%	-36.62%
25		10	20.3	17	23	0.5385	1.703	8.39%	-42.96%
50		10	19.1	0	25	2.35	7.43	38.9%	-34.51%
100		10	22.8	19	26	0.6633	2.098	9.2%	-60.56%

Reproduction Detail											
C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Negative Control	0	17	19	3	14	16	21	17	17	18
1.56		12	18	19	16	16	15	16	19	19	0
3.12		20	13	18	20	14	19	17	16	15	14
6.25		20	18	21	19	15	17	16	18	17	19
12.5		15	20	23	21	20	14	18	21	23	19
25		19	21	17	23	21	19	22	20	20	21
50		19	23	25	19	22	24	23	22	14	0
100		22	23	26	19	23	26	21	23	22	23

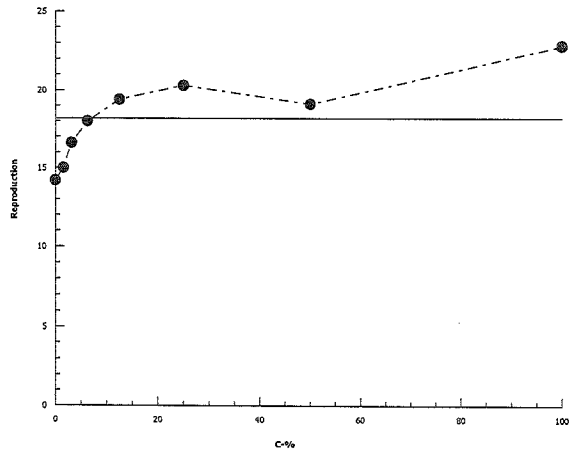
CETIS Analytical Report

Report Date: 27 Jun-18 18:52 (p 2 of 2)
Test Code: 180978a | 05-2865-6447

Ceriodaphnia 7-d Survival and Reproduction Test Nautilus Environmental

Analysis ID: 16-7826-1129	Endpoint: Reproduction	CETIS Version: CETISv1.8.7
Analyzed: 27 Jun-18 18:51	Analysis: Linear Interpolation (ICPIN)	Official Results: Yes

Graphics



Ceriodaphnia dubia Summary Sheet

Client: ALS
Work Order No.: 180978

Start Date/Time: June 15/18 1030h
Set up by: EMM

Sample Information:

Sample ID: W50 L211715-3 W50
Sample Date: June 12/18
Date Received: June 15/18
Sample Volume: 7X 1L + 1X20L

Test Validity Criteria:

- 1) Mean survival of first generation controls is $\geq 80\%$
- 2) At least 60% of controls have produced three broods within 8 days
- 3) An average of ≥ 15 live young produced per surviving female in the control solutions during the first three broods.
- 4) Invalid if ephippia observed in any control solution at any time.

WQ Ranges:

T ($^{\circ}$ C) = 25 ± 1 ; DO (mg/L) = 3.3 to 8.4 ; pH = 6.0 to 8.5

Test Organism Information:

Broodstock No.: B3060718 A & B
Age of young (Day 0): <24-h (within 12-h)
Avg No. young in first 3 broods of previous 7 d: 20
Mortality (%) in previous 7 d: 0
Individual female # used ≥ 8 young on test day: 2, 6, 7, 10, 11, 13-17, 21-30, 32, 33, 35, 36, 37

NaCl Reference Toxicant Results:

Reference Toxicant ID: Cd186
Stock Solution ID: 18Na02 (100g/L NaCl)
Date Initiated: June 13/18

7-d LC50 (95% CL): 2.0(1.7 - 2.3) g/L NaCl
7-d IC50 (95% CL): 1.0(0.7 - 1.1) g/L NaCl

7-d LC50 Reference Toxicant Mean and Historical Range: 2.0(1.8 - 2.3) g/L NaCl CV (%): 7
7-d IC50 Reference Toxicant Mean and Historical Range: 1.3(0.9 - 1.9) g/L NaCl CV (%): 23

Test Results:

	Survival	Reproduction
LC50 % (v/v) (95% CL)	<u>>100</u>	
IC25 % (v/v) (95% CL)		<u>>100</u>
IC50 % (v/v) (95% CL)		<u>>100</u>

Reviewed by: JOU

Date reviewed: June 29/18

Chronic Freshwater Toxicity Test Initial and Final Water Quality Measurements

Client:
Sample ID:
Work Order #:

ALS (Minto)
W50 LUM715-3 W50
80978

Start Date & Time: June 15/18 @ 1030h
Stop Date & Time: June 21/18 @ 1600h
CER #: 4
Test Species: Ceriodaphnia dubia

Concentration	Days													
	0	1		2		3		4		5		6		7
	init.	old	new	old	new	old	new	old	new	old	new	old	new	final
Control														
Temperature (°C)	24.0	25.0	24.0	25.0	24.0	25.0	25.0	25.0	24.5	25.0	24.0	25.0		
DO (mg/L)	8.1	7.6	8.0	7.5	8.0	7.6	8.2	7.2	8.1	7.4	7.9	7.1		
pH	7.9	7.8	8.0	7.9	8.0	8.0	8.2	8.0	8.2	8.1	8.3	7.8		
Cond. (µS/cm)	210	209		209		211		211		211		210		
Initials	EMM	A		A		AW		W		W		W		

024.5

Concentration	Days													
	0	1		2		3		4		5		6		7
	init.	old	new	old	new	old	new	old	new	old	new	old	new	final
1.5% (v/v)														
Temperature (°C)	24.0	25.0	24.0	25.0	24.0	25.0	24.0	25.0	24.5	25.0	25.0	25.0		
DO (mg/L)	8.1	7.6	8.1	7.7	8.2	7.6	7.6	7.2	8.0	7.4	7.9	7.1		
pH	8.2	7.9	8.0	8.0	8.0	8.1	8.1	8.0	8.2	8.1	8.3	7.9		
Cond. (µS/cm)	219	211		212		216		215		215		212		
Initials	EMM	A		A		AW		W		W		W		

Concentration	Days													
	0	1		2		3		4		5		6		7
	init.	old	new	old	new	old	new	old	new	old	new	old	new	final
12.5% (v/v)														
Temperature (°C)	24.0	25.0	24.0	25.0	24.0	25.0	24.0	25.0	24.5	25.0	25.0	25.0		
DO (mg/L)	8.1	7.6	8.1	7.5	8.2	7.5	7.7	7.1	8.0	7.4	7.9	7.1		
pH	8.1	7.9	8.0	8.2	8.0	8.1	8.1	8.0	8.2	8.1	8.3	7.9		
Cond. (µS/cm)	241	242		242		238		238		238		235		
Initials	EMM	A		A		AW		W		W		W		

Concentration	Days													
	0	1		2		3		4		5		6		7
	init.	old	new	old	new	old	new	old	new	old	new	old	new	final
100% (v/v)														
Temperature (°C)	24.0	25.0	24.0	25.0	24.0	25.0	24.0	25.0	24.5	25.0	25.0	25.0		
DO (mg/L)	8.1	7.5	8.1	7.6	8.2	7.5	7.7	7.1	8.0	7.4	7.9	7.1		
pH	8.0	8.1	8.0	8.1	8.0	8.2	8.0	8.2	7.9	8.2	8.1	8.1		
Cond. (µS/cm)	416	420		422		419		420		414		407		
Initials	EMM	EMM		A		AW		W		W		W		

Thermometer: 4 DO meter/probe: 21, 1 pH meter/probe: 21, 1 Conductivity meter/probe: 21, 1

	Control	100% (v/v)	
Hardness*	100	188	
Alkalinity*	92.94	148	

* mg/L as CaCO₃

Analysts: KL, EMM,
AWB, AW

Reviewed by: JCH
Date reviewed: June 29/18

Sample Description: clear, yellow, no particulates, no precipitate

Comments: Broodboard Used: 18060718 (2, 6, 7, 10, 11, 13-14) & 18060718 (21-30, 32, 33, 35, 36, 37)

Chronic Freshwater Toxicity Test
C. dubia Reproduction Data

Client: ALS (minto)
Sample ID: W50 L211715-3 WSO
Work Order: 180978

Start Date & Time: June 15/18 @ 1030h
Stop Date & Time: June 21/18 @ 1600h
Set up by: EMM

Days	Concentration: <u>control</u>											Concentration: <u>1.56</u>											Concentration: <u>3.12</u>										
	A	B	C	D	E	F	G	H	I	J	Init	A	B	C	D	E	F	G	H	I	J	Init	A	B	C	D	E	F	G	H	I	J	Init
1	/	/	/	/	/	/	/	/	/	/	EMM	/	/	/	/	/	/	/	/	/	/	EMM	/	/	/	/	/	/	/	/	/	/	EMM
2	/	/	/	/	/	/	/	/	/	/	EMM	/	/	/	/	/	/	/	/	/	/	EMM	/	/	/	/	/	/	/	/	/	/	EMM
3	/	/	/	/	/	/	/	/	/	/	EMM	/	/	/	/	/	/	/	/	/	/	EMM	/	/	/	/	/	/	/	/	/	/	EMM
4	3	2	/	3	2	3	2	2	2	/	EMM	3	2	/	3	3	2	2	2	3	/	EMM	4	2	2	4	2	4	2	3	3	3	EMM
5	7	6	/	7	5	5	5	7	9	5	EMM	7	6	3	7	8	6	6	8	6	/	EMM	7	5	6	6	5	4	7	7	6	6	EMM
6	8	10	4	9	7	7	8	10	10	7	EMM	9	9	7	10	12	7	11	10	10	/	EMM	10	10	12	11	6	13	7	11	10	11	EMM
7																																	
8																																	
Total	18	18	4	19	14	15	15	19	21	12	EMM	19	17	10	20	23	15	19	20	19	OX	EMM	21	17	20	21	13	21	16	21	19	20	EMM

Days	Concentration: 6.25											Concentration: 12.5											Concentration: 25										
	A	B	C	D	E	F	G	H	I	J	Init	A	B	C	D	E	F	G	H	I	J	Init	A	B	C	D	E	F	G	H	I	J	Init
1	/	/	/	/	/	/	/	/	/	/	EMM	/	/	/	/	/	/	/	/	/	/	EMM	/	/	/	/	/	/	/	/	/	/	EMM
2	/	/	/	/	/	/	/	/	/	/	EMM	/	/	/	/	/	/	/	/	/	/	EMM	/	/	/	/	/	/	/	/	/	/	EMM
3	/	/	/	/	/	/	/	/	/	/	EMM	X	/	/	/	/	X	/	/	/	/	EMM	/	/	/	/	/	/	/	/	/	3	EMM
4	4	3	2	3	3	4	/	2	2	4	EMM	3	4	2	/	/	3	3	2	2	EMM	3	2	4	3	4	5	4	4	5	/	EMM	
5	4	6	6	6	6	7	5	7	2	7	EMM	7	5	8	7	/	6	6	8	6	EMM	8	7	9	6	8	7	8	7	8	5	EMM	
6	10	11	10	11	10	6	10	12	9	10	EMM	13	12	11	11	/	13	10	9	10	EMM	14	6	9	13	10	14	8	12	13	12	EMM	
7																																	
8																																	
Total	18	20	18	20	19	17	15	21	13	21	EMM	23	21	21	18	OX	22	19	19	18	EMM	25	15	22	22	22	26	20	23	26	20	EMM	

Days	Concentration: <u>50</u>											Concentration: <u>100</u>											Concentration:										
	A	B	C	D	E	F	G	H	I	J	Init	A	B	C	D	E	F	G	H	I	J	Init	A	B	C	D	E	F	G	H	I	J	Init
1	/	/	/	/	/	/	/	/	/	/	EMM	/	/	/	/	/	/	/	/	/	/	EMM											
2	/	/	/	/	/	/	/	/	/	/	EMM	/	/	/	/	/	/	/	/	/	/	EMM											
3	/	/	/	/	/	/	/	/	/	/	EMM	/	/	/	/	/	/	/	/	/	/	EMM											
4	4	4	4	4	/	2	4	2	4	/	EMM	5	/	/	3	/	6	3	4	3	/	EMM											
5	9	8	6	5	8	8	5	8	7	8	EMM	9	3	8	9	/	7	7	5	7	EMM												
6	11	13	11	13	4	12	12	9	11	13	EMM	12	12	12	12	/	12	10	7	12	13	EMM											
7																																	
8																																	
Total	24	25	21	22	12	22	21	19	22	22	EMM	26	15	24	24	OX	18	20	18	20	20	EMM											

Notes: X = mortality.

Sample Description: See WQ sheet
Comments: Total # Young only based on the first 3 Broods. Fourth and subsequent broods not included in total count.

Reviewed by: Jon

Date reviewed: June 29/18

CETIS Analytical Report

Report Date: 27 Jun-18 18:57 (p 1 of 2)
Test Code: 180978b | 10-3740-9722

Ceriodaphnia 7-d Survival and Reproduction Test

Nautilus Environmental

Analysis ID: 12-8440-5973 Endpoint: 7d Survival Rate CETIS Version: CETISv1.8.7
Analyzed: 27 Jun-18 18:56 Analysis: Linear Interpolation (ICPIN) Official Results: Yes

Batch ID: 17-1521-1839 Test Type: Reproduction-Survival (7d) Analyst: Kania Lywe
Start Date: 15 Jun-18 10:30 Protocol: EC/EPS 1/RM/21 Diluent: 20% Perrier Water
Ending Date: 21 Jun-18 16:00 Species: Ceriodaphnia dubia Brine:
Duration: 6d 5h Source: In-House Culture Age: <24h

Sample ID: 10-2908-3130 Code: 3D568FFA Client:
Sample Date: 12 Jun-18 09:05 Material: Water Sample Project:
Receive Date: 15 Jun-18 09:38 Source: ALS
Sample Age: 73h (7.6 °C) Station: L2111715-3 W50

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	624302	200	Yes	Two-Point Interpolation

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
EC5	8.893	0.7577	N/A	11.24	NA	132
EC10	100	8.893	N/A	1	NA	11.24
EC15	>100	N/A	N/A	<1	NA	NA
EC20	>100	N/A	N/A	<1	NA	NA
EC25	>100	N/A	N/A	<1	NA	NA
EC40	>100	N/A	N/A	<1	NA	NA
EC50	>100	N/A	N/A	<1	NA	NA

7d Survival Rate Summary

Calculated Variate(A/B)

C-%	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
0	Negative Control	10	1	1	1	0	0	0.0%	0.0%	10	10
1.56		10	0.9	0	1	0.1	0.3162	35.14%	10.0%	9	10
3.12		10	1	1	1	0	0	0.0%	0.0%	10	10
6.25		10	1	1	1	0	0	0.0%	0.0%	10	10
12.5		10	0.8	0	1	0.1333	0.4216	52.7%	20.0%	8	10
25		10	1	1	1	0	0	0.0%	0.0%	10	10
50		10	1	1	1	0	0	0.0%	0.0%	10	10
100		10	0.9	0	1	0.1	0.3162	35.14%	10.0%	9	10

7d Survival Rate Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Negative Control	1	1	1	1	1	1	1	1	1	1
1.56		1	1	1	1	1	1	1	1	1	0
3.12		1	1	1	1	1	1	1	1	1	1
6.25		1	1	1	1	1	1	1	1	1	1
12.5		0	1	1	1	1	0	1	1	1	1
25		1	1	1	1	1	1	1	1	1	1
50		1	1	1	1	1	1	1	1	1	1
100		1	1	1	1	0	1	1	1	1	1

CETIS Analytical Report

Report Date: 27 Jun-18 18:57 (p 2 of 2)
Test Code: 180978b | 10-3740-9722

Ceriodaphnia 7-d Survival and Reproduction Test

Nautilus Environmental

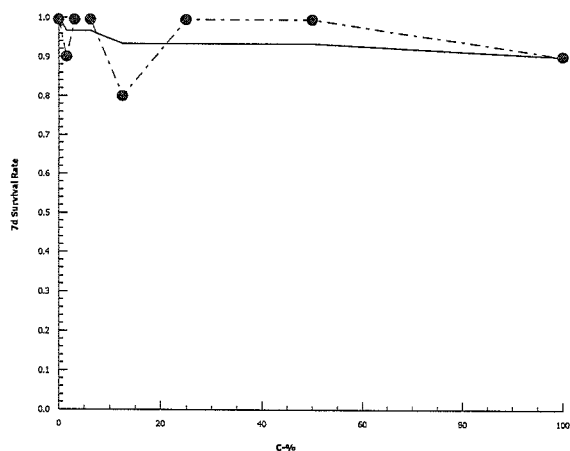
Analysis ID: 12-8440-5973 Endpoint: 7d Survival Rate
Analyzed: 27 Jun-18 18:56 Analysis: Linear Interpolation (ICPIN)

CETIS Version: CETISv1.8.7
Official Results: Yes

7d Survival Rate Binomials

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Negative Control	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
1.56		1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	0/1
3.12		1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
6.25		1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
12.5		0/1	1/1	1/1	1/1	1/1	0/1	1/1	1/1	1/1	1/1
25		1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
50		1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
100		1/1	1/1	1/1	1/1	0/1	1/1	1/1	1/1	1/1	1/1

Graphics



CETIS Analytical Report

Report Date: 27 Jun-18 18:57 (p 1 of 2)
Test Code: 180978b | 10-3740-9722

Ceriodaphnia 7-d Survival and Reproduction Test

Nautilus Environmental

Analysis ID: 07-5800-3744	Endpoint: Reproduction	CETIS Version: CETISv1.8.7
Analyzed: 27 Jun-18 18:56	Analysis: Linear Interpolation (ICPIN)	Official Results: Yes
Batch ID: 17-1521-1839	Test Type: Reproduction-Survival (7d)	Analyst: Kania Lywe
Start Date: 15 Jun-18 10:30	Protocol: EC/EPS 1/RM/21	Diluent: 20% Perrier Water
Ending Date: 21 Jun-18 16:00	Species: Ceriodaphnia dubia	Brine:
Duration: 6d 5h	Source: In-House Culture	Age: <24h
Sample ID: 10-2908-3130	Code: 3D568FFA	Client:
Sample Date: 12 Jun-18 09:05	Material: Water Sample	Project:
Receive Date: 15 Jun-18 09:38	Source: ALS	
Sample Age: 73h (7.6 °C)	Station: L2111715-3 W50	

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	1040264	200	Yes	Two-Point Interpolation

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
IC5	>100	N/A	N/A	<1	NA	NA
IC10	>100	N/A	N/A	<1	NA	NA
IC15	>100	N/A	N/A	<1	NA	NA
IC20	>100	N/A	N/A	<1	NA	NA
IC25	>100	N/A	N/A	<1	NA	NA
IC40	>100	N/A	N/A	<1	NA	NA
IC50	>100	N/A	N/A	<1	NA	NA

Reproduction Summary

Calculated Variate

C-%	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	10	15.5	4	21	1.544	4.882	31.5%	0.0%
1.56		10	16.2	0	23	2.112	6.68	41.23%	-4.52%
3.12		10	18.9	13	21	0.8622	2.726	14.43%	-21.94%
6.25		10	18.2	13	21	0.8273	2.616	14.37%	-17.42%
12.5		10	16.1	0	23	2.734	8.647	53.71%	-3.87%
25		10	22.1	15	26	1.048	3.315	15.0%	-42.58%
50		10	20.9	12	25	1.12	3.542	16.95%	-34.84%
100		10	18.5	0	26	2.306	7.292	39.41%	-19.35%

Reproduction Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Negative Control	18	18	4	19	14	15	15	19	21	12
1.56		19	17	10	20	23	15	19	20	19	0
3.12		21	17	20	21	13	21	16	21	19	20
6.25		18	20	18	20	19	17	15	21	13	21
12.5		0	23	21	21	18	0	22	19	19	18
25		25	15	22	22	22	26	20	23	26	20
50		24	25	21	22	12	22	21	19	22	21
100		26	15	24	24	0	18	20	18	20	20

CETIS Analytical Report

Report Date: 27 Jun-18 18:57 (p 2 of 2)
Test Code: 180978b | 10-3740-9722

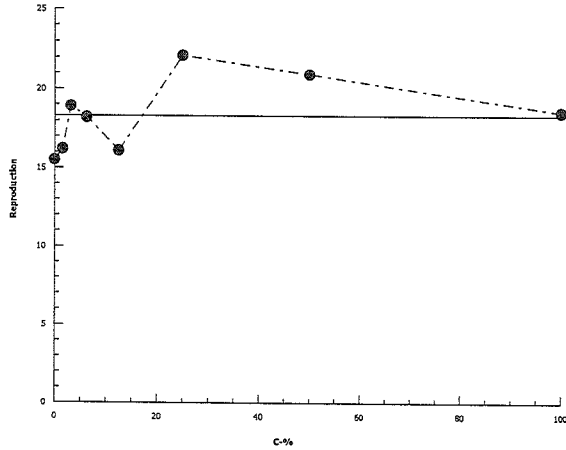
Ceriodaphnia 7-d Survival and Reproduction Test

Nautilus Environmental

Analysis ID: 07-5800-3744 Endpoint: Reproduction
Analyzed: 27 Jun-18 18:56 Analysis: Linear Interpolation (ICPIN)

CETIS Version: CETISv1.8.7
Official Results: Yes

Graphics



W.O.#: 180972

[illegible]

Reviewed by:

Love

Date Reviewed:

June 29/18

APPENDIX B – Chain-of-Custody Form



L2111715

VANCOUVER

See Minto's COC

Subcontract Request Form

Subcontract To:

NAUTILUS ENVIRONMENTAL

8664 COMMERCE COURT
BURNABY, BC V5A 4N7

NOTES: Please reference on final report and invoice: PO# L2111715
ALS requires QC data to be provided with your final results.

Please see enclosed **4** sample(s) in **8** Container(s)

SAMPLE NUMBER	ANALYTICAL REQUIRED	DATE SAMPLED	Priority Flag
		DUE DATE	
L2111715-1 W2	Special Request- Nautilus Environmental (SPECIAL REQUEST-NL 14)	6/12/2018 6/21/2018	7d ceno
L2111715-2 W3	Special Request- Nautilus Environmental (SPECIAL REQUEST-NL 14)	6/12/2018 6/21/2018	LT50 RBT LT50 D. magna
L2111715-3 W50	Special Request- Nautilus Environmental (SPECIAL REQUEST-NL 14)	6/12/2018 6/21/2018	7d ceno LT50 RBT LT50 D. magna
L2111715-4 W16A	Special Request- Nautilus Environmental (SPECIAL REQUEST-NL 14)	6/12/2018 6/21/2018	LT50 RBT LT50 D. magna

Subcontract Info Contact: Walter Lin (604) 253-4188

Analysis and reporting info contact: Shane Stack
8081 LOUGHEED HWY
SUITE 100
BURNABY, BC V5A 1W9

Phone: (604) 253-4188

Email: Shane.Stack@alsglobal.com

Please email confirmation of receipt to: **Shane.Stack@alsglobal.com**

Shipped By: _____ Date Shipped: _____

Received By: _____ Date Received: _____

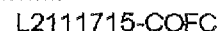
Verified By: _____ Date Verified: _____

Temperature: _____

Sample Integrity Issues: _____



Canada Toll Free: 1 800 668 9878



COC Number: 2018-06-13 C

Page 1 of 1

www.alsglobal.com

[illegible]

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

0070958 2015 DEC

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

① sample desc - clear, yellow, no odour, no particulates

Received by Nautilus
NY: Nari Yamamoto on Jun 15/18 @ 09:38

END OF REPORT



Acute Toxicity Test Results

Samples L2111715-2 W3, L2111715-3 W50
and L2111715-4 W16A,
collected June 12, 2018

Final Report

June 27, 2018

Submitted to: **ALS Environmental**
Burnaby, BC

SAMPLE INFORMATION

Sample ID	Dates			Daphnia magna test initiation	Receipt temperature
	Collected	Received	Rainbow trout test initiation		
L2111715-2 W3	12-Jun-18 at 0835h	15-Jun-18 at 0938h	15-Jun-18 at 1715h/1900h	15-Jun-18 at 1240h/1242h	7.6°C
L2111715-3 W50	12-Jun-18 at 0905h	15-Jun-18 at 0938h	15-Jun-18 at 1645h	15-Jun-18 at 1255h	7.6°C
L2111715-4 W16A	12-Jun-18 at 0940h	15-Jun-18 at 0938h	15-Jun-18 at 1645h	15-Jun-18 at 1230h	7.6°C

TESTS

- Rainbow trout 96-h LC50 test
- Rainbow trout 96-h LT50 test
- *Daphnia magna* 48-h LC50 test
- *Daphnia magna* 48-h LT50 test

RESULTS

Toxicity test results

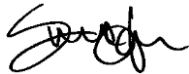
Sample ID	Rainbow trout		<i>Daphnia magna</i>	
	LC50 (% v/v)	LT50 (hours)	LC50 (% v/v)	LT50 (hours)
L2111715-2 W3	>100	>96	>100	>48
L2111715-3 W50	n/a	>96	n/a	>48
L2111715-4 W16A	n/a	>96	n/a	>48

n/a = not applicable

QA/QC

QA/QC summary	Rainbow trout	<i>Daphnia magna</i>
Reference toxicant LC50 (95% CL)	93.5 (66.2 – 123.7) µg/L Zn ¹	4.5 (3.8 – 5.4) g/L NaCl ²
Reference toxicant historical mean (2 SD range)	92.1 (43.6 – 194.6) µg/L Zn	5.8 (4.0 – 8.5) g/L NaCl
Reference toxicant CV	45%	21%
Organism health history	Acceptable	Acceptable
Protocol deviations	None	None
Water quality range deviations	None	None
Control performance	Acceptable	Acceptable
Test performance	Valid	Valid

¹Test date: June 8, 2018; ²Test date: June 15, 2018; LC = Lethal Concentration, CL = Confidence Limits, SD = Standard Deviation, CV = Coefficient of Variation



Report By:
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Reviewed By:
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 Senior Analyst

This report has been prepared by Nautilus Environmental Company Inc. based on data and/or sample provided by our client and the results of this study are for their sole benefit. Any reliance on the data by a third party is at the sole and exclusive risk of that party. The results presented here relate only to the sample tested.

APPENDIX A – Summary of test conditions

Table 1. Summary of test conditions: 96-h rainbow trout (*Oncorhynchus mykiss*) LC50 test.

Test species	Oncorhynchus mykiss
Organism source	Hatchery
Organism age	Juvenile
Test type	Static
Test duration	96 hours
Test vessel	20-L glass aquarium
Test volume	10 to 20 L (depending on size of fish)
Test solution depth	≥15 cm
Test concentrations	Five concentrations, plus laboratory control
Test replicates	1 per treatment
Number of organisms	10 per replicate
Control/dilution water	Dechlorinated Metro Vancouver municipal tapwater
Test solution renewal	None
Test temperature	15 ± 1°C
Feeding	None
Light intensity	100 to 500 lux
Photoperiod	16 hours light / 8 hours dark
Aeration	6.5 ± 1 mL/min/L
Test measurements	Temperature, dissolved oxygen and pH measured daily; salinity measured in the undiluted sample at test initiation; conductivity measured at test initiation and termination; survival checked daily
Test protocol	Environment Canada (2000), EPS 1/RM/13, with 2007 & 2016 amendments
Statistical software	CETIS Version 1.8.7
Test endpoints	Survival (96-hour LC50)
Test acceptability criterion for controls	Survival ≥90%
Reference toxicant	Zinc (added as ZnSO ₄)

Table 2. Summary of test conditions: 96-h rainbow trout (*Oncorhynchus mykiss*) LT50 test.

Test species	<i>Oncorhynchus mykiss</i>
Organism source	Hatchery
Organism age	Juvenile
Test type	Static
Test duration	96 hours
Test vessel	20-L glass aquarium
Test volume	10 to 18 L (depending on size of fish)
Test solution depth	≥15 cm
Test concentrations	100% (undiluted) sample, plus laboratory control
Test replicates	1 per treatment
Number of organisms	10 per replicate
Control/dilution water	Dechlorinated Metro Vancouver municipal tapwater
Test solution renewal	None
Test temperature	15 ± 1°C
Feeding	None
Light intensity	100 to 500 lux
Photoperiod	16 hours light / 8 hours dark
Aeration	6.5 ± 1 mL/min/L
Test measurements	Temperature, dissolved oxygen and pH measured daily; salinity measured in the undiluted sample at test initiation; conductivity measured at test initiation and termination; survival checked at 1h, 2h, 4h and daily thereafter
Test protocol	Environment Canada (2000), EPS 1/RM/13, with 2007 & 2016 amendments
Statistical software	CETIS Version 1.8.7
Test endpoints	Time (hours) to 50% mortality
Test acceptability criterion for controls	Survival ≥90%
Reference toxicant	Zinc (added as ZnSO ₄)

Table 3. Summary of test conditions: 48-h *Daphnia magna* LC50 test.

Test species	<i>Daphnia magna</i>
Organism source	In-house culture
Organism age	<24-hour old neonates
Test type	Static
Test duration	48 hours
Test vessel	250-mL glass beaker
Test volume	200 mL
Test solution depth	6 cm
Test concentrations	Five concentrations, plus laboratory control
Test replicates	1 per treatment
Number of organisms	10 per replicate
Control/dilution water	Moderately-hard reconstituted water + 2.5 µg/L Se
Test solution renewal	None
Test temperature	20 ± 2°C
Feeding	None
Light intensity	400 to 800 lux
Photoperiod	16 hours light / 8 hours dark
Aeration	None
Test measurements	Temperature, dissolved oxygen and pH measured daily; salinity, hardness and alkalinity measured in the undiluted sample at test initiation; conductivity measured at test initiation and termination; survival checked daily
Test protocol	Environment Canada (2000), EPS 1/RM/14, with 2016 amendments
Statistical software	CETIS Version 1.8.7
Test endpoints	Survival (48-hour LC50)
Test acceptability criterion for controls	Survival ≥90%
Reference toxicant	Sodium chloride (NaCl)

Table 4. Summary of test conditions: 48-h *Daphnia magna* LT50 test.

Test species	<i>Daphnia magna</i>
Organism source	In-house culture
Organism age	<24-hour old neonates
Test type	Static
Test duration	48 hours
Test vessel	250-mL glass beaker
Test volume	200 mL
Test solution depth	6 cm
Test concentrations	100% (undiluted) sample, plus laboratory control
Test replicates	3 per treatment
Number of organisms	10 per replicate
Control/dilution water	Moderately-hard reconstituted water + 2.5 µg/L Se
Test solution renewal	None
Test temperature	20 ± 2°C
Feeding	None
Light intensity	400 to 800 lux
Photoperiod	16 hours light / 8 hours dark
Aeration	None
Test measurements	Temperature, dissolved oxygen and pH measured daily; salinity, hardness and alkalinity measured in the undiluted sample at test initiation; conductivity measured at test initiation and termination; survival checked at 1h, 2h, 4h and daily thereafter.
Test protocol	Environment Canada (2000), EPS 1/RM/14, with 2016 amendments
Statistical software	CETIS Version 1.8.7
Test endpoint	Time (hours) to 50% mortality
Test acceptability criterion for controls	Survival ≥90%
Reference toxicant	Sodium chloride (NaCl)

APPENDIX B – Toxicity test data

Rainbow Trout Summary Sheet

Client: ALS Environmental

Start Date/Time: June 15, 2018, 1715h

Work Order No.: 180979

Test Species: Oncorhynchus mykiss

Sample Information:

Sample ID: L2111715-2
Sample Date: June 12, 2018
Date Received: June 15, 2018
Sample Volume: 3 x 20L
Other: -

Test Validity Criteria:

≥ 90% control survival

WQ Ranges:

T (°C) = 15 ± 1; DO (mg/L) = 7.0 to 10.3; pH = 5.5 to 8.5

Dilution Water:

Type: Dechlorinated Municipal Tap Water
Hardness (mg/L CaCO₃): 12
Alkalinity (mg/L CaCO₃): 10

Test Organism Information:

Batch No.: 050718a
Source: Aqua Farms
No. Fish/Volume (L): 10 / 12L
Loading Density (g/L): 0.49
Mean Length ± SD (mm): 39 ± 2
Mean Weight ± SD (g): 0.58 ± 0.08

Range: 36 - 42

Range: 0.46 - 0.70

Zinc Reference Toxicant Results:

Reference Toxicant ID: RTZn124
Stock Solution ID: 18Zn03
Date Initiated: 08 June 18
96-h LC50 (95% CL): 93.5 (66.2 - 123.7) µg/L Zn

Reference Toxicant Mean and Historical Range: 92.1 (43.6 - 194.6) µg/L Zn

Reference Toxicant CV (%): 45%

Test Results: The 96 hour LT50 is estimated to be >96 hours. 0% trout mortality in undiluted sample.

Reviewed by: Ans

Date reviewed: for 22/18

96-Hour Rainbow Trout Toxicity Test Data Sheet

Client/Project#: ALS (Minto)
 Sample I.D. 2111715-2 w3
 W.O. # 180979
 RBT Batch #: 050718a
 Date Collected/Time: Sun 12/18 @ 8:35
 Date Setup/Time: Sun 15/18 @ 15:50 1715
 CER #: 3
 Sample Setup By: JD

Number Fish/Volume: 10/12L
 7-d % Mortality: 0.27
 Total Pre-aeration Time (mins): 30
 Aeration rate adjusted to 6.5 ± 1 mL/min/L? (Y/N): Y

Thermometer: Cer3
 D.O. meter/probe: 2102
 Cond./Salinity meter/probe: 2102
 pH meter/probe: 2102

Undiluted Sample WQ			
Parameters	Initial WQ	Adjustment	30 min WQ
Temp °C	16.0	/	16.2
D.O. (mg/L)	9.6		9.7
pH	7.6		7.8
Cond. (µS/cm)	405 452		453
Salinity (ppt)	0.2		0.2

Concentration (% v/v)	# Survivors LT50							Temperature (°C)					Dissolved Oxygen (mg/L)					pH					Conductivity (µS/cm)	
	1	2	4	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	96
ctrl	10	10	10	10	10	10	10	15.0	15.0	15.0	15.0	15.0	9.8	9.8	9.7	9.5	9.5	7.2	7.3	7.2	7.0	7.3	38	37
100	10	10	10	10	10	10	10	16.0	15.0	15.0	15.0	15.0	9.7	9.9	9.6	9.5	9.6	7.8	8.3	8.2	8.1	8.3	453	458
Initials	JP	JD	SD	EL	ML	SD	JD	JD	EL	ML	SD	SD	SD	EL	ML	JD	JD	JD	EL	ML	JD	JD	JD	SD

Sample Description/Comments: Yellow clear liquid. No particulates. No smell.

Fish Description at 96 h All fish appear normal Number of Stressed Fish at 96 h 0

Other Observations: _____

Reviewed by: AS

Date Reviewed: Jan 22/18

Rainbow Trout Summary Sheet

Client: ALS Environmental

Start Date/Time: June 15, 2018; 1645h

Work Order No.: 180979

Test Species: Oncorhynchus mykiss

Sample Information:

Sample ID: L2111715-3
W50
Sample Date: June 12, 2018
Date Received: June 15, 2018
Sample Volume: 1x20L
Other: -

Test Validity Criteria:

≥ 90% control survival

WQ Ranges:

T (°C) = 15 ± 1; DO (mg/L) = 7.0 to 10.3; pH = 5.5 to 8.5

Dilution Water:

Type: Dechlorinated Municipal Tap Water
Hardness (mg/L CaCO₃): 12
Alkalinity (mg/L CaCO₃): 10

Test Organism Information:

Batch No.: 050718a
Source: Aqua Farms
No. Fish/Volume (L): 10/15L
Loading Density (g/L): 0.44
Mean Length ± SD (mm): 41 ± 5
Mean Weight ± SD (g): 0.66 ± 0.25

Range: 37 - 49

Range: 0.42 - 1.01

Zinc Reference Toxicant Results:

Reference Toxicant ID: RTZn124
Stock Solution ID: 18Zn03
Date Initiated: 08 June 18
96-h LC50 (95% CL): 93.5 (66.2 - 123.7) µg/L Zn

Reference Toxicant Mean and Historical Range: 92.1 (43.6 - 194.6) µg/L Zn

Reference Toxicant CV (%): 45%

Test Results: The 96 hour LT50 is estimated to be >96 hours. 0% trout mortality in undiluted sample.

Reviewed by: AS

Date reviewed: 6/22/18

96-Hour Rainbow Trout Toxicity Test Data Sheet

Client/Project#: ALS (Minto)
 Sample I.D.: WSD L2111715-3 WSD
 W.O. #: 050718a + JD
 RBT Batch #: 180979
 Date Collected/Time: Jun 12/18 @ 9:05
 Date Setup/Time: Jun 15/18 @ 1645
 CER #: 8
 Sample Setup By: JD

Number Fish/Volume: 10/15L
 7-d % Mortality: 0.27
 Total Pre-aeration Time (mins): 30
 Aeration rate adjusted to 6.5 ± 1 mL/min/L? (Y/N): Y

Thermometer: Cer 8
 D.O. meter/probe: S 1 DS
 Cond./Salinity meter/probe: S 1 CPS
 pH meter/probe: S 1 PS

Undiluted Sample WQ			
Parameters	Initial WQ	Adjustment	30 min WQ
Temp °C	14.0	/	14.0
D.O. (mg/L)	9.8		9.9
pH	7.7		7.8
Cond. (µS/cm)	410		410
Salinity (ppt)	0.2		0.2

Concentration (% v/v)	# Survivors							Temperature (°C)					Dissolved Oxygen (mg/L)					pH					Conductivity (µS/cm)	
	1	2	4	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	96
Control	10	10	10	10	10	10	10	15.0	14.5	14.5	14.5	14.5	9.7	9.9	9.7	9.4	9.4	7.2	7.3	7.2	7.1	7.1	34	37
100	10	10	10	10	10	10	10	14.0	14.5	14.5	14.5	14.5	9.9	9.9	9.6	9.5	9.6	7.8	7.9	7.8	7.6	7.8	410	417
Initials	JD	JD	JD	JD	JD	JD	JD	JD	JD	JD	JD	JD	JD	JD	JD	JD	JD	JD	JD	JD	JD	JD	JD	JD

Sample Description/Comments: Yellow clear liquid. No particulates. No swell.

Fish Description at 96 h: All fish appear normal Number of Stressed Fish at 96 h: 0

Other Observations: _____

Reviewed by: AS

Date Reviewed: June 22/18

Rainbow Trout Summary Sheet

Client: ALS Environmental

Start Date/Time: June 15, 2018; 1645h

Work Order No.: 180979

Test Species: Oncorhynchus mykiss

Sample Information:

Sample ID: L2111715-4
W16A
Sample Date: June 12, 2018
Date Received: June 15, 2018
Sample Volume: 1x20L
Other: -

Test Validity Criteria:

≥ 90% control survival

WQ Ranges:

T (°C) = 15 ± 1; DO (mg/L) = 7.0 to 10.3; pH = 5.5 to 8.5

Dilution Water:

Type: Dechlorinated Municipal Tap Water
Hardness (mg/L CaCO₃): 12
Alkalinity (mg/L CaCO₃): 10

Test Organism Information:

Batch No.: 050718a
Source: Aqua Farms
No. Fish/Volume (L): 10 / 85L
Loading Density (g/L): 0.42
Mean Length ± SD (mm): 40 ± 5
Mean Weight ± SD (g): 0.64 ± 0.27

Range: 35 - 49
Range: 0.38 - 1.10

Zinc Reference Toxicant Results:

Reference Toxicant ID: RTZn124
Stock Solution ID: 18Zn03
Date Initiated: 08 June 18
96-h LC50 (95% CL): 93.5 (66.2 - 123.7) µg/L Zn

Reference Toxicant Mean and Historical Range: 92.1 (43.6 - 194.6) µg/L Zn
Reference Toxicant CV (%): 45%

Test Results: The 96 hour LT50 is estimated to be >96 hours. 0% trout mortality in undiluted sample.

Reviewed by: AS

Date reviewed: Jun 24/18

96-Hour Rainbow Trout Toxicity Test Data Sheet

Client/Project#: ALS (Mintz)
 Sample I.D.: W16A L2111715-4 W16A
 W.O. #: 180979
 RBT Batch #: 050718a
 Date Collected/Time: Jun 12/18 @ 9:40
 Date Setup/Time: Jun 15/18 @ 1645
 CER #: 8
 Sample Setup By: JD

Number Fish/Volume: 10/15L
 7-d % Mortality: 0.27
 Total Pre-aeration Time (mins): 30
 Aeration rate adjusted to 6.5 ± 1 mL/min/L? (Y/N): Y

Thermometer: Cer8
 D.O. meter/probe: 851 DS
 Cond./Salinity meter/probe: S 1 CPS
 pH meter/probe: S 1 PS

Undiluted Sample WQ			
Parameters	Initial WQ	Adjustment	30 min WQ
Temp °C	14.0	/	14.0
D.O. (mg/L)	10.2		10.2
pH	8.2		8.2
Cond. (µS/cm)	408		410
Salinity (ppt)	0.2		0.2

Concentration (% v/v)	# Survivors LTSO							Temperature (°C)					Dissolved Oxygen (mg/L)					pH					Conductivity (µS/cm)	
	1	2	4	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	96
Ctrl	10	10	10	10	10	10	10	15.0	14.5	14.5	14.5	14.5	9.8	9.8	9.8	9.5	9.5	7.2	7.2	7.2	7.1	7.1	35	38
100	10	10	10	10	10	10	10	14.0	14.5	14.5	14.5	14.5	10.2	9.9	9.9	9.0	9.6	8.2	8.2	8.1	7.8	7.7	40	420
Initials	JD	JD	JD	JD	JD	JD	JD	JD	JD	JD	JD	JD	JD	JD	JD	JD	JD	JD	JD	JD	JD	JD	JD	JD

Sample Description/Comments: Yellow clear liquid. No particulates. No smell.

Fish Description at 96 h: All fish appear normal Number of Stressed Fish at 96 h: 0

Other Observations: _____

Reviewed by: AMS

Date Reviewed: June 22/18

Rainbow Trout Summary Sheet

Client: ALS Environmental

Start Date/Time: June 15, 2018; 1900h

Work Order No.: 180981

Test Species: Oncorhynchus mykiss

Sample Information:

Sample ID: 42 L2111715-2 W3
Sample Date: June 12, 2018
Date Received: June 15, 2018
Sample Volume: 3 x 20L
Other: -

Test Validity Criteria:

≥ 90% control survival

WQ Ranges:

T (°C) = 15 ± 1; DO (mg/L) = 7.0 to 10.3; pH = 5.5 to 8.5

Dilution Water:

Type: Dechlorinated Municipal Tap Water
Hardness (mg/L CaCO₃): 12
Alkalinity (mg/L CaCO₃): 10

Test Organism Information:

Batch No.: 050718a
Source: Aqua Farms
No. Fish/Volume (L): 10 / 12L
Loading Density (g/L): 0.52
Mean Length ± SD (mm): 39 ± 4
Mean Weight ± SD (g): 0.62 ± 0.17 0.18

Range: 33 - 43

Range: 0.36 - 0.84

Zinc Reference Toxicant Results:

Reference Toxicant ID: RTZn124
Stock Solution ID: 18Zn03
Date Initiated: 08 June 18
96-h LC50 (95% CL): 93.5 (66.2 - 123.7) µg/L Zn

Reference Toxicant Mean and Historical Range: 92.1 (43.6 - 194.6) µg/L Zn

Reference Toxicant CV (%): 45%

Test Results: The 96 hour LC50 is estimated to be >100 (1/4) 0% trout mortality in 100% concentration.

Reviewed by: [Signature]

Date reviewed: June 22/18

96-Hour Rainbow Trout Toxicity Test Data Sheet

Client/Project#: ALS (Minto)
 Sample I.D. LS L2111715-2 W3
 W.O. # 180981
 RBT Batch #: 050718a
 Date Collected/Time: Sun 12/18 @ 8:35
 Date Setup/Time: Sun 15/18 @ 1400
 CER #: 2
 Sample Setup By: JD

Number Fish/Volume: 10/12L
 7-d % Mortality: 0-27%
 Total Pre-aeration Time (mins): 30
 Aeration rate adjusted to 6.5 ± 1 mL/min/L? (Y/N): Y

Thermometer: Cer3
 D.O. meter/probe: 2 1 D2
 Cond./Salinity meter/probe: 2 1 CP2
 pH meter/probe: 2 1 P2

Undiluted Sample WQ			
Parameters	Initial WQ	Adjustment	30 min WQ
Temp °C	15.0	/	15.0
D.O. (mg/L)	9.6		9.8
pH	7.7		8.0
Cond. (µS/cm)	460		456
Salinity (ppt)	0.2		0.2

Concentration	# Survivors							Temperature (°C)					Dissolved Oxygen (mg/L)					pH					Conductivity (µS/cm)	
(% v/v)	1	2	4	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	96
Ctrl				10	10	10	10	15.0	15.0	15.0	15.0	15.0	9.9	9.9	9.7	9.3	9.6	7.3	7.3	7.2	7.2	7.2	34	38
6.25				10	10	10	10	15.0	15.0	15.0	15.0	15.0	10.0	9.7	9.6	9.3	9.5	7.4	7.5	7.4	7.1	7.2	64	63
12.5				10	10	10	10	15.0	15.0	15.0	15.0	15.0	10.0	9.8	9.6	9.2	9.2	7.6	7.7	7.8	7.3	7.4	89	91
25				10	10	10	10	15.0	15.0	15.0	15.0	15.0	10.0	9.9	9.7	9.4	9.5	7.7	7.9	7.9	7.5	7.6	152	157
50				10	10	10	10	15.0	15.0	15.0	15.0	15.0	9.9	9.9	9.8	9.5	9.6	7.9	8.1	8.0	7.8	7.8	251	254
100				10	10	10	10	15.0	15.0	15.0	15.0	15.0	9.8	9.9	9.8	9.5	9.6	8.0	8.3	8.2	8.1	8.1	456	502 & 459
Initials				EL	MM	JD	JD	JD	EL	MM	JD	JD	JD	EL	MM	JD	JD	JD	EL	MM	JD	JD	JD	JD

Sample Description/Comments: Clear yellow liquid. No particulates. No smell.

Fish Description at 96 h All fish appear normal Number of Stressed Fish at 96 h 0

Other Observations: _____

Reviewed by: AM

Date Reviewed: June 22/18

Daphnia magna Summary Sheet

Client: ALS (Minto)
Work Order No.: 180980

Start Date/Time: June 15/2018 @ 1240h
Test Species: Daphnia magna
Set up by: CW

Sample Information:

Sample ID: W3 L211715-2 W3
Sample Date: June 12/2018
Date Received: June 15/2018
Sample Volume: 3 x 20L

Test Validity Criteria:

≥ 90% mean control survival and/or mobility and ≤ 2 daphnids exhibit immobility and/or mortality in any single control replicate.

WQ Ranges:

T (°C) = 20 ± 2; DO (mg/L) = 3.6 to 9.4; pH = 6 to 8.5

Test Organism Information:

Broodstock No.: 060118A
Age of young (Day 0): <24 h
Avg No. young per brood in previous 7 d: 24
Mortality (%) in previous 7 d: 0
Days to first brood: 8

NaCl Reference Toxicant Results:

Reference Toxicant ID: DMDC13
Stock Solution ID: 18Na02
Date Initiated: June 15/2018
48-h LC50 (95% CL): 4.5 (3.8 - 5.4) g/L NaCl

Reference Toxicant Mean and Historical Range: 5.8 (4.0 - 8.5) g/L NaCl
Reference Toxicant CV (%): 21%

Test Results: The LT50 is estimated to be > 48h.

Reviewed by: A

Date reviewed: June 21/18

Freshwater Acute 48 Hour Toxicity Test Data Sheet

Client: ALS (Minto)
 Sample ID: WLS L2111715-2 W3
 Work Order No.: 130920

Start Date/Time: June 15/2018 @ 12:40h
 CER #: 8
 No. Organisms/volume: 10/200mL
 Test Organism: D. magna
 Set up by: CW

Thermometer: CER#5 pH meter/probe: 3 / 3 DO meter/probe: 3 / 3 Cond./Salinity meter/probe: 3 / 3

Concentration (% v/v)	Number of Live Organisms Rep	24		48	No. Immobilized	Temperature (°C)			Dissolved oxygen (mg/L)			pH			Conductivity (µS/cm)	
		24	48			0	24	48	0	24	48	0	24	48	0	48
Control	A	10	10	0	0	19.5	19.5	19.5	9.0	8.4	8.5	8.0	7.8	7.9	350	354
	B	10	10	0	0							7.8				
	C	10	10	0	0											
	D															
100	A	10	10	0	0	20.0	19.5	19.5	8.6	8.5	8.4	7.8	8.1	8.2	467	465
	B	10	10	0	0											
	C	10	10	0	0											
	D															
	A															
	B															
	C															
	D															
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	D															
	A															
	B															
	C															
	D															
	A															
	B															
	C															
	D															
Technician Initials		EW	MM	MM		CW	EW	MM	CW	EW	MM	CW	EW	MM	CW	MM

	Hardness*	Alkalinity*
Concentration	*(mg/L as CaCO ₃)	
Control (MHW)	100	74
Highest conc.	350	178
Hardness adjusted		

	Initial WQ	Adjustment	Adjusted WQ
Temp (°C)	20.0		
DO (mg/L)	8.6		
pH	7.8		
Cond (µS/cm)	467		
Salinity (ppt)	0.2		

Survival: 100% # organisms alive: 1h: A 10/10 2h: A 10/10 4h: A 10/10
 (control/100%) 8 10/10 9 10/10 9 10/10
 C 10/10 C 10/10 C 10/10

Comments: Mortality: Heartbeat checked under microscope not needed

Sample Description: clear, yellow, no odor, no particulates

Batch#: 060118A 7-d previous # young/brood: 24 Previous 7-d Mortality (%): 0 Day of 1st Brood: 8

Reviewed by: A Date reviewed: 6/22/18

Daphnia magna Summary Sheet

Client: ALS (Minto)
Work Order No.: 180980

Start Date/Time: June 15/2018 @ 1235h
Test Species: Daphnia magna
Set up by: CW

Sample Information:

Sample ID: L2111715-3
W50
Sample Date: June 12/2018
Date Received: June 15/2018
Sample Volume: 3rd 1x20L

Test Validity Criteria:

≥ 90% mean control survival and/or mobility and ≤ 2 daphnids exhibit immobility and/or mortality in any single control replicate.

WQ Ranges:

T (°C) = 20 ± 2; DO (mg/L) = 3.6 to 9.4; pH = 6 to 8.5

Test Organism Information:

Broodstock No.: 060118A
Age of young (Day 0): <24 h
Avg No. young per brood in previous 7 d: 24
Mortality (%) in previous 7 d: 0
Days to first brood: 8

NaCl Reference Toxicant Results:

Reference Toxicant ID: DMDC13
Stock Solution ID: 18Na02
Date Initiated: June 15/2018
48-h LC50 (95% CL): 4.5 (3.8 - 5.4) g/L NaCl

Reference Toxicant Mean and Historical Range: 5.8 (4.0-8.5) g/L NaCl
Reference Toxicant CV (%): 21%

Test Results: The LT50 is estimated to be > 48h.

Reviewed by: AS

Date reviewed: Jun 22/18

Freshwater Acute 48 Hour Toxicity Test Data Sheet

Client: ALS (Minto)
 Sample ID: W50 L2111715-3 W50
 Work Order No.: 180980

1235h
 Start Date/Time: June 15/2018 @ 1235h
 CER #: 5
 No. Organisms/volume: 10/200mL
 Test Organism: D. magna
 Set up by: CW

Thermometer: CRHS pH meter/probe: 3 / 3 DO meter/probe: 3 / 3 Cond./Salinity meter/probe: 3 / 3

Concentration (% v/v)	Rep	Number of Live Organisms		No. Immobilized	Temperature (°C)			Dissolved oxygen (mg/L)			pH			Conductivity (µS/cm)	
		24	48		0	24	48	0	24	48	0	24	48	0	48
Control	A	10	10	0	19.5	19.5	19.5	9.0	8.4	8.4	7.8	7.8	7.8	352	354
	B	10	10	0											
	C	10	10	0											
	D														
100	A	10	10	0	20.0	19.5	19.5	9.0	8.5	8.2	8.0	8.1	8.2	421	416
	B	10	10	0											
	C	10	10	0											
	D														
	A														
	B														
	C														
	D														
	A														
	B														
	C														
	D														
	A														
	B														
	C														
	D														
	A														
	B														
	C														
	D														
Technician Initials		EW	um	um	CW	EW	um	CW	EW	um	CW	EW	um	CW	um

	Hardness*	Alkalinity*
	*(mg/L as CaCO3)	
Control (MHW)	100	74
Highest conc.	318	136
Hardness adjusted		

	Initial WQ	Adjustment	Adjusted WQ
Temp (°C)	20.0		
DO (mg/L)	9.0		
pH	8.0		
Cond (µS/cm)	421		
Salinity (ppt)	0.2		

organisms alive: 1h: A 10/10 2h: A 10/10 4h: A 10/10
 (Control 100%) 8: 10/10 10: 10/10 12: 10/10

Comments: Mortality: Heartbeat checked under microscope not req cel

Sample Description: clear, yellow, no odour, no particulates

Batch#: 060118A 7-d previous # young/brood: 24 Previous 7-d Mortality (%): 0 Day of 1st Brood: 8

Reviewed by: A Date reviewed: 22/10

Daphnia magna Summary Sheet

Client: ALS (Minto)
Work Order No.: 180980

Start Date/Time: June 15/2018 @ 1230h
Test Species: Daphnia magna
Set up by: CW

Sample Information:

Sample ID: L2111715-4
Sample Date: W16A
Date Received: June 12/2018
Date Received: June 15/2018
Sample Volume: 1 x 20L

Test Validity Criteria:

≥ 90% mean control survival and/or mobility and ≤ 2 daphnids exhibit immobility and/or mortality in any single control replicate.

WQ Ranges:

T (°C) = 20 ± 2; DO (mg/L) = 3.6 to 9.4; pH = 6 to 8.5

Test Organism Information:

Broodstock No.: 060118A
Age of young (Day 0): <24 h
Avg No. young per brood in previous 7 d: 24
Mortality (%) in previous 7 d: 0
Days to first brood: 8

NaCl Reference Toxicant Results:

Reference Toxicant ID: DMDC 13
Stock Solution ID: 18Na 02
Date Initiated: June 15/2018
48-h LC50 (95% CL): 4.5 (3.8 - 5.4) g/L NaCl

Reference Toxicant Mean and Historical Range: 5.8 (4.0 - 8.5) g/L NaCl
Reference Toxicant CV (%): 21%

Test Results: The ⁵⁰LT₅₀ is estimated to be > 48h.

Reviewed by: A

Date reviewed: Jun 22/18

Freshwater Acute 48 Hour Toxicity Test Data Sheet

Client: ALS(MINTO)
 Sample ID: W16A 22111715-4 W16A
 Work Order No.: 180980

Start Date/Time: June 15/2018 12:30h
 CER #: 5
 No. Organisms/volume: 10/200mL
 Test Organism: D.magna
 Set up by: OW

Thermometer: CE45 pH meter/probe: 3/3 DO meter/probe: 3/3 Cond./Salinity meter/probe: 3/3

Concentration (% v/v)	Number of Live Organisms Rep	No. of Live Organisms		No. Immobilized	Temperature (°C)			Dissolved oxygen (mg/L)			pH			Conductivity (µS/cm)	
		24	48		0	24	48	0	24	48	0	24	48	0	48
Control	A	10	10	0	19.5	19.5	19.5	9.0	8.4	8.4	7.8	7.8	7.8	350	355
	B	10	10	0											
	C	10	10	0											
	D														
100	A	10	10	0	18.5	19.5	19.5	9.0	8.5	8.5	8.0	8.2	8.2	413	412
	B	10	10	0											
	C	10	10	0											
	D														
	A														
	B														
	C														
	D														
	A														
	B														
	C														
	D														
	A														
	B														
	C														
	D														
	A														
	B														
	C														
	D														
Technician Initials		EW	mm	mm	BW	EW	mm	mm	EW	mm	mm	EW	mm	OW	mm

	Hardness*	Alkalinity*
Concentration	*(mg/L as CaCO ₃)	
Control (MHW)	100	74
Highest conc.	278	134
Hardness adjusted	-	-

	Initial WQ	Adjustment	Adjusted WQ
Temp (°C)	18.5		
DO (mg/L)	9.0		
pH	8.0		
Cond (µS/cm)	413		
Salinity (ppt)	0.2		

organisms alive: 1h: A 10/10 2h: A 10/10 4h: A 10/10
 Comments: 2 10/10 2 10/10 2 10/10

Mortality: Heartbeat checked under microscope not required

Sample Description: clear, yellow, no odour, no particulates

Batch#: 052518A 7-d previous # young/brood: 24 Previous 7-d Mortality (%): 0 Day of 1st Brood: 8

Reviewed by: AW Date reviewed: Jun 22/18

Daphnia magna Summary Sheet

Client: ALS (Minto)
Work Order No.: 180982

Start Date/Time: June 15/2018 @ 1242h
Test Species: Daphnia magna
Set up by: CW

Sample Information:

Sample ID: 4-11-13 L2111715-2 W3
Sample Date: June 12/2018
Date Received: June 15/2018
Sample Volume: 3x 20L

Test Validity Criteria:

≥ 90% mean control survival and/or mobility and ≤ 2 daphnids exhibit immobility and/or mortality in any single control replicate.

WQ Ranges:

T (°C) = 20 ± 2; DO (mg/L) = 3.6 to 9.4; pH = 6 to 8.5

Test Organism Information:

Broodstock No.: 1060113 A
Age of young (Day 0): <24 h
Avg No. young per brood in previous 7 d: 24
Mortality (%) in previous 7 d: 0
Days to first brood: 8

NaCl Reference Toxicant Results:

Reference Toxicant ID: DMDC 13
Stock Solution ID: 18 Na 02
Date Initiated: June 15/2018
48-h LC50 (95% CL): 4.5 (3.8 - 5.4) g/L NaCl

Reference Toxicant Mean and Historical Range: 5.8 (4.0 - 8.5) g/L NaCl
Reference Toxicant CV (%): 21%

Test Results: The 48h LC50 is estimated to be >100% (v/v).

Reviewed by: AS

Date reviewed: June 22/18

Freshwater Acute 48 Hour Toxicity Test Data Sheet

Client: ALS (Mintol)
 Sample ID: W3 1211715-2 W3
 Work Order No.: 180982

Start Date/Time: June 15 / 2018 @ 1247h
 CER #: 5
 No. Organisms/volume: 10/200mL
 Test Organism: D. magna
 Set up by: CW

Thermometer: CER#5 pH meter/probe: 3 / 3 DO meter/probe: 3 / 3 Cond./Salinity meter/probe: 3 / 3

Concentration (% v/v)	Number of Live Organisms Rep	24		48	No. Immobilized	Temperature (°C)			Dissolved oxygen (mg/L)			pH			Conductivity (µS/cm)	
		24	48			0	24	48	0	24	48	0	24	48	0	48
Control	A	10	10	0		19.5	19.5	19.5	9.0	8.3	8.5	7.8	7.9	7.9	350	349
	B															
	C															
	D															
6.25	A	10	10	0		19.5	19.5	19.5	9.0	8.5	8.5	7.8	7.9	7.8	358	357
	B															
	C															
	D															
12.5	A	10	10	0		19.5	19.5	19.5	9.0	8.5	8.5	7.8	7.9	7.8	366	364
	B															
	C															
	D															
25	A	10	10	0		19.5	19.5	19.5	9.0	8.5	8.5	7.8	7.9	8.0	377	375
	B															
	C															
	D															
50	A	10	10	0		19.5	19.5	19.5	9.0	8.5	8.4	7.8	7.9	8.1	407	405
	B															
	C															
	D															
100	A	10	10	0		20.0	19.5	19.5	8.9	8.5	8.4	7.8	8.2	8.3	467	462
	B															
	C															
	D															
Technician Initials		EL	Ym	Ym		CW	EL	Ym	CW	EL	Ym	CW	EL	Ym	CW	Ym

	Hardness*	Alkalinity*
	*(mg/L as CaCO ₃)	
Concentration		
Control (MHW)	100	74
Highest conc.	350	178
Hardness adjusted	—	—

	Initial WQ	Adjustment	Adjusted WQ
Temp (°C)	20.0		
DO (mg/L)	CW 8.9		
pH	7.8		
Cond (µS/cm)	467		
Salinity (ppt)	0.2		

Comments: _____ Mortality: Heartbeat checked under microscope not required

Sample Description: clear, yellow, no odors, no particulates

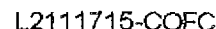
Batch#: 060118A 7-d previous # young/brood: 24 Previous 7-d Mortality (%): 0 Day of 1st Brood: 8

Reviewed by: EL Date reviewed: June 15/18

APPENDIX C – Chain-of-custody form



Canada Toll Free: 1 800 668 9878



COC Number: 2018-06-13 C

Page 1 of 1

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[illegible]

REFER TO BACK PAGE FOR AIS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2016 EDITION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

① sample desc - clear, yellow, no odour, no particulates

Received by Nautilus
NY: Nari Yamamoto - Jun 15/18 @ 09:38

**L2111715**

VANCOUVER

*See Minto's COC***Subcontract Request Form****Subcontract To:****NAUTILUS ENVIRONMENTAL**8664 COMMERCE COURT
BURNABY, BC V5A 4N7**NOTES:** Please reference on final report and invoice: PO# L2111715
ALS requires QC data to be provided with your final results.Please see enclosed **4** sample(s) in **8** Container(s)

SAMPLE NUMBER	ANALYTICAL REQUIRED	DATE SAMPLED	Priority Flag
		DUE DATE	
L2111715-1 W2	Special Request- Nautilus Environmental (SPECIAL REQUEST-NL 14)	6/12/2018 6/21/2018	7d ceno
L2111715-2 W3	Special Request- Nautilus Environmental (SPECIAL REQUEST-NL 14)	6/12/2018 6/21/2018	L150 RBT L150 D. magna
L2111715-3 W50	Special Request- Nautilus Environmental (SPECIAL REQUEST-NL 14)	6/12/2018 6/21/2018	7d ceno L150 RBT L150 D. magna
L2111715-4 W16A	Special Request- Nautilus Environmental (SPECIAL REQUEST-NL 14)	6/12/2018 6/21/2018	L150 RBT L150 D. magna

Subcontract Info Contact: Walter Lin (604) 253-4188

Analysis and reporting info contact: Shane Stack
8081 LOUGHEED HWY
SUITE 100
BURNABY, BC V5A 1W9

Phone: (604) 253-4188

Email: Shane.Stack@alsglobal.com

Please email confirmation of receipt to: Shane.Stack@alsglobal.com

Shipped By: _____	Date Shipped: _____
Received By: _____	Date Received: _____
Verified By: _____	Date Verified: _____
	Temperature: _____

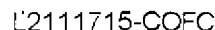
Sample Integrity Issues: _____

END OF REPORT



Canada Toll Free: 1 800 668 9878

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COC Number: 2018-06-13 C

Page 1 of 1

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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OCTOBER 2015 FROM

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 08-AUG-18
Report Date: 27-AUG-18 15:47 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2143380
Project P.O. #: 229101
Job Reference:
C of C Numbers: 2018-08-08 B
Legal Site Desc:

Comments: Please note, this report contains only Nautilus Environmental reports (at the end of the attachment).

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID						
Grouping	Analyte					

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
---------------	--------	------------------	--------------------

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
----------------------------	---------------------

Chain of Custody Numbers:

2018-08-08 B

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Acute Toxicity Test Results

Sample L2143380-1 W3,
collected August 7, 2018

Final Report

August 22, 2018

Submitted to: **ALS Environmental**
Burnaby, BC

SAMPLE INFORMATION

Sample ID	Dates				Receipt temp.
	Collected	Received	Rainbow trout test initiation	<i>Daphnia magna</i> test initiation	
L2143380-1 W3	07-Aug-18 at 1000h	09-Aug-18 at 1714h	10-Aug-18 at 1210h	10-Aug-18 at 1520h	20.6°C

TESTS

- Rainbow trout 96-h LC50 test
- *Daphnia magna* 48-h LC50 test

RESULTS

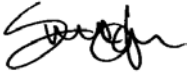
Toxicity test results

Sample ID	LC50 (% v/v)	
	Rainbow trout	<i>Daphnia magna</i>
L2143380-1 W3	> 100	> 100

QA/QC

QA/QC summary	Rainbow trout	<i>Daphnia magna</i>
Reference toxicant LC50 (95% CL)	46.6 (37.6 – 57.8) µg/L Zn ¹	5.2 (4.2 – 6.4) g/L NaCl ²
Reference toxicant historical mean (2 SD range)	90.6 (41.6 – 197.7) µg/L Zn	5.7 (3.9 – 8.4) g/L NaCl
Reference toxicant CV	40%	20%
Organism health history	Acceptable	Acceptable
Protocol deviations	None	None
Water quality range deviations	None	None
Control performance	Acceptable	Acceptable
Test performance	Valid	Valid

¹Test date: August 3, 2018; ²Test date: August 7, 2018; LC = Lethal Concentration, CL = Confidence Limits, SD = Standard Deviation, CV = Coefficient of Variation



Report By:
Yvonne Lam, B.Sc.
Laboratory Biologist



Reviewed By:
Julianna Kalocai, M.Sc., R.P.Bio
QA Manager

This report has been prepared by Nautilus Environmental Company Inc. based on data and/or samples provided by our client and the results of this study are for their sole benefit. Any reliance on the data by a third party is at the sole and exclusive risk of that party. The results presented here relate only to the samples tested.

APPENDIX A – Summary of test conditions

Table 1. Summary of test conditions: 96-h rainbow trout (*Oncorhynchus mykiss*) LC50 test.

Test species	<i>Oncorhynchus mykiss</i>
Organism source	Hatchery
Organism age	Juvenile
Test type	Static
Test duration	96 hours
Test vessel	20-L glass aquarium
Test volume	10 to 20 L (depending on size of fish)
Test solution depth	≥15 cm
Test concentrations	Five concentrations, plus laboratory control
Test replicates	1 per treatment
Number of organisms	10 per replicate
Control/dilution water	Dechlorinated Metro Vancouver municipal tapwater
Test solution renewal	None
Test temperature	15 ± 1°C
Feeding	None
Light intensity	100 to 500 lux
Photoperiod	16 hours light / 8 hours dark
Aeration	6.5 ± 1 mL/min/L
Test measurements	Temperature, dissolved oxygen and pH measured daily; salinity measured in the undiluted sample at test initiation; conductivity measured at test initiation and termination; survival checked daily
Test protocol	Environment Canada (2000), EPS 1/RM/13, with 2007 & 2016 amendments
Statistical software	CETIS Version 1.9.4
Test endpoints	Survival (96-hour LC50)
Test acceptability criterion for controls	Survival ≥90%
Reference toxicant	Zinc (added as ZnSO ₄)

Table 2. Summary of test conditions: 48-h *Daphnia magna* LC50 test.

Test species	<i>Daphnia magna</i>
Organism source	In-house culture
Organism age	<24-hour old neonates
Test type	Static
Test duration	48 hours
Test vessel	250-mL glass beaker
Test volume	200 mL
Test solution depth	6 cm
Test concentrations	Five concentrations, plus laboratory control
Test replicates	1 per treatment
Number of organisms	10 per replicate
Control/dilution water	Moderately-hard reconstituted water + 2.5 µg/L Se
Test solution renewal	None
Test temperature	20 ± 2°C
Feeding	None
Light intensity	400 to 800 lux
Photoperiod	16 hours light / 8 hours dark
Aeration	None
Test measurements	Temperature, dissolved oxygen and pH measured daily; salinity, hardness and alkalinity measured in the undiluted sample at test initiation; conductivity measured at test initiation and termination; survival checked daily
Test protocol	Environment Canada (2000), EPS 1/RM/14, with 2016 amendments
Statistical software	CETIS Version 1.9.4
Test endpoints	Survival (48-hour LC50)
Test acceptability criterion for controls	Survival ≥90%
Reference toxicant	Sodium chloride (NaCl)

APPENDIX B – Toxicity test data

Rainbow Trout Summary Sheet

Client: ALS (Minto)

Start Date/Time: Aug 10/18 @ 1210h

Work Order No.: 181314

Test Species: Oncorhynchus mykiss

Sample Information:

Sample ID: L2143380-1 W3
Sample Date: Aug 7/18
Date Received: Aug 9/18
Sample Volume: 2 x 20L
Other: —

Test Validity Criteria:

≥ 90% control survival

WQ Ranges:

T (°C) = 15 ± 1; DO (mg/L) = 7.0 to 10.3; pH = 5.5 to 8.5

Dilution Water:

Type: Dechlorinated Municipal Tap Water
Hardness (mg/L CaCO₃): 6
Alkalinity (mg/L CaCO₃): 7

Test Organism Information:

Batch No.: 071218a
Source: Aqua Farms
No. Fish/Volume (L): 10/12L
Loading Density (g/L): 0.52
Mean Length ± SD (mm): 38 ± 2
Mean Weight ± SD (g): 0.62 ± 0.11

Range: 34 - 42

Range: 0.48 - 0.85

Zinc Reference Toxicant Results:

Reference Toxicant ID: RTZn13i
Stock Solution ID: 18Zn06
Date Initiated: Aug 3/18
96-h LC50 (95% CL): 46.76 (37.6 - 57.8) µg/L Zn

Reference Toxicant Mean and Historical Range: 90.76 (41.6 - 197.7) µg/L Zn

Reference Toxicant CV (%): 40%

Test Results: The 96h LC50 is estimated to be >100% (w/v).

Reviewed by: John

Date reviewed: Aug. 22/18

96-Hour Rainbow Trout Toxicity Test Data Sheet

Client/Project#: ALS (Minto)
 Sample I.D. L2143380-1 W3
 W.O. # 181314
 RBT Batch #: 071218a
 Date Collected/Time: Aug 7/18 @ 10:00h
 Date Setup/Time: Aug 10/18 @ 12:10h
 CER #: 2
 Sample Setup By: SD

Number Fish/Volume: 10/12L
 7-d % Mortality: 0.05
 Total Pre-aeration Time (mins): 30
 Aeration rate adjusted to 6.5 ± 1 mL/min/L? (Y/N): Y

Thermometer: Cer 2
 D.O. meter/probe: 2 102
 Cond./Salinity meter/probe: 2 1 CP2
 pH meter/probe: 2 1 p2

Undiluted Sample WQ			
Parameters	Initial WQ	Adjustment	30 min WQ
Temp °C	16.0	/	16.0
D.O. (mg/L)	9.1		9.5
pH	8.0		8.1
Cond. (µS/cm)	553		554
Salinity (ppt)	0.3		0.3

Concentration	# Survivors							Temperature (°C)					Dissolved Oxygen (mg/L)					pH					Conductivity (µS/cm)	
(% v/v)	1	2	4	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	96
Ctrl				10	10	10	10	15.0	15.0	15.0	15.0	15.0	9.5	9.1	9.6	9.3	9.8	7.2	7.2	7.1	7.2	7.2	30	35
6.25				10	10	10	10	15.0	15.0	15.0	15.0	15.0	9.6	9.5	9.7	9.6	9.8	7.1	7.2	7.1	7.1	7.0	58	63
12.5				10	10	10	10	15.0	15.0	15.0	15.0	15.0	9.7	9.8	9.7	9.7	9.8	7.2	7.2	7.3	7.1	7.2	81	86
25				10	10	10	10	15.0	15.0	15.0	15.0	15.0	9.6	9.4	9.5	9.6	9.6	7.8	8.0	7.7	7.6	7.7	167	173
50				10	10	10	10	15.0	15.0	15.0	15.0	15.0	9.7	9.5	9.6	9.7	9.7	8.0	8.3	8.0	8.0	8.0	300	303
100				10	10	10	10	15.0	15.0	15.0	15.0	15.0	9.5	9.4	9.7	9.9	9.9	8.1	8.0	8.4	8.3	8.4	554	559
								16.0																
Initials				m	a	JD	JD	JD	m	a	JD	JD	JD	m	a	JD	JD	JD	m	a	JD	JD	JD	JD

Sample Description/Comments: Clear yellow fluid. No particulates. No odour.

Fish Description at 96 h All fish appear normal Number of Stressed Fish at 96 h 0

Other Observations: _____

Reviewed by: JBW

Date Reviewed: Aug. 22/18

Daphnia magna Summary Sheet

Client: ALS Environmental
Work Order No.: 181315

Start Date/Time: Aug. 10/2018 1520h
Test Species: Daphnia magna
Set up by: cw

Sample Information:

Sample ID: L2143380-1 W3
Sample Date: Aug. 7/2018
Date Received: Aug. 10/2018
Sample Volume: 2x20L

Test Validity Criteria:

≥ 90% mean control survival and/or mobility and ≤ 2 daphnids exhibit immobility and/or mortality in any single control replicate.

WQ Ranges:

T (°C) = 20 ± 2; DO (mg/L) = 3.6 to 9.4; pH = 6 to 8.5

Test Organism Information:

Broodstock No.: 071818C
Age of young (Day 0): <24 h
Avg No. young per brood in previous 7 d: 16
Mortality (%) in previous 7 d: 10
Days to first brood: 8

NaCl Reference Toxicant Results:

Reference Toxicant ID: DMDC16
Stock Solution ID: 18Na03
Date Initiated: Aug. 7/2018
48-h LC50 (95% CL): 5.2 (4.2 - 6.4) g/L NaCl

Reference Toxicant Mean and Historical Range: 5.7 (3.9 - 8.4) g/L NaCl
Reference Toxicant CV (%): 20%

Test Results: The 48h LC50 is estimated to be >100% (v/v).

Reviewed by: JGh

Date reviewed: Aug. 22/18

Freshwater Acute 48 Hour Toxicity Test Data Sheet

Client: ALS Environmental
 Sample ID: L2143380-1 W3
 Work Order No.: 181315

Start Date/Time: Aug. 10/2018 1520h
 CER #: 5
 No. Organisms/volume: 10/200mL
 Test Organism: D.magna
 Set up by: CW

Thermometer: CERH5 pH meter/probe: 3 / 3 DO meter/probe: 3 / 3 Cond./Salinity meter/probe: 3 / 3

Concentration	Number of Live Organisms Rep			No. Immobilized	Temperature (°C)			Dissolved oxygen (mg/L)			pH			Conductivity (µS/cm)	
					0	24	48	0	24	48	0	24	48	0	48
(% v/v)		24	48	48	0	24	48	0	24	48	0	24	48	0	48
Control	A	10	10	0	20.5	20.0	20.0	8.3	8.6	8.8	7.8	7.9	7.9	350	371
	B														
	C														
	D														
6.25	A	10	10	0	20.5	20.0	20.0	8.3	8.5	8.9	7.8	7.9	8.0	360	387
	B														
	C														
	D														
12.5	A	10	10	0	20.0	20.0	20.0	8.2	8.5	8.8	7.8	8.0	8.0	374	391
	B														
	C														
	D														
25	A	10	10	0	20.0	20.0	20.0	8.2	8.5	8.8	7.8	8.0	8.1	402	405
	B														
	C														
	D														
50	A	10	10	0	20.0	20.0	20.0	8.3	8.5	8.8	7.8	8.0	8.1	452	458
	B														
	C														
	D														
100	A	10	10	0	20.5	20.0	20.0	8.5	8.5	8.8	7.6	8.0	8.2	559	555
	B														
	C														
	D														
Technician Initials		AW	AW	AW	CW	AW	AW	CW	AW	AW	CW	AW	AW	CW	AW

	Hardness*	Alkalinity*
Concentration	*(mg/L as CaCO ₃)	
Control (MHW)	100	76
Highest conc.	262	256
Hardness adjusted	—	—

	Initial WQ	Adjustment	Adjusted WQ
Temp (°C)	20.5		
DO (mg/L)	8.5		
pH	7.6		
Cond (µS/cm)	559		
Salinity (ppt)	0.3		

Comments: _____ Mortality: Heartbeat checked under microscope NO

Sample Description: Clear, yellow fluid. No particulates. No odour.

Batch#: 071818C 7-d previous # young/brood: 16 Previous 7-d Mortality (%): 10 Day of 1st Brood: 8

Reviewed by: YOU Date reviewed: Aug. 22/18

APPENDIX C – Chain-of-custody form

**L2143380**

VANCOUVER

Subcontract Request Form**Subcontract To:****NAUTILUS ENVIRONMENTAL**8664 COMMERCE COURT
BURNABY, BC V5A 4N7**NOTES:** Please reference on final report and invoice: PO# L2143380
ALS requires QC data to be provided with your final results.Please see enclosed 1 sample(s) in 4 Container(s)

SAMPLE NUMBER	ANALYTICAL REQUIRED	DATE SAMPLED		Priority Flag
		DUE DATE		
L2143380-1 W3	Special Request- Nautilus Environmental (SPECIAL REQUEST-NL 14)	8/7/2018	8/17/2018	

Subcontract Info Contact: Walter Lin (604) 253-4188

Analysis and reporting info contact: Shane Stack
8081 LOUGHEED HWY
SUITE 100
BURNABY, BC V5A 1W9
Phone: (604) 253-4188***NEW* Reporting Contacts:**
1.Account Manager Listed Below
2.ALSEVDataSublet@ALSGlobal.com (PDF / EXCEL)
3.ALSE.CASDG@ALSGlobal.com (EDD/Database Formats)

Email: Shane.Stack@alsglobal.com

Please email confirmation of receipt to: **Shane.Stack@alsglobal.com**

Shipped By:	_____	Date Shipped:	_____
Received By:	<u>Nautilus Environmental</u>	Date Received:	<u>Aug 09/18 @ 17:14</u>
Verified By:	<u>Jaymee Buchanan</u>	Date Verified:	_____
		Temperature:	<u>20-6°C</u>
Sample Integrity Issues:	<u>None</u>		

WO# 181314 - 96H Rbt LCSO

Qty 2x20L

WO# 181315 - 48H D. Magna LCSO

(MINTO)



Canada Toll Free: 1 800 668 9878

L2143380-COFC

Page 1 of 4

www.alsglobal.com

[illegible]

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY

YELLOW - CLIENT COPY

GOVERNMENT OF CANADA

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white-report copy

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

END OF REPORT

**ALS Environmental****Chain of Custody (COC) / Analytical
Request Form**

Canada Toll Free: 1 800 668 9878

www.alsglobal.com



L2143380-COFC

COC Number: 2018- 08- 08 B

Page 1 of 1

Report To		Report Format / Distribution		Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply													
Contact and company name below will appear on the final report		Select Report Format: ☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)		Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply													
Company:	Minto Explorations Ltd.	Quality Control (QC) Report with Report ☒ YES ☐ NO		PRIORITY (Business Days)	4 day [P4] ☐				EMERGENCY	1 Business day [E1] ☐							
Contact:	Minto Environment - Coordinator	☒ Compare Results to Criteria on Report - provide details below if box checked			3 day [P3] ☐					Same Day, Weekend or Statutory holiday [E0] ☐							
Phone:	1-604-759-4659	Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX			2 day [P2] ☐												
Company address below will appear on the final report		Email 1 or Fax minto_environment@mintomine.com		Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm													
Street:	2100-510 West Georgia St.	Email 2		For tests that can not be performed according to the service level selected, you will be contacted.													
City/Province:	Vancouver, British Columbia	Email 3		Analysis Request													
Postal Code:	V6B 0M3	Invoice Distribution		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (FP) below													
Invoice To	Same as Report To ☐ YES ☒ NO	Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX															
	Copy of Invoice with Report ☐ YES ☒ NO	Email 1 or Fax ap@mintomine.com															
Company:	Minto Explorations Ltd.	Email 2															
Contact:	Ruth Cayetano	Oil and Gas Required Fields (client use)															
Project Information		AFF/Cost Center:		PO#													
ALS Account # / Quote #:		Major/Minor Code:		Routing Code:													
Job #:		Requisitioner:															
PO / AFE: 229101 (MMER)		Location:															
LSD:		ALS Contact:		Sampler: EB/SMB													
ALS Lab Work Order # (lab use only)																	
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	96hr LC50 Rainbow Trout	48hr - LC50 Daphnia	7day - Rainbow Trout Embryo Toxicity	7day - Ceriodaphnia	7day - Lemna minor	Alga 72-h Growth Inhibition	7day - Fathead Minnow					Number of Containers	
	W3	7-Aug-18	10:00	Water	R	R									4		
Drinking Water (DW) Samples ¹ (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)				SAMPLE CONDITION AS RECEIVED (lab use only)											
Are samples taken from a Regulated DW System? ☐ YES ☒ NO						Frozen ☐ SIF Observations Yes ☐ No ☐											
Are samples for human drinking water use? ☐ YES ☒ NO						Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐											
						Cooling Initiated ☐											
						INITIAL COOLER TEMPERATURES °C: 15° FINAL COOLER TEMPERATURES °C: 11.6°											
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)				FINAL SHIPMENT RECEPTION (lab use only)											
Released by: SMB		Date: 8/8/2018	Time:	Received by:	Date: Aug 8/18	Time: 16:25	Received by: HA		Date: 8/9	Time: 12:54							

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

OCTOBER 2015 FORM



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 03-OCT-18
Report Date: 22-NOV-18 19:22 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2175227
Project P.O. #: 229101 (MMER)
Job Reference:
C of C Numbers: 2018-10-03 C
Legal Site Desc:

Comments: Please note, this report contains only Nautilus Environmental reports (at the end of the attachment).

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID						
Grouping	Analyte					

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
---------------	--------	------------------	--------------------

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
----------------------------	---------------------

Chain of Custody Numbers:

2018-10-03 C

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Acute Toxicity Test Results

Sample L2175227-1 W3,
collected October 2, 2018

Final Report

October 23, 2018

Submitted to: **ALS Environmental**
Burnaby, BC

SAMPLE INFORMATION

Sample ID	Dates			<i>Daphnia magna</i> test initiation	Receipt temp.
	Collected	Received	Rainbow trout test initiation		
L2175227-1 W3	02-Oct-18 at 0835h	04-Oct-18 at 1330h	05-Oct-18 at 1545h	04-Oct-18 at 1640h	5.0°C

TESTS

- Rainbow trout 96-h LC50 test
- *Daphnia magna* 48-h LC50 test

RESULTS

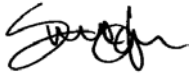
Toxicity test results

Sample ID	LC50 (% v/v)	
	Rainbow trout	<i>Daphnia magna</i>
L2175227-1 W3	> 100	> 100

QA/QC

QA/QC summary	Rainbow trout	<i>Daphnia magna</i>
Reference toxicant LC50 (95% CL)	178.2 (132.2 – 358.8) µg/L Zn ¹	6.8 (5.7 – 8.1) g/L NaCl ²
Reference toxicant historical mean (2 SD range)	85.0 (33.6 – 215.0) µg/L Zn	5.7 (4.0 – 8.1) g/L NaCl
Reference toxicant CV	49%	18%
Organism health history	Acceptable	Acceptable
Protocol deviations	None	None
Water quality range deviations	None	None
Control performance	Acceptable	Acceptable
Test performance	Valid	Valid

¹Test date: October 5, 2018, 2018; ²Test date: October 2, 2018; LC = Lethal Concentration, CL = Confidence Limits, SD = Standard Deviation, CV = Coefficient of Variation



Report By:
Yvonne Lam, B.Sc.
Laboratory Biologist



Reviewed By:
Edmund Canaria, R.P.Bio
Senior Analyst

This report has been prepared by Nautilus Environmental Company Inc. based on data and/or samples provided by our client and the results of this study are for their sole benefit. Any reliance on the data by a third party is at the sole and exclusive risk of that party. The results presented here relate only to the samples tested.

APPENDIX A – Summary of test conditions

Table 1. Summary of test conditions: 96-h rainbow trout (*Oncorhynchus mykiss*) LC50 test.

Test species	<i>Oncorhynchus mykiss</i>
Organism source	Hatchery
Organism age	Juvenile
Test type	Static
Test duration	96 hours
Test vessel	20-L glass aquarium
Test volume	10 to 20 L (depending on size of fish)
Test solution depth	≥15 cm
Test concentrations	Five concentrations, plus laboratory control
Test replicates	1 per treatment
Number of organisms	10 per replicate
Control/dilution water	Dechlorinated Metro Vancouver municipal tapwater
Test solution renewal	None
Test temperature	15 ± 1°C
Feeding	None
Light intensity	100 to 500 lux
Photoperiod	16 hours light / 8 hours dark
Aeration	6.5 ± 1 mL/min/L
Test measurements	Temperature, dissolved oxygen and pH measured daily; salinity measured in the undiluted sample at test initiation; conductivity measured at test initiation and termination; survival checked daily
Test protocol	Environment Canada (2000), EPS 1/RM/13, with 2007 & 2016 amendments
Statistical software	CETIS Version 1.9.4
Test endpoints	Survival (96-hour LC50)
Test acceptability criterion for controls	Survival ≥90%
Reference toxicant	Zinc (added as ZnSO ₄)

Table 2. Summary of test conditions: 48-h *Daphnia magna* LC50 test.

Test species	<i>Daphnia magna</i>
Organism source	In-house culture
Organism age	<24-hour old neonates
Test type	Static
Test duration	48 hours
Test vessel	250-mL glass beaker
Test volume	200 mL
Test solution depth	6 cm
Test concentrations	Five concentrations, plus laboratory control
Test replicates	1 per treatment
Number of organisms	10 per replicate
Control/dilution water	Moderately-hard reconstituted water + 2.5 µg/L Se
Test solution renewal	None
Test temperature	20 ± 2°C
Feeding	None
Light intensity	400 to 800 lux
Photoperiod	16 hours light / 8 hours dark
Aeration	None
Test measurements	Temperature, dissolved oxygen and pH measured daily; salinity, hardness and alkalinity measured in the undiluted sample at test initiation; conductivity measured at test initiation and termination; survival checked daily
Test protocol	Environment Canada (2000), EPS 1/RM/14, with 2016 amendments
Statistical software	CETIS Version 1.9.4
Test endpoints	Survival (48-hour LC50)
Test acceptability criterion for controls	Survival ≥90%
Reference toxicant	Sodium chloride (NaCl)

APPENDIX B – Toxicity test data

Rainbow Trout Summary Sheet

Client: ALS Environmental

Start Date/Time: 05 October 2018; 1545h

Work Order No.: 181670

Test Species: Oncorhynchus mykiss

Sample Information:

Sample ID: L2175227-1 W3
Sample Date: 02 October 2018
Date Received: 04 October 2018
Sample Volume: 7x20L, 3x1L
Other: -

Test Validity Criteria:

≥ 90% control survival

WQ Ranges:

T (°C) = 15 ± 1; DO (mg/L) = 7.0 to 10.3; pH = 5.5 to 8.5

Dilution Water:

Type: Dechlorinated Municipal Tap Water
Hardness (mg/L CaCO₃): 15
Alkalinity (mg/L CaCO₃): 12

Test Organism Information:

Batch No.: 083018b
Source: Lyndon Fish Hatcheries
No. Fish/Volume (L): 10/12L
Loading Density (g/L): 0.42
Mean Length ± SD (mm): 38 ± 3
Mean Weight ± SD (g): 0.50 ± 0.09

Range: 34 - 43
Range: 0.34 - 0.68

Zinc Reference Toxicant Results:

Reference Toxicant ID: RTZn138
Stock Solution ID: 18Zn06
Date Initiated: 05 October 2018
96-h LC50 (95% CL): 178.2 (132.2 - 358.8) µg/L Zn

Reference Toxicant Mean and Historical Range: 85.0 (33.6 - 215.0) µg/L Zn
Reference Toxicant CV (%): 49

Test Results: The 96 hour LC50 is estimated to be >100% (1/v).

Reviewed by: 

Date reviewed: Oct 23, 2018

96-Hour Rainbow Trout Toxicity Test Data Sheet

Client/Project#: ALS Environmental
 Sample I.D. L2175227-1 W3
 W.O. # 181670
 RBT Batch #: 0830186
 Date Collected/Time: 02Oct18 @ 0835h
 Date Setup/Time: 05Oct18 @ 1545h
 CER #: 10
 Sample Setup By: DK

Number Fish/Volume: 10/12L
 7-d % Mortality: 0.05%
 Total Pre-aeration Time (mins): 30
 Aeration rate adjusted to 6.5 ± 1 mL/min/L? (Y/N): Y

Thermometer: Cer 10
 D.O. meter/probe: 2 / D2
 Cond./Salinity meter/probe: 2 / CP2
 pH meter/probe: 2 / P2

Undiluted Sample WQ			
Parameters	Initial WQ	Adjustment	30 min WQ
Temp °C	15.5	/	15.0
D.O. (mg/L)	9.7		9.8
pH	6.4 7.9		7.9
Cond. (µS/cm)	586		586
Salinity (ppt)	0.3		0.3

Concentration	# Survivors							Temperature (°C)					Dissolved Oxygen (mg/L)					pH					Conductivity (µS/cm)	
(% v/v)	1	2	4	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	96
CH1				10	10	10	10	14.5	14.5	14.5	15.0	14.5	9.8	9.7	9.9	9.5	9.4	7.2	7.0	6.9	7.2	7.0	38	43
6.25				10	10	10	10	14.5	14.5	14.5	15.0	14.5	9.7	9.7	9.8	9.5	9.5	7.5	7.3	7.1	7.3	7.2	39	93
12.5				10	10	10	10	15.0	14.5	14.5	15.0	14.5	9.8	9.6	9.8	9.6	9.5	7.6	7.5	7.3	7.4	7.4	112	117
25				10	10	10	10	15.0	14.5	14.5	15.0	14.5	9.8	9.7	9.9	9.6	9.6	7.8	7.6	7.5	7.6	7.8	230	231
50				10	10	10	10	15.0	14.5	14.5	15.0	14.5	9.8	9.7	9.8	9.6	9.6	7.8	7.9	7.7	8.1	8.0	332	336
100				10	10	10	10	15.0	14.5	14.5	15.0	14.5	9.8	9.8	9.8	9.7	9.6	7.9	8.0	8.0	8.3	8.3	586	580
Initials				A	~	ML	ML	DK	~	~	ML	ML	DK	~	~	ML	ML	DK	~	~	ML	ML	DK	~

Sample Description/Comments: DK Pale yellow clear liquid, no odors, black particulates

Fish Description at 96 h All fish appear normal Number of Stressed Fish at 96 h 0

Other Observations: _____

Reviewed by: EW Date Reviewed: Oct 23, 2018

Daphnia magna Summary Sheet

Client: ALS
Work Order No.: 181671

Start Date/Time: Oct 4/2018 @ 1640h
Test Species: Daphnia magna
Set up by: CW

Sample Information:

Sample ID: L217522-1 W3
Sample Date: Oct 2/2018
Date Received: Oct 4/2018
Sample Volume: 3x1L

Test Validity Criteria:

≥ 90% mean control survival and/or mobility and ≤ 2 daphnids exhibit immobility and/or mortality in any single control replicate.

WQ Ranges:

T (°C) = 20 ± 2; DO (mg/L) = 3.6 to 9.4; pH = 6 to 8.5

Test Organism Information:

Broodstock No.: 091118C
Age of young (Day 0): <24 h
Avg No. young per brood in previous 7 d: 15
Mortality (%) in previous 7 d: 10
Days to first brood: 8

NaCl Reference Toxicant Results:

Reference Toxicant ID: DMDC19
Stock Solution ID: 18Na03
Date Initiated: October 2/2018
48-h LC50 (95% CL): 6.8 (5.7 - 8.1) g/L NaCl

Reference Toxicant Mean and Historical Range: 5.7 (4.0 - 8.1) g/L NaCl

Reference Toxicant CV (%): 18

Test Results: The 48h LC50 is estimated to be >100% (V/V).

Reviewed by: CW

Date reviewed: Oct. 18, 2018

Freshwater Acute 48 Hour Toxicity Test Data Sheet

Client: ALS
 Sample ID: L2175227-1 W3
 Work Order No.: 181671

Start Date/Time: Oct-4/2018 @ 1640h
 CER #: 5
 No. Organisms/volume: 10/200mL
 Test Organism: D.magna
 Set up by: CW

Thermometer: 0845 pH meter/probe: 3 / 3 DO meter/probe: 3 / 3 Cond./Salinity meter/probe: 3 / 3

Concentration (% v/v)	Number of Live Organisms Rep	24		No. Immobilized 48	Temperature (°C)			Dissolved oxygen (mg/L)			pH			Conductivity (µS/cm)	
		48	48		0	24	48	0	24	48	0	24	48	0	48
Control	A	10	10	0	18.5	19.0	19.0	8.8	8.2	8.7	7.5	7.8	7.8	352	354
	B														
	C														
	D														
6.25	A	10	10	0	19.0	19.0	19.0	8.8	8.3	8.7	7.5	7.8	7.8	365	369
	B														
	C														
	D														
12.5	A	10	10	0	19.0	19.0	19.0	8.9	8.3	8.6	7.5	7.8	7.9	380	381
	B														
	C														
	D														
25	A	10	10	0	19.0	19.0	19.0	8.8	8.3	8.6	7.5	7.8	8.0	408	407
	B														
	C														
	D														
50	A	10	10	0	19.0	19.0	19.0	8.7	8.2	8.6	7.5	8.0	8.1	467	469
	B														
	C														
	D														
100	A	10	10	0	18.0	19.0	19.0	8.7	8.2	8.6	7.3	8.1	8.3	571	566
	B														
	C														
	D														
Technician Initials	CW	a	a	a	CW	CW	a	CW	CW	a	CW	CW	a	CW	a

	Hardness*	Alkalinity*
Concentration	*(mg/L as CaCO ₃)	
Control (MHW)	100	78
Highest conc.	296	248
Hardness adjusted	—	—

	Initial WQ	Adjustment	Adjusted WQ
Temp (°C)	18.0		
DO (mg/L)	8.7		
pH	7.3		
Cond (µS/cm)	571		
Salinity (ppt)	0.3		

Comments: _____ Mortality: Heartbeat checked under microscope NO
 Sample Description: Pale yellow^{clear} liquid, no odour, no^{ew} black particulates
 Batch#: 091119 C 7-d previous # young/brood: 15 Previous 7-d Mortality (%): 10 Day of 1st Brood: 8
 Reviewed by: CW Date reviewed: Oct-18, 2018

APPENDIX C – Chain-of-custody form

**L2175227**

VANCOUVER

Subcontract Request Form**Subcontract To:****NAUTILUS ENVIRONMENTAL**8664 COMMERCE COURT
BURNABY, BC V5A 4N7**NOTES:** Please reference on final report and invoice: PO# L2175227
ALS requires QC data to be provided with your final results.Please see enclosed 1 sample(s) in 8 Container(s)

SAMPLE NUMBER	ANALYTICAL REQUIRED	DATE SAMPLED	Priority Flag
		DUE DATE	
L2175227-1 W3		10/2/2018	
	Special Request- Nautilus Environmental (SPECIAL REQUEST-NL 14)	11/5/2018	

Subcontract Info Contact: Walter Lin (604) 253-4188

Analysis and reporting info contact: Shane Stack
8081 LOUGHEED HWY
SUITE 100
BURNABY, BC V5A 1W9

Phone: (604) 253-4188

Email: Shane.Stack@alsglobal.com

Please email confirmation of receipt to:

Shane.Stack@alsglobal.com

Shipped By: me!Date Shipped: Oct 04 2018Received By: NautilusDate Received: Oct 04/18 @ 13:30Verified By: Tyrene Hamilton

Date Verified: _____

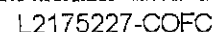
Temperature: 5.0°C

Sample Integrity Issues: _____

7x20L + 3x1L



Canada Toll Free: 1 800 668 9878



Page 1 of 1

[illegible]

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2016 FROM

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backside of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

END OF REPORT



Toxicity Testing for L2175227-1 W3

Sample collected October 2, 2018

Final Report

November 22, 2018

Submitted to: **ALS Environmental**
Burnaby, BC

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SIGNATURE PAGE

Report By:
Emma Marus, B.Sc.
Laboratory Biologist



Reviewed By:
Armando Tang, R.P. Bio
Senior Reviewer

This report has been prepared by Nautilus Environmental Company Inc. based on data and/or samples provided by our client and the results of this study are for their sole benefit. Any reliance on the data by a third party is at the sole and exclusive risk of that party. The results presented here relate only to the samples tested.

SUMMARY

Sample Information and Test Type

Sample ID	L2175227-1 W3
Sample collection date	October 2, 2018
Sample receipt date	October 4, 2018
Sample receipt temperature	5.0°C
Test types	<i>Ceriodaphnia dubia</i> survival and reproduction
	7-d rainbow trout (<i>Oncorhynchus mykiss</i>) embryo viability
	7-d <i>Lemna minor</i> growth inhibition
	72-h <i>Pseudokirchneriella subcapitata</i> growth inhibition

Summary of Results

Endpoint	% v/v
<i>Ceriodaphnia dubia</i>	
Survival LC50	>100
Reproduction IC25	>100
Reproduction IC50	>100
<i>Oncorhynchus mykiss</i>	
Embryo viability EC25	>100
Embryo viability EC50	>100
<i>Lemna minor</i>	
Frond count IC25	>97
Frond count IC50	>97
Dry weight IC25	>97
Dry weight IC50	>97
<i>Pseudokirchneriella subcapitata</i>	
Growth IC25	>95.2
Growth IC50	>95.2

LC = Lethal Concentration, IC = Inhibition Concentration, EC = Effective Concentration

1.0 INTRODUCTION

Nautilus Environmental Company Inc. conducted sub-lethal toxicity tests for ALS Environmental on sample identified as L2175227-1 W3. The sample was collected on October 2, 2018 and delivered to the Nautilus Environmental laboratory in Burnaby, BC on October 4, 2018. The sample was transported in seven 20-L and three 1-L plastic containers and received at a temperature of 5.0°C. The sample was stored in the dark at $4 \pm 2^\circ\text{C}$ prior to testing.

The following toxicity tests were performed on sample L2175227-1 W3:

- *Ceriodaphnia dubia* survival and reproduction
- 7-d rainbow trout (*Oncorhynchus mykiss*) embryo viability
- 7-d *Lemna minor* growth inhibition
- 72-h *Pseudokirchneriella subcapitata* growth inhibition

Testing for L2175227-1 W3 was initiated on October 4, 2018 for *C. dubia*, *O. mykiss* and *L. minor* and on October 5, 2018 for *P. subcapitata*. This report describes the results of these toxicity tests. Copies of raw laboratory data sheets and statistical analyses for each test species are provided in Appendices A to D. The chain-of-custody form is provided in Appendix E.

2.0 METHODS

Methods for the toxicity tests are summarized in Tables 1 to 4. Testing using *C. dubia*, *L. minor* and *P. subcapitata* were conducted according to procedures described by Environment Canada (2007a, 2007b and 2007c). The rainbow trout embryo viability test followed procedures described by Environment Canada (1998) and modified by Canaria *et al.* (1999). Statistical analyses for all the tests were performed using CETIS (Tidepool Scientific Software, 2013).

Table 1. Summary of test conditions: *Ceriodaphnia dubia* survival and reproduction test.

Test species	<i>Ceriodaphnia dubia</i>
Organism source	In-house culture
Organism age	<24 hour old neonates, produced within a 12 hour window
Test type	Static-renewal
Test duration	7 ± 1 day
Test vessel	20-mL glass test tube
Test volume	15 mL
Test solution depth	10 cm
Test concentrations	Seven concentrations, plus laboratory control
Test replicates	10 per treatment
Number of organisms	1 per replicate
Control/dilution water	20% Perrier water and 80% deionized water + 5 µg/L Se and 2 µg/L vitamin B12
Test solution renewal	Daily (100% renewal)
Test temperature	25 ± 1°C
Feeding	Daily with <i>Pseudokirchneriella subcapitata</i> and YCT (3:1 ratio)
Light intensity	100 to 600 lux at water surface
Photoperiod	16 hours light / 8 hours dark
Aeration	None
Test measurements	Temperature, dissolved oxygen, pH and conductivity measured daily; hardness and alkalinity of undiluted sample measured at test initiation; survival and reproduction checked daily
Test protocol	Environment Canada (2007a), EPS 1/RM/21
Statistical software	CETIS Version 1.9.4
Test endpoints	Survival and reproduction ≥80% survival; ≥15 young per surviving control producing three broods; ≥60% of controls producing three or more broods; no ephippia present
Test acceptability criteria for controls	
Reference toxicant	Sodium chloride (NaCl)

Table 2. Summary of test conditions: 7-d rainbow trout (*Oncorhynchus mykiss*) embryo viability test.

Test species	<i>Oncorhynchus mykiss</i>
Organism source	Hatchery
Organism age	<30 minutes post fertilization, <24 hour old gametes
Test type	Static-renewal
Test duration	7 days
Test vessel	2-L plastic container
Test volume	2 L
Test solution depth	17 cm
Test concentrations	Five concentrations, plus laboratory control
Test replicates	4 per treatment
Number of organisms	30 per replicate
Control/dilution water	Dechlorinated Metro Vancouver municipal tapwater
Test solution renewal	Daily (80% renewal)
Test temperature	14 ± 1°C
Feeding	None
Light intensity	Dark
Photoperiod	24 hours dark
Aeration	Continuous gentle aeration
Test measurements	Temperature, dissolved oxygen, pH and conductivity measured daily; hardness and alkalinity of undiluted sample measured at test initiation; survival checked daily
Test protocol	Environment Canada (1998), EPS 1/RM/28; Canaria et al. (1999)
Statistical software	CETIS Version 1.9.4
Test endpoint	Embryo viability
Test acceptability criterion for controls	Embryo viability ≥70%
Reference toxicant	Sodium dodecyl sulphate (SDS)

Table 3. Summary of test conditions: 7-d *Lemna minor* growth inhibition test.

Test species	<i>Lemna minor</i> , strain CPCC# 490
Organism source	In-house axenic culture, obtained from Canadian Phycological Culture Centre, and originally isolated from Wainfleet, Stinking Barn, Niagara Peninsula, Ontario, Canada
Organism age	7- to 10-day old culture
Test type	Static
Test duration	7 days
Test vessel	250-mL glass container
Test volume	100 mL
Test solution depth	4 cm
Test concentrations	Seven concentrations, plus laboratory control
Test replicates	4 per treatment
Number of organisms	Two 3-frond plants per replicate
Control/dilution water	Modified APHA media (deionized water plus 1% of each APHA stock solution A, B and C)
Test solution renewal	None
Test temperature	25 ± 2°C
Feeding	None
Light intensity	4000 to 5600 lux
Photoperiod	24 hours light
Aeration	None
Test measurements	Test area temperature measured daily; temperature, pH and conductivity measured in all concentrations at test initiation; dissolved oxygen of highest concentration measured at test initiation; temperature and pH measured at test termination
Test protocol	Environment Canada (2007b), EPS 1/RM/37
Statistical software	CETIS Version 1.9.4
Test endpoints	Number of fronds and dry weight
Test acceptability criterion for controls	≥ 8-fold increase in number of fronds
Reference toxicant	Potassium chloride (KCl)

Table 4. Summary of test conditions: 72-h *Pseudokirchneriella subcapitata* growth inhibition test.

Test species	<i>Pseudokirchneriella subcapitata</i> , strain CPCC #37
Organism source	In-house axenic culture, obtained from Canadian Phycological Culture Center, and originally isolated from Nivelta River, Norway.
Organism age	3-to 7-day old culture in logarithmic growth phase
Test type	Static
Test duration	72 hours
Test vessel	Microplate
Test volume	220 µL
Test concentrations	Seven concentrations, plus laboratory control
Test replicates	4 per treatment; 8 for laboratory control
Number of organisms	10,000 cells/mL
Control/dilution water	Deionized water supplemented with nutrients
Test solution renewal	None
Test temperature	24 ± 2°C
Feeding	None
Light intensity	3600 to 4400 lux
Photoperiod	24 hours light
Aeration	None
Test measurements	Test area temperature measured daily; temperature and pH measured at test initiation; pH of two control wells measured at test termination
Test protocol	Environment Canada (2007c), EPS 1/RM/25
Statistical software	CETIS Version 1.9.4
Test endpoint	Algal cell growth inhibition
Test acceptability criteria for controls	> 16-fold increase in number of algal cells; CV ≤ 20%; no trend when analyzed using Mann-Kendall test
Reference toxicant	Zinc (added as ZnSO ₄)

3.0 RESULTS

Results of the toxicity tests are summarized in Tables 5 to 8. For sample L2175227-1 W3, there were no adverse effects observed on survival and reproduction of *C. dubia* (Table 5), embryo viability of *O. mykiss* (Table 6), cell yield of *P. subcapitata* (Table 8) or on frond growth and dry weight of *L. minor* (Table 7). The LC and IC values were therefore greater than the highest test concentration for each of these endpoints in the toxicity tests. Stimulatory effects were observed for *P. subcapitata* cell yield, with percent stimulation ranging from 5.6 to 464.5%.

Table 5. Results: *Ceriodaphnia dubia* survival and reproduction test.

Concentration (% v/v)	Survival (%)	Reproduction (Mean ± SD)
Laboratory Control	100	16.8 ± 2.9
1.56	90	15.7 ± 7.2
3.12	100	19.8 ± 3.0
6.25	100	20.6 ± 2.2
12.5	100	21.2 ± 3.7
25	100	17.6 ± 5.4
50	100	18.1 ± 4.0
100	90	19.2 ± 8.2
Test Endpoint (% v/v)		
LC50	>100	--
IC25	--	>100
IC50	--	>100

SD = Standard Deviation, LC = Lethal Concentration, IC = Inhibition Concentration

Table 6. Results: 7-d rainbow trout (*Oncorhynchus mykiss*) embryo viability test.

Concentration (% v/v)	Embryo Viability (%) (Mean $\pm$ SD)
Laboratory Control	90.8 $\pm$ 8.3
6.25	95.0 $\pm$ 4.3
12.5	93.3 $\pm$ 7.2
25	90.8 $\pm$ 7.9
50	90.1 $\pm$ 4.7
100	88.3 $\pm$ 8.8
Test Endpoint (% v/v)	
EC25	> 100
EC50	> 100

SD = Standard Deviation, EC = Effective Concentration

Table 7. Results: 7-d *Lemna minor* growth inhibition test.

Concentration (% v/v)	Frond Growth (No. of Fronds) (Mean $\pm$ SD)	Dry Weight (mg) (Mean $\pm$ SD)
Laboratory Control	69.8 $\pm$ 4.0	5.8 $\pm$ 0.4
1.5	81.0 $\pm$ 16.9	6.4 $\pm$ 1.0
3.0	80.2 $\pm$ 16.9	6.4 $\pm$ 1.2
6.1	77.0 $\pm$ 14.6	6.4 $\pm$ 1.1
12.1	79.2 $\pm$ 5.0	6.4 $\pm$ 0.2
24.2	100.8 $\pm$ 6.1	7.6 $\pm$ 0.5
48.5	106.0 $\pm$ 8.1	8.5 $\pm$ 0.7
97	72.8 $\pm$ 14.6	6.5 $\pm$ 0.8
Test Endpoint (% v/v)		
IC25	>97	>97
IC50	>97	>97

SD = Standard Deviation, IC = Inhibition Concentration

Table 8. Results: 72-h *Pseudokirchneriella subcapitata* growth inhibition test.

Concentration (% v/v)	Cell Yield (x 10⁴ cells/mL) (Mean ± SD)	Stimulation (%)
Laboratory Control	31.0 ± 2.6	--
1.5	32.8 ± 2.4	5.6
3.0	47.5 ± 4.9 *	53.2
6.0	85.8 ± 5.7 *	176.6
11.9	133.5 ± 5.2 *	330.6
23.8	164.5 ± 6.5 *	430.6
47.6	175.0 ± 3.2 *	464.5
95.2	150.0 ± 7.4 *	383.9
Test Endpoint (% v/v)		
IC25	>95.2	--
IC50	>95.2	--

SD = Standard Deviation, IC = Inhibition Concentration

* = Indicates cell yield that were significantly greater than the control

4.0 QA/QC

The health histories of the test organisms used in the exposures were acceptable and met the requirements of the Environment Canada protocols. The tests met all control acceptability criteria and water quality parameters remained within ranges specified in the protocols throughout the tests. Uncertainty associated with the tests is best described by the standard deviation around the means and/or the confidence intervals around the point estimates.

There were no deviations from the test methodologies, except for the 7-d rainbow trout embryo viability test. The eggs were exposed using a blocked design (eggs from each of the four female fish were distributed separately in each replicate A to D) rather than pooled, as specified in the test protocol. The modification was used because the egg quality from each female varied considerably, and blocking would minimize the effects of poor quality eggs from one particular female fish. The deviations did not seem to affect the results of the test since control criterion was met at the end of the exposure.

Results of the reference toxicant tests conducted during the testing program are summarized in Table 9. Results for these tests fell within the range for organism performance of the mean and two standard deviations, based on historical results obtained by the laboratory with these tests. Thus, the sensitivity of the organisms used in the tests was appropriate. The reference toxicant tests were performed under the same conditions as those used for the samples.

Table 9. Reference toxicant test results.

Test Species	Endpoint	Historical Mean (2 SD Range)	CV (%)	Test Date
<i>C. dubia</i>	Survival (LC50): 1.8 g/L NaCl	2.0 (1.8 – 2.2) g/L NaCl	5	October 17, 2018
	Reproduction (IC50): 1.2 g/L NaCl	1.3 (0.8 – 1.9) g/L NaCl	21	
<i>O. mykiss</i>	Viability (EC50): 4.4 mg/L SDS	4.2 (2.0 – 8.8) mg/L SDS	38	October 4, 2018
<i>L. minor</i>	No. Fronds (IC50): 3.5 g/L KCl	3.5 (2.9 – 4.2) g/L KCl	10	September 21, 2018
<i>P. subcapitata</i>	Growth (IC50): 29.1 µg/L Zn	31.2 (25.9 – 37.7) µg/L Zn	9	September 21, 2018

SD = Standard Deviation, CV = Coefficient of Variation, LC = Lethal Concentration, IC = Inhibition Concentration, EC = Effective Concentration

5.0 REFERENCES

- Canaria, E.C., J.R. Elphick and H.C. Bailey. 1999. A simplified procedure for conducting small-scale short-term embryo toxicity tests with salmonids. *Environ Toxicol* 14:301-307.
- Environment Canada. 1998. Biological test method: toxicity tests using early life stages of salmonid fish (rainbow trout). Environmental Protection Series EPS 1/RM/28. Second Edition, July 1998. Environment Canada, Method Development and Application Section, Environmental Technology Centre, Ottawa, ON. 102 pp.
- Environment Canada. 2007a. Biological test method: test of reproduction and survival using the cladoceran *Ceriodaphnia dubia*. Environmental Protection Series. Report EPS 1/RM/21, Second Edition, February 2007. Environment Canada, Method Development and Application Section, Environmental Science and Technology Centre, Science and Technology Branch, Ottawa, ON. 74 pp.
- Environment Canada. 2007b. Biological test method: tests for measuring the inhibition of growth using the freshwater macrophyte, *Lemna minor*. Environmental Protection Series, Report EPS 1/RM/37. Second Edition. January 2007. Environment Canada, Method Development and Application Section, Environmental Technology Centre, Ottawa, ON. 112 pp.
- Environment Canada. 2007c. Biological test method: growth inhibition test using the freshwater alga. Environmental Protection Series, Report EPS 1/RM/25. Second Edition, March 2007. Environment Canada, Method Development and Application Section, Environmental Science and Technology Centre, Science and Technology Branch, Ottawa, ON. 53 pp.
- Tidepool Scientific Software. 2013. CETIS comprehensive environmental toxicity information system, version 1.9.4 Tidepool Scientific Software, McKinleyville, CA. 275 pp.

APPENDIX A – *Ceriodaphnia dubia* Toxicity Test Data

Ceriodaphnia dubia Summary Sheet

Client: ALS (Minto)
Work Order No.: 181673

Start Date/Time: 04/18/18 1400h
Set up by: U/JS

Sample Information:

Sample ID: 217522-1 W-3
Sample Date: 04/2/18
Date Received: 04/4/18
Sample Volume: 7x20L & 3x1L

Test Validity Criteria:

- 1) Mean survival of first generation controls is $\geq 80\%$
- 2) At least 60% of controls have produced three broods within 8 days
- 3) An average of ≥ 15 live young produced per surviving female in the control solutions during the first three broods.
- 4) Invalid if ephippia observed in any control solution at any time.

WQ Ranges:

T ($^{\circ}$ C) = 25 ± 1 ; DO (mg/L) = 3.3 to 8.4; pH = 6.0 to 8.5

Test Organism Information:

Broodstock No.: BB092518A & B
Age of young (Day 0): <24-h (within 12-h)
Avg No. young in first 3 broods of previous 7 d: 18
Mortality (%) in previous 7 d: 2.5
Individual female # used ≥ 8 young on test day: 2, 3, 5, 7-10, 14, 18, 19, 22, 23, 26, 30, 32-40

NaCl Reference Toxicant Results:

Reference Toxicant ID: 18NaCl Cd198
Stock Solution ID: 18NaCl (100g/L NaCl)
Date Initiated: 04/17/18

7-d LC50 (95% CL): 1.8(1.6-2.2) g/L NaCl
7-d IC50 (95% CL): 1.2(1.1-1.3) g/L NaCl

7-d LC50 Reference Toxicant Mean and Historical Range: 2.0(1.8-2.2) g/L NaCl CV (%): 5
7-d IC50 Reference Toxicant Mean and Historical Range: 1.3(0.8-1.9) g/L NaCl CV (%): 21

Test Results:

	Survival	Reproduction
LC50 % (v/v) (95% CL)	<u>>100</u>	
IC25 % (v/v) (95% CL)		<u>>100</u>
IC50 % (v/v) (95% CL)		<u>>100</u>

Reviewed by: JGK

Date reviewed: Nov. 5/18

Chronic Freshwater Toxicity Test Initial and Final Water Quality Measurements

Client: ALS (MINTO)
Sample ID: W-3 2475227-1 W-3
Work Order #: 181673

Start Date & Time: July 10 Oct. 04/18 @ 1400h
Stop Date & Time: Oct 11/18 @ 1500h
CER #: 4
Test Species: Ceriodaphnia dubia

Concentration Control	Days													
	0	1		2		3		4		5		6		7
	init.	old.	new	old.	new	old.	new	old.	new	old.	new	old.	new	final
Temperature (°C)	25.0	25.0	25.0	25.0	24.0	25.0	24.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
DO (mg/L)	8.0	7.8	8.2	7.5	8.0	7.4	8.0	7.1	7.8	7.3	8.0	7.9	8.0	6.4
pH	7.6	7.7	8.0	7.0	7.9	7.8	8.1	8.1	8.4	7.8	8.1	7.7	8.2	7.8
Cond. (µS/cm)	224	225		224		223		223		224		221		227
Initials	JB	JB		A		A		K		JB		JB		JB

Concentration 1.56	Days													
	0	1		2		3		4		5		6		7
	init.	old.	new	old.	new	old.	new	old.	new	old.	new	old.	new	final
Temperature (°C)	24.0	25.0	24.0	25.0	24.0	25.0	24.0	25.0	24.5	25.0	25.0	25.0	25.0	25.0
DO (mg/L)	7.8	7.7	7.8	7.5	8.2	7.4	8.0	7.1	7.9	7.3	7.9	7.9	7.7	6.7
pH	7.8	7.9	7.9	8.1	8.1	7.9	8.1	8.1	8.2	7.9	7.9	7.7	8.0	7.8
Cond. (µS/cm)	231	231		230		232		226		222		214		211
Initials	JB	JB		A		A		K		JB		JB		JB

Concentration 12.5	Days													
	0	1		2		3		4		5		6		7
	init.	old.	new	old.	new	old.	new	old.	new	old.	new	old.	new	final
Temperature (°C)	24.0	25.0	24.0	25.0	24.0	25.0	24.0	25.0	24.5	25.0	25.0	25.0	25.0	25.0
DO (mg/L)	7.9	7.8	7.8	7.8	8.1	7.4	8.0	6.6	7.9	7.4	7.9	7.4	7.7	6.7
pH	7.8	8.0	7.9	8.2	8.1	8.0	8.1	8.0	8.1	7.9	7.9	7.7	8.0	7.8
Cond. (µS/cm)	270	271		268		266		266		264		261		255
Initials	JB	JB		A		A		K		JB		JB		JB

Concentration 100	Days													
	0	1		2		3		4		5		6		7
	init.	old.	new	old.	new	old.	new	old.	new	old.	new	old.	new	final
Temperature (°C)	25.0	25.0	25.0	25.0	24.0	25.0	24.0	25.0	24.5	25.0	25.0	25.0	25.0	25.0
DO (mg/L)	8.1	7.7	7.8	7.5	8.1	7.4	8.0	7.0	7.9	7.4	7.9	8.1	8.1	6.5
pH	7.5	8.3	7.6	8.4	7.8	8.3	7.9	8.4	8.0	8.2	7.7	7.6	7.8	8.2
Cond. (µS/cm)	569	569		566		570		559		567		565		524
Initials	JB	JB		A		A		K		JB		JB		JB

Thermometer: 4 DO meter/probe: 1/1/1 pH meter/probe: 1/1/1 Conductivity meter/probe: 1/1/1

	Control	100%		
Hardness*	100	296		
Alkalinity*	98	248		

Analysts: JB, HD, KL

Reviewed by: JB

Date reviewed: Oct-29/18

Sample Description: Brown pale yellow, clear, odourless, no black particulates

Comments: Broodboard Used: 000925A & B (1, 2, 3, 5, 7-10, 14, 18, 19, 22, 23, 26, 30, 32-40)

Chronic Freshwater Toxicity Test C. dubia Reproduction Data

Client: ALB (MINTO)
Sample ID: W-3-123456 1235223-1 W-3
Work Order: 181673

Start Date & Time: Oct 04/18 @ 1400h
Stop Date & Time: Oct 11/18 @ 1500h
Set up by: KL/JS

Days	Concentration:										100% control										Concentration:										150										312									
	A	B	C	D	E	F	G	H	I	J	Init	A	B	C	D	E	F	G	H	I	J	Init	A	B	C	D	E	F	G	H	I	J	Init																	
1	/	/	/	/	/	/	/	/	/	/	JB	/	/	/	/	/	/	/	/	/	/	JB	/	/	/	/	/	/	/	/	/	/	JB																	
2	/	/	/	/	/	/	/	/	/	/	A	/	/	/	/	/	/	/	/	/	/	A	/	/	/	/	/	/	/	/	/	/	A																	
3	/	/	/	/	/	/	/	/	/	/	A	/	/	/	/	/	/	/	/	/	/	A	/	/	/	/	/	/	/	/	/	/	A																	
4	/	/	/	/	/	/	/	/	/	/	A	/	/	/	/	/	/	/	/	/	/	A	/	/	/	/	/	/	/	/	/	/	A																	
5	3	7	3	4	1	2	3	2	3	5	JB	3	5	5	2	3	1	2	5	3	4	JB	4	3	4	3	6	2	4	5	4	JB	JB																	
6	8	/	6	8	4	9	8	6	6	8	JB	8	8	X	6	6	/	9	7	8	JB	9	8	9	9	7	10	9	8	9	8	JB																		
7	10	/	10	8	9	9	9	7	8	8	1	9	10	4	9	2	2	10	7	9	5	9	9	10	10	7	8	10	10	9	10	JB																		
8																																																		
Total	21	14	17	21	12	14	16	16	17	15	W	20	19	24	4X	18	2	21	15	19	19	W	22	20	23	22	15	20	16	22	16	22	W																	

Days	Concentration: 6.25										Concentration: 12.5										Concentration: 25												
	A	B	C	D	E	F	G	H	I	J	Init	A	B	C	D	E	F	G	H	I	J	Init	A	B	C	D	E	F	G	H	I	J	Init
1	/	/	/	/	/	/	/	/	/	/	JB	/	/	/	/	/	/	/	/	/	/	JB	/	/	/	/	/	/	/	/	/	/	JB
2	/	/	/	/	/	/	/	/	/	/	A	/	/	/	/	/	/	/	/	/	/	A	/	/	/	/	/	/	/	/	/	/	A
3	/	/	/	/	/	/	/	/	/	/	A	/	/	/	/	/	/	/	/	/	/	A	/	/	/	/	/	/	/	/	/	/	A
4	/	/	/	/	/	/	/	/	/	/	A	/	/	/	/	/	/	/	/	/	/	A	/	/	/	/	/	/	/	/	/	/	A
5	3	2	3	2	2	5	4	3	6	4	JB	3	6	6	4	4	2	4	4	5	7	JB	4	5	/	5	4	3	3	5	3	JB	
6	8	8	9	8	9	12	9	9	/	6	JB	10	/	11	12	9	9	6	13	/	7	JB	10	/	3	9	9	6	/	9	9	JB	
7	11	11	10	8	10	11	10	12	10	8	A	10	10	11	9	10	8	11	9	13	13	A	11	11	11	11	8	10	9	7	9	10	A
8	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W
Total	22	21	20	18	21	19	24	24	18	18	W	22	18	19	25	23	23	18	28	16	20	W	25	18	8	16	21	22	18	10	16	22	W

Days	Concentration: 50										Concentration: 100										Concentration: 150												
	A	B	C	D	E	F	G	H	I	J	Init	A	B	C	D	E	F	G	H	I	J	Init	A	B	C	D	E	F	G	H	I	J	Init
1	/	/	/	/	/	/	/	/	/	/	JB	/	/	/	/	/	/	/	/	/	/	JB	/	/	/	/	/	/	/	/	/	/	JB
2	/	/	/	/	/	/	/	/	/	/	A	/	/	/	/	/	/	/	/	/	/	A	/	/	/	/	/	/	/	/	/	/	A
3	/	/	/	/	/	/	/	/	/	/	A	/	/	/	/	/	/	/	/	/	/	A	/	/	/	/	/	/	/	/	/	/	A
4	/	2	2	1	1	1	2	2	2	2	A	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	2	1	1	1	1	1
5	4	4	6	3	3	6	5	5	5	4	JB	2	X	4	3	4	4	4	4	5	3	JB											
6	10	9	1	1	10	1	12	11	8	9	JB	1	10	9	10	10	10	12	14	10	8	JB											
7	13	11	11	11	9	11								10	8	13	10																
8																																	
total	27	15	19	14	32	17	19	18	15	15	W	13	0X	24	20	27	24	18	28	17	21	W											

Notes: X = mortality.

Sample Description: see lab sheet
Comments: Total # Young only based on the first 3 Broods, Fourth and subsequent broods not included in total count.
Reviewed by: JS

Date reviewed: Oct 24/18

CETIS Analytical Report

Report Date: 02 Nov-18 18:41 (p 1 of 2)

Test Code/ID: 181673 / 02-3281-0147

Ceriodaphnia 7-d Survival and Reproduction Test

Nautilus Environmental

Analysis ID: 15-3289-3941	Endpoint: 7d Survival Rate	CETIS Version: CETISv1.9.4
Analyzed: 23 Oct-18 17:09	Analysis: Linear Interpolation (ICPIN)	Status Level: 1
Batch ID: 11-3243-4269	Test Type: Reproduction-Survival (7d)	Analyst: Kania Lywe
Start Date: 04 Oct-18 14:00	Protocol: EC/EPS 1/RM/21	Diluent: 20% Perrier Water
Ending Date: 11 Oct-18 15:00	Species: Ceriodaphnia dubia	Brine:
Test Length: 7d 1h	Taxon: Branchiopoda	Source: In-House Culture Age: <24
Sample ID: 00-9926-6391	Code: 5EAAF57	Project:
Sample Date: 02 Oct-18 08:35	Material: Water Sample	Source: ALS
Receipt Date: 04 Oct-18 13:30	CAS (PC):	Station: L2175227-1 W3
Sample Age: 53h (5 °C)	Client: ALS	

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	1180215	200	Yes	Two-Point Interpolation

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
EC5	66.03	50	n/a	1.514	n/a	2
EC10	100	61.35	n/a	1	n/a	1.63
EC15	>100	n/a	n/a	<1	n/a	n/a
EC20	>100	n/a	n/a	<1	n/a	n/a
EC25	>100	n/a	n/a	<1	n/a	n/a
EC40	>100	n/a	n/a	<1	n/a	n/a
EC50	>100	n/a	n/a	<1	n/a	n/a

7d Survival Rate Summary

Conc-%	Code	Count	Calculated Variate(A/B)							Isotonic Variate	
			Mean	Min	Max	Std Dev	CV%	%Effect	A/B	Mean	%Effect
0	N	10	1.0000	1.0000	1.0000	0.0000	0.00%	0.0%	10/10	1	0.0%
1.56		10	0.9000	0.0000	1.0000	0.3162	35.14%	10.0%	9/10	0.9833	1.67%
3.12		10	1.0000	1.0000	1.0000	0.0000	0.00%	0.0%	10/10	0.9833	1.67%
6.25		10	1.0000	1.0000	1.0000	0.0000	0.00%	0.0%	10/10	0.9833	1.67%
12.5		10	1.0000	1.0000	1.0000	0.0000	0.00%	0.0%	10/10	0.9833	1.67%
25		10	1.0000	1.0000	1.0000	0.0000	0.00%	0.0%	10/10	0.9833	1.67%
50		10	1.0000	1.0000	1.0000	0.0000	0.00%	0.0%	10/10	0.9833	1.67%
100		10	0.9000	0.0000	1.0000	0.3162	35.14%	10.0%	9/10	0.9	10.0%

7d Survival Rate Detail

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	N	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1.56		1.0000	1.0000	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
3.12		1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
6.25		1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
12.5		1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
25		1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
50		1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
100		1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

7d Survival Rate Binomials

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	N	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
1.56		1/1	1/1	1/1	0/1	1/1	1/1	1/1	1/1	1/1	1/1
3.12		1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
6.25		1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
12.5		1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
25		1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
50		1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
100		1/1	0/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1

CETIS Analytical Report

Report Date: 02 Nov-18 18:41 (p 2 of 2)
Test Code/ID: 181673 / 02-3281-0147

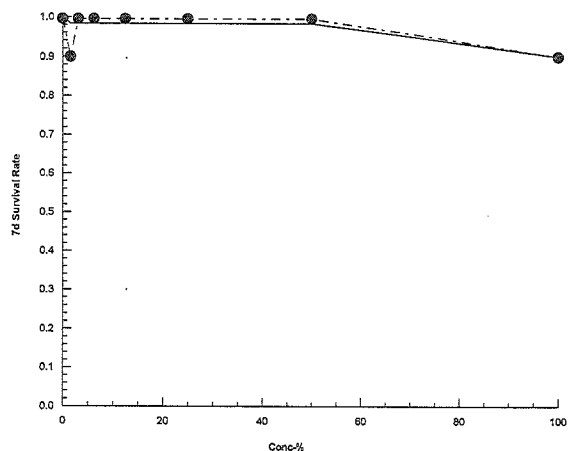
Ceriodaphnia 7-d Survival and Reproduction Test

Nautilus Environmental

Analysis ID: 15-3289-3941 Endpoint: 7d Survival Rate
Analyzed: 23 Oct-18 17:09 Analysis: Linear Interpolation (ICPIN)

CETIS Version: CETISv1.9.4
Status Level: 1

Graphics



CETIS Analytical Report

Report Date: 02 Nov-18 18:42 (p 1 of 2)
Test Code/ID: 181673 / 02-3281-0147

Ceriodaphnia 7-d Survival and Reproduction Test					Nautilus Environmental	
Analysis ID:	16-4050-3872	Endpoint:	Reproduction	CETIS Version:	CETISv1.9.4	
Analyzed:	23 Oct-18 17:10	Analysis:	Linear Interpolation (ICPIN)	Status Level:	1	
Batch ID:	11-3243-4269	Test Type:	Reproduction-Survival (7d)	Analyst:	Kania Lywe	
Start Date:	04 Oct-18 14:00	Protocol:	EC/EPS 1/RM/21	Diluent:	20% Perrier Water	
Ending Date:	11 Oct-18 15:00	Species:	Ceriodaphnia dubia	Brine:		
Test Length:	7d 1h	Taxon:	Branchiopoda	Source:	In-House Culture	Age: <24
Sample ID:	00-9926-6391	Code:	5EAAF57	Project:		
Sample Date:	02 Oct-18 08:35	Material:	Water Sample	Source:	ALS	
Receipt Date:	04 Oct-18 13:30	CAS (PC):		Station:	L2175227-1 W3	
Sample Age:	53h (5 °C)	Client:	ALS			

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	1803119	200	Yes	Two-Point Interpolation

Residual Analysis

Attribute	Method	Test Stat	Critical	P-Value	Decision(α:5%)
Control Trend	Mann-Kendall Trend Test		1.96	0.1032	Non-Significant Trend in Controls

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
IC5	>100	n/a	n/a	<1	n/a	n/a
IC10	>100	n/a	n/a	<1	n/a	n/a
IC15	>100	n/a	n/a	<1	n/a	n/a
IC20	>100	n/a	n/a	<1	n/a	n/a
IC25	>100	n/a	n/a	<1	n/a	n/a
IC40	>100	n/a	n/a	<1	n/a	n/a
IC50	>100	n/a	n/a	<1	n/a	n/a

Reproduction Summary

			Calculated Variate						Isotonic Variate	
Conc-%	Code	Count	Mean	Min	Max	Std Dev	CV%	%Effect	Mean	%Effect
0	N	10	16.8	12	21	2.898	17.25%	0.0%	18.82	0.0%
1.56		10	15.7	2	24	7.15	45.54%	6.55%	18.82	0.0%
3.12		10	19.8	15	23	3.011	15.21%	-17.86%	18.82	0.0%
6.25		10	20.6	18	24	2.221	10.78%	-22.62%	18.82	0.0%
12.5		10	21.2	16	28	3.676	17.34%	-26.19%	18.82	0.0%
25		10	17.6	8	25	5.379	30.56%	-4.76%	18.3	2.76%
50		10	18.1	14	27	3.985	22.01%	-7.74%	18.3	2.76%
100		10	19.2	0	28	8.176	42.58%	-14.29%	18.3	2.76%

Reproduction Detail

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	N	21	19	17	21	12	14	16	16	17	15
1.56		20	17	24	4	18	2	21	15	19	17
3.12		22	20	23	22	15	20	16	22	16	22
6.25		22	21	22	18	21	19	23	24	18	18
12.5		22	18	19	25	23	23	18	28	16	20
25		25	18	8	16	21	22	18	10	16	22
50		27	15	19	14	22	17	19	18	15	15
100		13	0	24	20	27	24	18	28	17	21

CETIS Analytical Report

Report Date: 02 Nov-18 18:42 (p 2 of 2)

Test Code/ID: 181673 / 02-3281-0147

Ceriodaphnia 7-d Survival and Reproduction Test

Nautilus Environmental

Analysis ID: 16-4050-3872

Endpoint: Reproduction

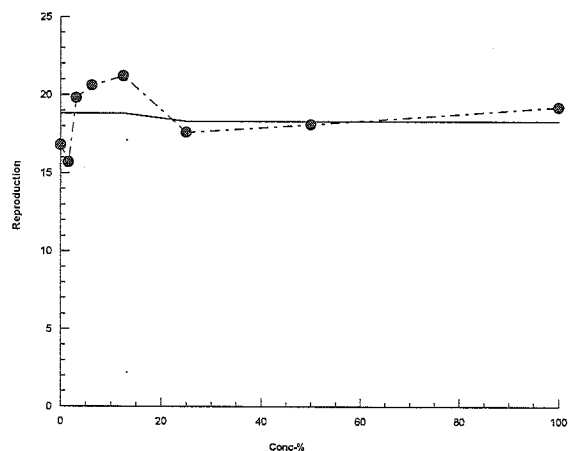
CETIS Version: CETISv1.9.4

Analyzed: 23 Oct-18 17:10

Analysis: Linear Interpolation (ICPIN)

Status Level: 1

Graphics



APPENDIX B – *Oncorhynchus mykiss* Toxicity Test Data

Rainbow Trout Early Life Stage Summary Sheet

Client: ALS

Start Date/Time: October 4, 2018 @ 1450h

Work Order No.: 181672

Test Species: Oncorhynchus mykiss

Sample Information:

Sample ID: L2175227-1 W3

Sample Date: October 2, 2018

Date Received: October 4, 2018

Sample Volume: 7 x 20 L

Dilution Water:

Type: Dechlorinated Tap Water

Hardness (mg/L CaCO₃): 12

Alkalinity (mg/L CaCO₃): 14

Test Organism Information:

Batch No.: 100418

Source: Lynden Fish Hatcheries, New Dundee, ON

Loading Density: 1.06 g/L

Number of male broodstock used: 4

Number of female broodstock used: 4

Sperm motility check: Verification of sperm motility using a compound microscope

SDS Reference Toxicant Results:

Reference Toxicant ID: RTE108

Stock Solution ID: 18502

Date Initiated: October 4, 2018

7-d EC50 (95% CL): 4.4 (4.2-4.6) mg/L SDS

Reference Toxicant Mean and Range: 4.2 (2.0-8.8) mg/L SDS

Reference Toxicant CV (%): 38

Test Results:

		Sample ID	
		L2175227-1 W3	
EC25 % (v/v) (95% CL)	>100		
EC50 % (v/v) (95% CL)	>100		

Reviewed by: JCH

Date reviewed: Oct-23/18

7-d Chronic Freshwater Toxicity Test **Initial and Final Water Quality Measurements**

Client: ALS
 Sample ID: L2175227-1 W3
 Work Order #: 181672

Start Date & Time: October 4, 2018 @ 1450h
 Stop Date & Time: October 11, 2018 @ 1115h
 CER #: 3
 Test Species: Oncorhynchus mykiss

Control Concentration (% v/v)	Days													
	0	1		2		3		4		5		6		7
	init.	new	old	new	old	new	old	new	old	new	old	new	old	final
Temperature (°C)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	13.5	14.0	14.0	14.0	14.0	14.0
DO (mg/L)	9.9	10.0	9.9	10.2	9.9	10.1	9.8	9.9	10.0	10.0	9.9	9.9	10.1	9.9
pH	7.1	6.9	7.0	7.1	7.0	7.0	6.9	7.1	7.0	7.1	7.1	7.2	7.2	7.3
Cond. (µS/cm)	38	39		38		39		39		39		39		39
Initials	UML	UML		A		A		UML		UML		UML		UML

6.25 Concentration	Days													
	0	1		2		3		4		5		6		7
	init.	new	old	new	old	new	old	new	old	new	old	new	old	final
Temperature (°C)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	13.5	14.0	14.0	14.0	14.0	14.0
DO (mg/L)	10.0	10.0	9.9	10.2	9.9	10.1	9.7	9.9	10.1	10.1	10.0	10.0	10.1	9.9
pH	7.1	7.1	7.1	7.2	7.1	7.1	7.1	7.1	7.2	7.2	7.3	7.3	7.4	7.45
Cond. (µS/cm)	77	79		76		78		73		76		79		78
Initials	UML	UML		A		A		UML		UML		UML		UML

25 Concentration	Days													
	0	1		2		3		4		5		6		7
	init.	new	old	new	old	new	old	new	old	new	old	new	old	final
Temperature (°C)	14.5	14.0	14.0	14.0	14.0	14.0	14.0	14.0	13.5	14.0	14.0	14.0	14.0	14.0
DO (mg/L)	10.0	10.0	10.0	10.2	9.8	10.2	9.8	10.0	10.1	10.1	10.0	10.0	10.1	10.0
pH	7.1	7.3	7.4	7.3	7.3	7.3	7.4	7.3	7.6	7.6	7.7	7.6	7.9	7.9
Cond. (µS/cm)	188	189		192		190		186		196		185		190
Initials	UML	UML		A		A		UML		UML		UML		UML

100 Concentration	Days													
	0	1		2		3		4		5		6		7
	init.	new	old	new	old	new	old	new	old	new	old	new	old	final
Temperature (°C)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	13.5	14.0	14.0	14.0	14.0	14.0
DO (mg/L)	10.3	10.1	10.0	10.3	9.9	10.2	9.8	10.0	10.1	10.2	10.0	9.9	10.1	10.0
pH	7.3	7.5	7.5	7.5	7.9	7.5	7.9	7.6	8.2	7.5	8.3	7.7	8.2	8.4
Cond. (µS/cm)	570	575		575		575		575		575		572		574
Initials	UML	UML		A		A		UML		UML		UML		UML

Thermometer: CER-3 DO meter/probe: 213 / 213 pH meter/probe: 213 / 213 Conductivity meter/probe: 213 / 213

	Control	100%		
Hardness*	12	296		
Alkalinity*	14	248		

Analysts: AWD, UML

Reviewed by: Joh

Date reviewed: Oct. 23/18

* mg/L as CaCO₃

Sample Description: clear, light yellow, no odour, some particulates

Comments:

Embryo Toxicity Test Daily Mortality

Client: ALS
 Sample ID: L2175227-1 W3
 Work Order #: 181672

Start Date & Time: October 4, 2018 @ 1450h
 Stop Date & Time: October 11, 2018 @ 1115h
 Test Species: Oncorhynchus mykiss

Concentration (% v/v)	Rep	Day of Test - No. of Mortalities							Total Dead Eggs	Total Undeveloped	Total No. Embryo	Total Exposed
		1	2	3	4	5	6	7				
Control	1	0	0	0	0	0	0	0	0	3	27	30
	2	1	1	1	1	1	1	0	0	0	30	30
	3	1	1	1	1	1	1	1	1	5	24	30
	4	1	1	1	1	1	1	1	1	1	28	30
6.25	1	1	1	1	1	1	1	0	0	1	29	30
	2	1	1	1	1	1	1	1	0	0	30	30
	3	1	1	1	1	1	1	1	0	3	27	30
	4	1	1	1	1	1	1	1	0	2	28	30
12.5	1	1	1	1	1	1	1	1	0	0	30	30
	2	1	1	1	1	1	1	1	1	0	28	29
	3	1	1	1	1	1	1	0	0	5	25	30
	4	1	1	1	1	1	1	1	2	0	28	30
25	1	1	1	1	1	1	1	0	0	1	29	30
	2	1	1	1	1	1	1	0	0	1	29	30
	3	1	1	1	1	1	1	3	3	3	24	30
	4	1	1	1	1	1	1	0	1	2	27	30
50	1	1	1	1	0	1	1	0	0	2	28	30
	2	1	1	1	1	1	1	1	2	0	28	30
	3	1	1	1	0	1	1	2	2	3	25	30
	4	1	1	1	0	1	1	0	1	2	28	31
100	1	1	1	1	0	1	1	0	0	1	29	30
	2	1	1	1	0	1	1	2	2	0	28	30
	3	1	1	1	1	1	1	4	6	1	23	30
	4	1	1	1	0	1	1	1	2	2	26	30
	1											
	2											
	3											
	4											
	1											
	2											
	3											
	4											
Tech Initials		mm	a	~	mm	mm	mm	mm	mm	mm	mm	mm

Comments:

Reviewed by:

John

Date reviewed:

Oct. 23/18

CETIS Analytical Report

Report Date: 23 Oct-18 09:01 (p 1 of 2)

Test Code/ID: 181672 / 01-0182-5393

Salmonid Embryo Survival and Development Test

Nautilus Environmental

Analysis ID: 08-3146-9398	Endpoint: Proportion Normal	CETIS Version: CETISv1.9.4
Analyzed: 23 Oct-18 9:01	Analysis: Linear Interpolation (ICPIN)	Status Level: 1
Batch ID: 21-3271-3291	Test Type: Development	Analyst: Yvonne Lam
Start Date: 04 Oct-18 14:50	Protocol: EC/EPS 1/RM/28	Diluent: Dechlorinated Tap Water
Ending Date: 11 Oct-18 11:15	Species: Oncorhynchus mykiss	Brine:
Test Length: 6d 20h	Taxon: Actinopterygii	Source: Lyndon Fish Hatcheries Age:
Sample ID: 00-9926-6391	Code: 5EAAF57	Project:
Sample Date: 02 Oct-18 08:35	Material: Water Sample	Source: ALS
Receipt Date: 04 Oct-18 13:30	CAS (PC):	Station: L2175227-1 W3
Sample Age: 54h (5 °C)	Client: ALS	

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	2095694	200	Yes	Two-Point Interpolation

Residual Analysis

Attribute	Method	Test Stat	Critical	P-Value	Decision(α:5%)
Control Trend	Mann-Kendall Trend Test			1.0000	Non-Significant Trend in Controls

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
EC5	97.98	n/a	n/a	1.021	n/a	n/a
EC10	>100	n/a	n/a	<1	n/a	n/a
EC15	>100	n/a	n/a	<1	n/a	n/a
EC20	>100	n/a	n/a	<1	n/a	n/a
EC25	>100	n/a	n/a	<1	n/a	n/a
EC40	>100	n/a	n/a	<1	n/a	n/a
EC50	>100	n/a	n/a	<1	n/a	n/a

Proportion Normal Summary

Proportion Normal Summary			Calculated Variate(A/B)							Isotonic Variate	
Conc-%	Code	Count	Mean	Min	Max	Std Dev	CV%	%Effect	A/B	Mean	%Effect
0	N	4	0.9083	0.8000	1.0000	0.0833	9.17%	0.0%	109/120	0.9305	0.0%
6.25		4	0.9500	0.9000	1.0000	0.0430	4.53%	-4.59%	114/120	0.9305	0.0%
12.5		4	0.9330	0.8333	1.0000	0.0718	7.70%	-2.72%	111/119	0.9305	0.0%
25		4	0.9083	0.8000	0.9667	0.0788	8.67%	0.0%	109/120	0.9083	2.38%
50		4	0.9008	0.8333	0.9333	0.0472	5.24%	0.83%	109/121	0.9008	3.19%
100		4	0.8833	0.7667	0.9667	0.0882	9.98%	2.75%	106/120	0.8833	5.07%

Proportion Normal Detail

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4
0	N	0.9000	1.0000	0.8000	0.9333
6.25		0.9667	1.0000	0.9000	0.9333
12.5		1.0000	0.9655	0.8333	0.9333
25		0.9667	0.9667	0.8000	0.9000
50		0.9333	0.9333	0.8333	0.9032
100		0.9667	0.9333	0.7667	0.8667

Proportion Normal Binomials

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4
0	N	27/30	30/30	24/30	28/30
6.25		29/30	30/30	27/30	28/30
12.5		30/30	28/29	25/30	28/30
25		29/30	29/30	24/30	27/30
50		28/30	28/30	25/30	28/31
100		29/30	28/30	23/30	26/30

CETIS Analytical Report

Report Date: 23 Oct-18 09:01 (p 2 of 2)
Test Code/ID: 181672 / 01-0182-5393

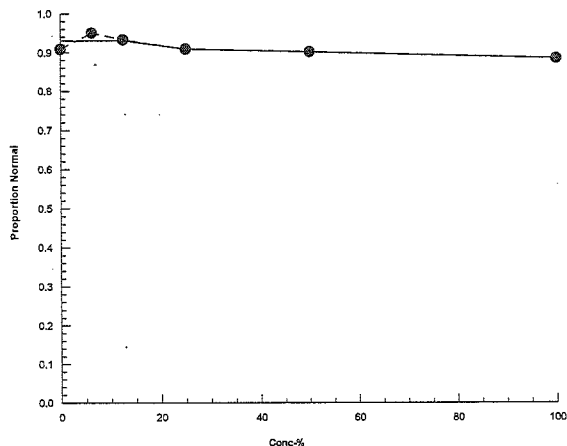
Salmonid Embryo Survival and Development Test

Nautilus Environmental

Analysis ID: 08-3146-9398 Endpoint: Proportion Normal
Analyzed: 23 Oct-18 9:01 Analysis: Linear Interpolation (ICPIN)

CETIS Version: CETISv1.9.4
Status Level: 1

Graphics



APPENDIX C – *Lemna minor* Toxicity Test Data

Lemna minor Summary Sheet

Client: ALS (minto)
Work Order No.: 181

Start Date: Oct 4/18
Set up by: MLJ

Sample Information:

Sample ID: L2175227-1 W3
Sample Date: Oct 2/18
Date Received: Oct 4/18
Sample Volume: 7X20L, 3X1L

Test Organism Information:

Culture Date: 092718
Age of culture (Day 0): 7 days
>8X growth in APHA?: Y (35 Fronds)

KCI Reference Toxicant Results:

Reference Toxicant ID: Lm164
Date Initiated: Sept 21/18

7-d No. of Fronds IC50 (95% CL): ^{MLJ}
3.6 (3.0 - 4.2) g/L KCl
3.5 (2.9 - 4.3)

7-d No. Fronds IC50 Reference Toxicant Mean (2 SD Range): 3.5 (2.9 - 4.2) CV (%): 10
g/L KCl

Test Results:	Number of Fronds		Dry Weight	
	IC25 %(v/v) (95% CL)	797	797	797
	IC50 %(v/v) (95% CL)	797	797	797

Reviewed by: 

Date reviewed: Nov. 15, 2018

Plant Growth Inhibition Toxicity Test Water Quality Measurements

Client : ALS (mint) Setup by: MLJ
 Sample ID: L2175227-1 W3 Test Date: Oct 4/18
 Work Order No.: 181674 CER #: 1
 Culture Source: CPEC #490 Test Species: Lemna minor
 Test Culture Age: 7 days > 8X Growth? (Y/N): y (25 Fronds)
 Light Intensity Range: 4600-5100 lux Date Measured: Oct 4/18

Day	0	1	2	3	4	5	6	7
Shelf Temp (°C)	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Initials	MLJ	MLJ	MLJ	MLJ	MLJ	MLJ	MLJ	MLJ

Sample Characteristics: Initial Water Quality Adjusted Water Quality
 Temperature (°C) 25.0 Aeration?: 20 min 25.0
 DO (mg/L) 8.3 Nutrients added?¹: y 8.0
 pH 7.5 8.0
 Conductivity (µS) 585 1352

¹ 10 mL of each APHA stock (A,B and C) added to 970 mL sample.

Concentration % (v/v)	Temperature (°C)		pH		Conductivity (µS)
	Day 0	Day 7	Day 0	Day 7	0 h
Control	25.0	25.0	8.3	8.8	885
1.5	25.0	25.0	8.3	8.8	899
3	25.0	25.0	8.3	8.8	902
MLJ 36.1	25.0	25.0	8.2	8.7	918
12.1	25.0	25.0	8.2	8.9	950
24.2	25.0	25.0	8.1	9.1	1010
48.5	25.0	25.0	8.0	8.9	1125 1124
97	25.0	25.0	8.0	8.9	1352
Initials	JB	MLJ	JB	MLJ	JB

Thermometer: 4 Light meter: 1 pH meter/probe: 1,1 DO meter/probe: 1,1 Conductivity meter/probe: 1,1

Sample Description: pale yellow, clear, colourless, black particulates

Comments: _____

Reviewed: MLJ

Date Reviewed: NN-14, 2018

Lemma minor Toxicity Test Data Sheet - 7-d Frond Counts

Client: ALs (mnpb)
 Sample ID: L2175227-1 W3
 Work Order #: 181674

Start Date: Oct 4/18
 Termination Date: Oct 11/18
 Test set up by: WJ

Concentration	Rep	No. of fronds		Chlorosis	Necrosis	Yellow	Abnormal size	Gibbosity	Single fronds	Root destruction	Loss of buoyancy	Comments	Initials
		Day 0	Day 7										
control	A	6	74										WJ
	B	6	78										
	C	6	71										
	D	6	80										
1.5	A	6	81										
	B	6	110										
	C	6	70										
	D	6	87										
3	A	6	82										
	B	6	73										
	C	6	79										
	D	6	111										
6.1	A	6	66										
	B	6	92										
	C	6	76										
	D	6	98										
12.1	A	6	78										
	B	6	86										
	C	6	89										
	D	6	88										
24.2	A	6	99										
	B	6	105										
	C	6	110										
	D	6	113										

Comments:

Reviewed by: WJ

Date Reviewed: Nov. 14, 2018

Lemma minor Toxicity Test Data Sheet - 7-d Frond Counts

Client: ALC(minh)
 Sample ID: 12175227-1 113
 Work Order #: 181674

Start Date: Oct 4/18
 Termination Date: Oct 11/18
 Test set up by: MLG

Concentration (% v/v)	Rep	No. of fronds		Chlorosis	Necrosis	Yellow	Abnormal size	Gibbosity	Single fronds	Root destruction	Loss of buoyancy	Comments	Initials
		Day 0	Day 7										
48.5	A	6	106										MLG
	B	6	109										
	C	6	109										
	D	6	124										
97	A	6	79										MLG
	B	6	89										
	C	6	58										
	D	6	89										
	A												
	B												
	C												
	D												
	A												
	B												
	C												
	D												
	A												
	B												
	C												
	D												
	A												
	B												
	C												
	D												

Comments:

Reviewed by: MLG

Date Reviewed:

Nov. 14, 2018

7-d Lemna minor Weight Data Sheet

Client:

Sample ID:

WO #:

0.6 (v/v)

ALS (Minto)

L2175227-1 W3

181674

purple - E

Start Date:

Oct 4/18

Termination Date:

Oct 11/18

Balance ID:

Bal - 1

Concentration	Rep	Pan No.	Pan weight (mg)	Pan + plant (mg)	Initials
control	A	1	1154.38	1160.03	JW
	B	2	1137.95	1144.30	
	C	3	1125.27	1130.77	
	D	4	1140.30	1146.12	
1.5	A	5	1146.42	1151.99	
	B	6	1136.65	1144.51	
	C	7	1129.77	1135.70	
	D	8	1138.80	1145.15	
3	A	9	1139.17	1144.93	
	B	10	1124.83	1130.39	
	C	11	1137.01	1143.19	
	D	12	1132.65	1140.74	
6.1	A	13	1138.49	1144.40	
	B	14	1125.53	1131.51	
	C	15	1123.09	1128.85	
	D	16	1123.16	1131.18	
12.1	A	17	1143.26	1149.48	
	B	18	1127.71	1134.01	
	C	19	1143.91	1150.39	
	D	20	1147.65	1154.21	
24.2	A	21	1142.11 1141.81	1149.23	
	B	22	1129.11	1136.45	
	C	23	1137.22	1144.58	
	D	24	1142.40	1150.75	
48.5	A	25	1145.32 1130.61	1138.87	
	B	26	1149.36 1145.32	1153.34	
	C	27	1119.35	1127.66	
	D	28	1125.46	1135.01	

Comments:

10% reweigh (mg): #7 - 1135.20

#24 - 1150.14

#16 - 1130.23

#30 - 1156.16

Reviewed by:

[Signature]

Date Reviewed:

11-14-2018

7-d Lemna minor Weight Data Sheet

Client:

Sample ID:

WO #:

o/v/v

ALS (mint)

L2175227-1 W3

181674

purple-E

Start Date:

Oct 4/18

Termination Date:

Oct 11/18

Balance ID:

Bal - 1

Concentration	Rep	Pan No.	Pan weight (mg)	Pan + plant (mg)	Initials
97	A	29	1150.39	1157.15	gan
	B	30	1149.61	1156.63	↓
	C	31	1139.50	1144.79	↓
	D	32	1123.97	1131.05	↓
	A				
	B				
	C				
	D				
	A				
	B				
	C				
	D				
	A				
	B				
	C				
	D				
	A				
	B				
	C				
	D				
	A				
	B				
	C				
	D				

Comments:

Reviewed by:

EW

Date Reviewed:

NN-14, 2018

CETIS Analytical Report

Report Date: 09 Nov-18 17:47 (p 1 of 2)
Test Code/ID: 181674 / 16-3568-5362

Lemna Growth Inhibition Test

Nautilus Environmental

Analysis ID: 03-9036-5693	Endpoint: Frond Count	CETIS Version: CETISv1.9.4
Analyzed: 09 Nov-18 17:46	Analysis: Linear Interpolation (ICPIN)	Status Level: 1
Batch ID: 05-8270-6827	Test Type: Lemna Growth	Analyst: Mimi Tran
Start Date: 04 Oct-18	Protocol: EC/EPS 1/RM/37	Diluent: Modified APHA
Ending Date: 11 Oct-18	Species: Lemna minor	Brine:
Test Length: 7d 0h	Taxon: Tracheophyta	Source: CPCC#490
		Age: 7d
Sample ID: 00-9926-6391	Code: 5EAAF57	Project:
Sample Date: 02 Oct-18 08:35	Material: Water Sample	Source: ALS
Receipt Date: 04 Oct-18 13:30	CAS (PC):	Station: L2175227-1 W3
Sample Age: 39h (5 °C)	Client: ALS	

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	1211040	200	Yes	Two-Point Interpolation

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
IC5	61.89	50.8	n/a	1.616	n/a	1.969
IC10	78.89	52.27	n/a	1.268	n/a	1.913
IC15	>97	n/a	n/a	<1.031	n/a	n/a
IC20	>97	n/a	n/a	<1.031	n/a	n/a
IC25	>97	n/a	n/a	<1.031	n/a	n/a
IC40	>97	n/a	n/a	<1.031	n/a	n/a
IC50	>97	n/a	n/a	<1.031	n/a	n/a

Frond Count Summary

Conc-%	Code	Count	Calculated Variate						Isotonic Variate	
			Mean	Min	Max	Std Dev	CV%	%Effect	Mean	%Effect
0	N	4	69.75	65	74	4.031	5.78%	0.0%	84.86	0.0%
1.5		4	81	64	104	16.87	20.83%	-16.13%	84.86	0.0%
3		4	80.25	67	105	16.92	21.08%	-15.05%	84.86	0.0%
6.1		4	77	60	92	14.65	19.03%	-10.39%	84.86	0.0%
12.1		4	79.25	72	83	4.992	6.30%	-13.62%	84.86	0.0%
24.2		4	100.8	93	107	6.131	6.09%	-44.44%	84.86	0.0%
48.5		4	106	100	118	8.124	7.66%	-51.97%	84.86	0.0%
97		4	72.75	52	83	14.61	20.09%	-4.3%	72.75	14.27%

Frond Count Detail

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4
0	N	68	72	65	74
1.5		75	104	64	81
3		76	67	73	105
6.1		60	86	70	92
12.1		72	80	83	82
24.2		93	99	104	107
48.5		100	103	103	118
97		73	83	52	83

CETIS Analytical Report

Report Date: 09 Nov-18 17:47 (p 2 of 2)
Test Code/ID: 181674 / 16-3568-5362

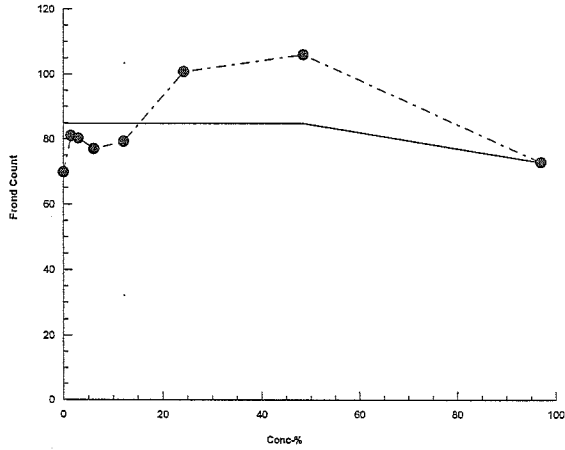
Lemna Growth Inhibition Test

Nautilus Environmental

Analysis ID: 03-9036-5693 Endpoint: Frond Count
Analyzed: 09 Nov-18 17:46 Analysis: Linear Interpolation (ICPIN)

CETIS Version: CETISv1.9.4
Status Level: 1

Graphics



CETIS Analytical Report

Report Date: 09 Nov-18 17:47 (p 1 of 2)
Test Code/ID: 181674 / 16-3568-5362

Lemna Growth Inhibition Test				Nautilus Environmental	
Analysis ID:	03-2457-1961	Endpoint:	Total Dry Weight-mg	CETIS Version:	CETISv1.9.4
Analyzed:	09 Nov-18 17:47	Analysis:	Linear Interpolation (ICPIN)	Status Level:	1
Batch ID:	05-8270-6827	Test Type:	Lemna Growth	Analyst:	Mimi Tran
Start Date:	04 Oct-18	Protocol:	EC/EPS 1/RM/37	Diluent:	Modified APHA
Ending Date:	11 Oct-18	Species:	Lemna minor	Brine:	
Test Length:	7d 0h	Taxon:	Tracheophyta	Source:	CPCC#490
Sample ID:	00-9926-6391	Code:	5EAAF57	Project:	
Sample Date:	02 Oct-18 08:35	Material:	Water Sample	Source:	ALS
Receipt Date:	04 Oct-18 13:30	CAS (PC):		Station:	L2175227-1 W3
Sample Age:	39h (5 °C)	Client:	ALS		

Linear Interpolation Options					
X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	1154959	200	Yes	Two-Point Interpolation

Point Estimates						
Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
IC5	>97	n/a	n/a	<1.031	n/a	n/a
IC10	>97	n/a	n/a	<1.031	n/a	n/a
IC15	>97	n/a	n/a	<1.031	n/a	n/a
IC20	>97	n/a	n/a	<1.031	n/a	n/a
IC25	>97	n/a	n/a	<1.031	n/a	n/a
IC40	>97	n/a	n/a	<1.031	n/a	n/a
IC50	>97	n/a	n/a	<1.031	n/a	n/a

Total Dry Weight-mg Summary			Calculated Variate						Isotonic Variate	
Conc-%	Code	Count	Mean	Min	Max	Std Dev	CV%	%Effect	Mean	%Effect
0	N	4	5.83	5.5	6.35	0.3705	6.36%	0.0%	6.802	0.0%
1.5		4	6.427	5.57	7.86	1.007	15.66%	-10.25%	6.802	0.0%
3		4	6.397	5.56	8.09	1.158	18.09%	-9.73%	6.802	0.0%
6.1		4	6.418	5.76	8.02	1.072	16.71%	-10.08%	6.802	0.0%
12.1		4	6.39	6.22	6.56	0.157	2.46%	-9.61%	6.802	0.0%
24.2		4	7.617	7.34	8.35	0.4895	6.43%	-30.66%	6.802	0.0%
48.5		4	8.535	8.02	9.55	0.6884	8.07%	-46.4%	6.802	0.0%
97		4	6.538	5.29	7.08	0.8432	12.90%	-12.14%	6.538	3.89%

Total Dry Weight-mg Detail					
Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4
0	N	5.65	6.35	5.5	5.82
1.5		5.57	7.86	5.93	6.35
3		5.76	5.56	6.18	8.09
6.1		5.91	5.98	5.76	8.02
12.1		6.22	6.3	6.48	6.56
24.2		7.42	7.34	7.36	8.35
48.5		8.26	8.02	8.31	9.55
97		6.76	7.02	5.29	7.08

CETIS Analytical Report

Report Date: 09 Nov-18 17:47 (p 2 of 2)
Test Code/ID: 181674 / 16-3568-5362

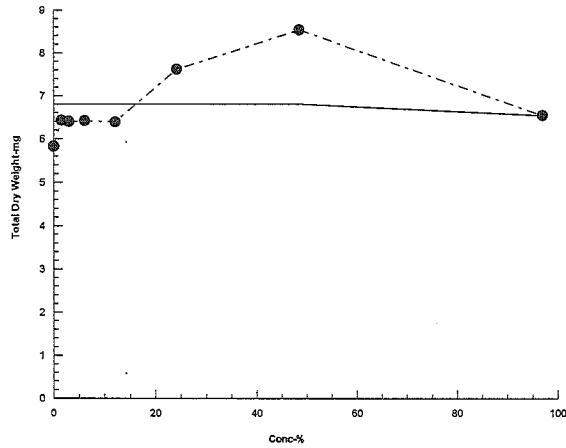
Lemna Growth Inhibition Test

Nautilus Environmental

Analysis ID: 03-2457-1961 Endpoint: Total Dry Weight-mg
Analyzed: 09 Nov-18 17:47 Analysis: Linear Interpolation (ICPIN)

CETIS Version: CETISv1.9.4
Status Level: 1

Graphics



CETIS Analytical Report

Report Date: 09 Nov-18 17:50 (p 1 of 2)
 Test Code/ID: 181674 / 16-3568-5362

Lemna Growth Inhibition Test

Nautilus Environmental

Analysis ID: 09-4497-2304	Endpoint: Frond Count	CETIS Version: CETISv1.9.4
Analyzed: 09 Nov-18 17:50	Analysis: Parametric-Control vs Treatments	Status Level: 1
Batch ID: 05-8270-6827	Test Type: Lemna Growth	Analyst: Mimi Tran
Start Date: 04 Oct-18	Protocol: EC/EPS 1/RM/37	Diluent: Modified APHA
Ending Date: 11 Oct-18	Species: Lemna minor	Brine:
Test Length: 7d 0h	Taxon: Tracheophyta	Source: CPCC#490 Age: 7d
Sample ID: 00-9926-6391	Code: 5EAAF57	Project:
Sample Date: 02 Oct-18 08:35	Material: Water Sample	Source: ALS
Receipt Date: 04 Oct-18 13:30	CAS (PC):	Station: L2175227-1 W3
Sample Age: 39h (5 °C)	Client: ALS	

Data Transform	Alt Hyp	NOEL	LOEL	TOEL	TU	PMSD
Untransformed	C < T	97	>97	n/a	1.031	30.09%

Dunnett Multiple Comparison Test

Control	vs	Conc-%	Test Stat	Critical	MSD	DF	P-Type	P-Value	Decision(α:5%)
Negative Control		1.5	1.331	2.482	20.99	6	CDF	0.3341	Non-Significant Effect
		3	1.242	2.482	20.99	6	CDF	0.3716	Non-Significant Effect
		6.1	0.8574	2.482	20.99	6	CDF	0.5476	Non-Significant Effect
		12.1	1.124	2.482	20.99	6	CDF	0.4240	Non-Significant Effect
		24.2*	3.666	2.482	20.99	6	CDF	0.0035	Significant Effect
		48.5*	4.287	2.482	20.99	6	CDF	7.7E-04	Significant Effect
		97	0.3548	2.482	20.99	6	CDF	0.7645	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	4741.47	677.353	7	4.737	0.0019	Significant Effect
Error	3431.75	142.99	24			
Total	8173.22		31			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance Test	10.24	18.48	0.1752	Equal Variances
Distribution	Shapiro-Wilk W Normality Test	0.974	0.9081	0.6164	Normal Distribution

Frond Count Summary

Conc-%	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	N	4	69.75	63.34	76.16	70	65	74	2.016	5.78%	0.00%
1.5		4	81	54.15	107.8	78	64	104	8.436	20.83%	-16.13%
3		4	80.25	53.33	107.2	74.5	67	105	8.459	21.08%	-15.05%
6.1		4	77	53.69	100.3	78	60	92	7.326	19.03%	-10.39%
12.1		4	79.25	71.31	87.19	81	72	83	2.496	6.30%	-13.62%
24.2		4	100.8	90.99	110.5	101.5	93	107	3.065	6.08%	-44.44%
48.5		4	106	93.07	118.9	103	100	118	4.062	7.66%	-51.97%
97		4	72.75	49.5	96	78	52	83	7.307	20.09%	-4.30%

Frond Count Detail

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4
0	N	68	72	65	74
1.5		75	104	64	81
3		76	67	73	105
6.1		60	86	70	92
12.1		72	80	83	82
24.2		93	99	104	107
48.5		100	103	103	118
97		73	83	52	83

CETIS Analytical Report

Report Date: 09 Nov-18 17:50 (p 2 of 2)
Test Code/ID: 181674 / 16-3568-5362

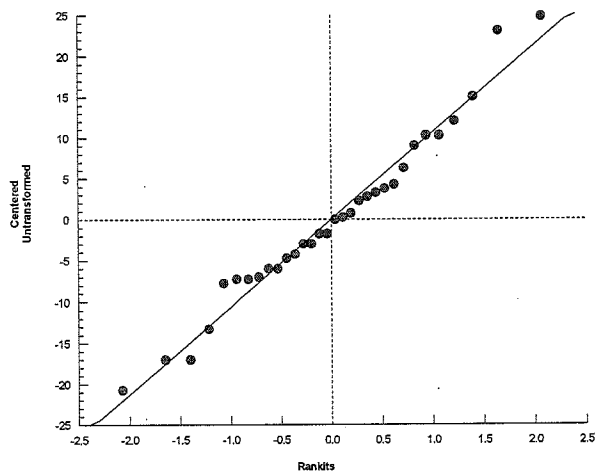
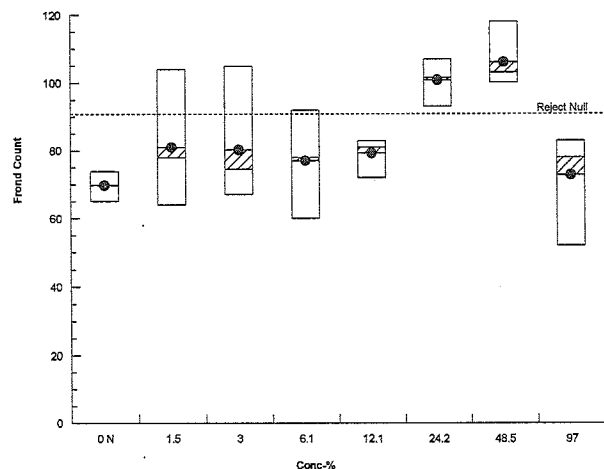
Lemna Growth Inhibition Test

Nautilus Environmental

Analysis ID: 09-4497-2304 Endpoint: Frond Count
Analyzed: 09 Nov-18 17:50 Analysis: Parametric-Control vs Treatments

CETIS Version: CETISv1.9.4
Status Level: 1

Graphics



CETIS Analytical Report

 Report Date: 09 Nov-18 17:50 (p 1 of 2)
 Test Code/ID: 181674 / 16-3568-5362

Lemna Growth Inhibition Test

Nautilus Environmental

Analysis ID: 00-9425-8105	Endpoint: Total Dry Weight-mg	CETIS Version: CETISv1.9.4
Analyzed: 09 Nov-18 17:50	Analysis: Parametric-Control vs Treatments	Status Level: 1
Batch ID: 05-8270-6827	Test Type: Lemna Growth	Analyst: Mimi Tran
Start Date: 04 Oct-18	Protocol: EC/EPS 1/RM/37	Diluent: Modified APHA
Ending Date: 11 Oct-18	Species: Lemna minor	Brine:
Test Length: 7d 0h	Taxon: Tracheophyta	Source: CPCC#490 Age: 7d
Sample ID: 00-9926-6391	Code: 5EAAF57	Project:
Sample Date: 02 Oct-18 08:35	Material: Water Sample	Source: ALS
Receipt Date: 04 Oct-18 13:30	CAS (PC):	Station: L2175227-1 W3
Sample Age: 39h (5 °C)	Client: ALS	

Data Transform	Alt Hyp	NOEL	LOEL	TOEL	TU	PMSD
Untransformed	C < T	97	>97	n/a	1.031	24.01%

Dunnnett Multiple Comparison Test

Control	vs	Conc-%	Test Stat	Critical	MSD	DF	P-Type	P-Value	Decision(α:5%)
Negative Control		1.5	1.059	2.482	1.4	6	CDF	0.4534	Non-Significant Effect
		3	1.006	2.482	1.4	6	CDF	0.4780	Non-Significant Effect
		6.1	1.042	2.482	1.4	6	CDF	0.4616	Non-Significant Effect
		12.1	0.9928	2.482	1.4	6	CDF	0.4842	Non-Significant Effect
		24.2*	3.169	2.482	1.4	6	CDF	0.0114	Significant Effect
		48.5*	4.796	2.482	1.4	6	CDF	2.2E-04	Significant Effect
		97	1.254	2.482	1.4	6	CDF	0.3662	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	21.1836	3.02623	7	4.757	0.0018	Significant Effect
Error	15.2692	0.636216	24			
Total	36.4528		31			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance Test	11.04	18.48	0.1367	Equal Variances
Distribution	Shapiro-Wilk W Normality Test	0.9197	0.9081	0.0204	Normal Distribution

Total Dry Weight-mg Summary

Conc-%	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	N	4	5.83	5.24	6.42	5.735	5.5	6.35	0.1853	6.36%	0.00%
1.5		4	6.427	4.825	8.03	6.14	5.57	7.86	0.5034	15.66%	-10.25%
3		4	6.397	4.556	8.239	5.97	5.56	8.09	0.5788	18.09%	-9.73%
6.1		4	6.418	4.711	8.124	5.945	5.76	8.02	0.5361	16.71%	-10.08%
12.1		4	6.39	6.14	6.64	6.39	6.22	6.56	0.07852	2.46%	-9.60%
24.2		4	7.617	6.839	8.396	7.39	7.34	8.35	0.2448	6.43%	-30.66%
48.5		4	8.535	7.44	9.63	8.285	8.02	9.55	0.3442	8.07%	-46.40%
97		4	6.538	5.196	7.879	6.89	5.29	7.08	0.4216	12.90%	-12.14%

Total Dry Weight-mg Detail

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4
0	N	5.65	6.35	5.5	5.82
1.5		5.57	7.86	5.93	6.35
3		5.76	5.56	6.18	8.09
6.1		5.91	5.98	5.76	8.02
12.1		6.22	6.3	6.48	6.56
24.2		7.42	7.34	7.36	8.35
48.5		8.26	8.02	8.31	9.55
97		6.76	7.02	5.29	7.08

11/14/18

CETIS Analytical Report

Report Date: 09 Nov-18 17:50 (p 2 of 2)
Test Code/ID: 181674 / 16-3568-5362

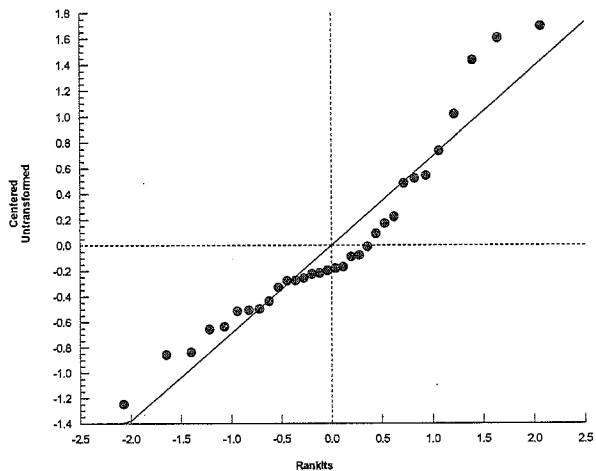
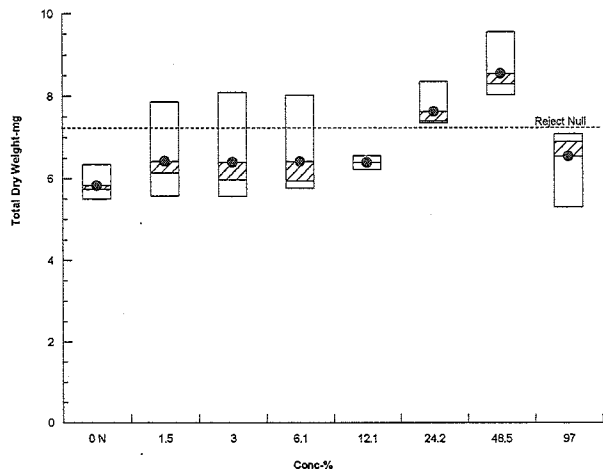
Lemna Growth Inhibition Test

Nautilus Environmental

Analysis ID: 00-9425-8105 Endpoint: Total Dry Weight-mg
Analyzed: 09 Nov-18 17:50 Analysis: Parametric-Control vs Treatments

CETIS Version: CETISv1.9.4
Status Level: 1

Graphics



APPENDIX D – *Pseudokirchneriella subcapitata* Toxicity Test Data

***Pseudokirchneriella subcapitata* Summary Sheet**

Client: ALS (mint)
Work Order No.: 181675

Start Date: Oct 5/18
Set up by: ML

Sample Information:

Sample ID: L2175227-1 W3
Sample Date: Oct 2/18
Date Received: Oct 4/18
Sample Volume: 7x20L, 3x1L

Test Organism Information:

Culture Date: Sept 28/18
Age of culture (Day 0): 7d

Zinc Reference Toxicant Results:

Reference Toxicant ID: SC174
Stock Solution ID: 18Zn05
Date Initiated: Sept 21/18

72-h IC50 (95% CL): 29.1(21.9-33.8) µg/L Zn

72-h IC50 Reference Toxicant Mean and Range: 31.2(25.9-37.7) µg/L Zn CV (%): 9

Test Results:

	Algal Growth
IC25 %(v/v) (95% CL)	<u>795.0</u>
IC50 %(v/v) (95% CL)	<u>795.0</u>

Reviewed by: 

Date reviewed: Nov 14, 2018

72-h Algal Growth Inhibition Toxicity Test Water Quality Measurements

Client : ALB (Minto) Setup by: MLT
 Sample ID: L2195227-1 W3 Test Date/Time: Oct 5/18 @ 0700h
 Work Order No.: 181675 CER #: 4
 Test Species: Pseudokirchneriella subcapitata
 Culture Date: Sept 28/18 Age of Culture: 7d Culture Health: Good
 Culture Count: 1 400 2 420 Average: 410 Culture Cell Density (c1): 410 x 10⁴ cells/mL

$$v1 = \frac{220,000 \text{ cells/mL} \times 10^5 \text{ mL}}{(c1) \quad 410 \times 10^4 \quad \text{cells/mL}} = 5.37 \text{ mL}$$

Time Zero Counts: 1 23 2 21 Average: 22

No. of Cells/mL: 22 x 10⁴ Initial Density: # cells/mL + 220 µL x 10 µL = 10000 cells/mL

Concentration %(v/v)	Water Quality		Incubator Temperature				Microplates rotated 2X per day?			
	pH	Temp (°C)	(°C)							
	0 h	0 h	0 h	24 h	48 h	72 h	0 h	24 h	48 h	72 h
Control	6.9	23.0	25.0	26.0	26.0	25.0	✓	✓	✓	✓
1.5	6.9	23.0	✓	✓	✓	✓	✓	✓	✓	✓
3	6.9	23.0	✓	✓	✓	✓	✓	✓	✓	✓
6	6.9	23.0	✓	✓	✓	✓	✓	✓	✓	✓
11.9	7.2	23.0	✓	✓	✓	✓	✓	✓	✓	✓
23.8	7.5	23.0	✓	✓	✓	✓	✓	✓	✓	✓
47.6	7.9	23.0	✓	✓	✓	✓	✓	✓	✓	✓
95.2	8.0	23.0	✓	✓	✓	✓	✓	✓	✓	✓
Initials	MLT	MLT	MLT	MLT	MLT	MLT	MLT	MLT	MLT	MLT

Initial control pH: Well 1: 6.9 Well 2: 6.9

Final control pH: Well 1: 7.0 Well 2: 7.0

Light intensity (lux): 4030 Date measured: Oct 5/18

Thermometer: 4 Light meter: 1 pH meter/probe: 1.1

Sample Description: pale yellow, clear, no clots, black particulates

Comments: _____

Reviewed: MLT Date reviewed: Nov 14, 2018

***Pseudokirchneriella subcapitata* Toxicity Test Data Sheet**
72-h Algal Cell Counts

Client: ALS (minto) Start Date/Time: Oct 5/18 @ 0700h
 Work Order #: 181675 Termination Date: Oct 8/18 @ 0700h
 Sample ID: L2175227-1 W3 Test set up by: MLG
 % (v/v)

Concentration	Rep	Count 1	Count 2	Count 3	Count 4	Comments	Initials
Control	A	30					MLG
	B	35					
	C	35					
	D	34					
	E	29					
	F	33					
	G	29					
	H	31					
1.5	A	32					
	B	34					
	C	32					
	D	33					
3.0	A	40					
	B	54					
	C	51					
	D	43					
6.0	A	84					
	B	91					
	C	80					
	D	92					
11.9	A	132					
	B	129					
	C	141					
	D	136					
23.8	A	161					
	B	167					
	C	174					
	D	160					
47.6	A	173					
	B	174					
	C	180					
	D	177					
95.2	A	150					
	B	142					
	C	152					
	D	160					✓

Comments: _____
 Reviewed by:  Date Reviewed: Nov. 14, 2018

***Pseudokirchneriella subcapitata* Algal Counts**

Client: ALS (Minto)
 WO#: 181675
 Sample ID: L2175227-1 W3

Start Date/Time: 5-Oct-18 @ 0700h
 Termination Date/Time: 8-Oct-18 @ 0700h

Initial Cell Density: 10000 cell/mL
 220000
 0.22
 0.01
 10000

Concentration %(v/v)	Rep	Count 1 (x 10 ⁴)	Count 2 (x 10 ⁴)	Count 3 (x 10 ⁴)	Count 4 (x 10 ⁴)	Mean (x 10 ⁴)	Cell Yield (x 10 ⁴) cell/mL		
Control	A	30				30	29.0	mean	31.0
	B	35				35	34.0	SD	2.56348
	C	35				35	34.0	CV	8.26929
	D	34				34	33.0		
	E	29				29	28.0		
	F	33				33	32.0		
	G	29				29	28.0		
	H	31				31	30.0		
1.5	A	32				32	31.0		
	B	34				34	33.0		
	C	32				32	31.0		
	D	37				37	36.0		
3	A	46				46	45.0		
	B	54				54	53.0		
	C	51				51	50.0		
	D	43				43	42.0		
6	A	84				84	83.0		
	B	91				91	90.0		
	C	80				80	79.0		
	D	92				92	91.0		
11.9	A	132				132	131.0		
	B	129				129	128.0		
	C	141				141	140.0		
	D	136				136	135.0		
23.8	A	161				161	160.0		
	B	167				167	166.0		
	C	174				174	173.0		
	D	160				160	159.0		
47.6	A	173				173	172.0		
	B	174				174	173.0		
	C	180				180	179.0		
	D	177				177	176.0		
95.2	A	150				150	149.0		
	B	142				142	141.0		
	C	152				152	151.0		
	D	160				160	159.0		

Reviewed by: 

Date reviewed: Nov. 15, 2018

CETIS Analytical Report

Report Date: 09 Nov-18 16:50 (p 1 of 2)

Test Code/ID: 181675 / 12-8863-8116

EC Alga Growth Inhibition Test

Nautilus Environmental

Analysis ID: 04-6998-3052	Endpoint: Cell Yield	CETIS Version: CETISv1.9.4
Analyzed: 09 Nov-18 16:50	Analysis: Linear Interpolation (ICPIN)	Status Level: 1
Batch ID: 06-2739-3271	Test Type: Cell Growth	Analyst: Mimi Tran
Start Date: 05 Oct-18 07:00	Protocol: EC/EPS 1/RM/25	Diluent: Deionized Water + nutrients
Ending Date: 08 Oct-18 07:00	Species: Pseudokirchneriella subcapitata	Brine:
Test Length: 72h	Taxon: Chlorophyta	Source: In-House Culture Age: 7d
Sample ID: 00-9926-6391	Code: 5EAAF57	Project:
Sample Date: 02 Oct-18 08:35	Material: Water Sample	Source: ALS
Receipt Date: 04 Oct-18 13:30	CAS (PC):	Station: L2175227-1 W3
Sample Age: 70h (5 °C)	Client: ALS	

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	1172048	200	Yes	Two-Point Interpolation

Residual Analysis

Attribute	Method	Test Stat	Critical	P-Value	Decision(α:5%)
Control Trend	Mann-Kendall Trend Test			0.1855	Non-Significant Trend in Controls

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
IC5	>95.2	n/a	n/a	<1.05	n/a	n/a
IC10	>95.2	n/a	n/a	<1.05	n/a	n/a
IC15	>95.2	n/a	n/a	<1.05	n/a	n/a
IC20	>95.2	n/a	n/a	<1.05	n/a	n/a
IC25	>95.2	n/a	n/a	<1.05	n/a	n/a
IC40	>95.2	n/a	n/a	<1.05	n/a	n/a
IC50	>95.2	n/a	n/a	<1.05	n/a	n/a

Cell Yield Summary

			Calculated Variate							Isotonic Variate	
Conc-%	Code	Count	Mean	Min	Max	Std Dev	CV%	%Effect		Mean	%Effect
0	N	8	31	28	34	2.563	8.27%	0.0%		102.5	0.0%
1.5		4	32.75	31	36	2.363	7.22%	-5.65%		102.5	0.0%
3		4	47.5	42	53	4.933	10.39%	-53.23%		102.5	0.0%
6		4	85.75	79	91	5.737	6.69%	-176.6%		102.5	0.0%
11.9		4	133.5	128	140	5.196	3.89%	-330.6%		102.5	0.0%
23.8		4	164.5	159	173	6.455	3.92%	-430.6%		102.5	0.0%
47.6		4	175	172	179	3.162	1.81%	-464.5%		102.5	0.0%
95.2		4	150	141	159	7.394	4.93%	-383.9%		102.5	0.0%

Cell Yield Detail

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	N	29	34	34	33	28	32	28	30
1.5		31	33	31	36				
3		45	53	50	42				
6		83	90	79	91				
11.9		131	128	140	135				
23.8		160	166	173	159				
47.6		172	173	179	176				
95.2		149	141	151	159				

CETIS Analytical Report

Report Date: 09 Nov-18 16:50 (p 2 of 2)
Test Code/ID: 181675 / 12-8863-8116

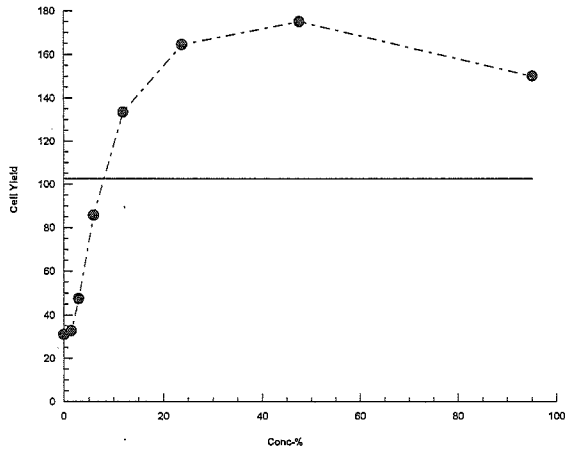
EC Alga Growth Inhibition Test

Nautilus Environmental

Analysis ID: 04-6998-3052 Endpoint: Cell Yield
Analyzed: 09 Nov-18 16:50 Analysis: Linear Interpolation (ICPIN)

CETIS Version: CETISv1.9.4
Status Level: 1

Graphics



CETIS Analytical Report

Report Date: 09 Nov-18 16:50 (p 1 of 2)
Test Code/ID: 181675 / 12-8863-8116

EC Alga Growth Inhibition Test

Nautilus Environmental

Analysis ID: 04-3656-0472	Endpoint: Cell Yield	CETIS Version: CETISv1.9.4
Analyzed: 09 Nov-18 16:50	Analysis: Parametric-Control vs Treatments	Status Level: 1
Batch ID: 06-2739-3271	Test Type: Cell Growth	Analyst: Mimi Tran
Start Date: 05 Oct-18 07:00	Protocol: EC/EPS 1/RM/25	Diluent: Deionized Water + nutrients
Ending Date: 08 Oct-18 07:00	Species: Pseudokirchneriella subcapitata	Brine:
Test Length: 72h	Taxon: Chlorophyta	Source: In-House Culture Age: 7d
Sample ID: 00-9926-6391	Code: 5EAAF57	Project:
Sample Date: 02 Oct-18 08:35	Material: Water Sample	Source: ALS
Receipt Date: 04 Oct-18 13:30	CAS (PC):	Station: L2175227-1 W3
Sample Age: 70h (5 °C)	Client: ALS	

Data Transform	Alt Hyp	NOEL	LOEL	TOEL	TU	PMSD
Untransformed	C < T	1.5	3	2.121	66.67	23.76%

Dunnett Multiple Comparison Test

Control	vs	Conc-%	Test Stat	Critical	MSD	DF	P-Type	P-Value	Decision(α:5%)
Negative Control		1.5	0.6003	2.526	7.364	10	CDF	0.7421	Non-Significant Effect
		3*	5.66	2.526	7.364	10	CDF	1.5E-05	Significant Effect
		6*	18.78	2.526	7.364	10	CDF	<1.0E-37	Significant Effect
		11.9*	35.16	2.526	7.364	10	CDF	<1.0E-37	Significant Effect
		23.8*	45.8	2.526	7.364	10	CDF	<1.0E-37	Significant Effect
		47.6*	49.4	2.526	7.364	10	CDF	<1.0E-37	Significant Effect
		95.2*	40.82	2.526	7.364	10	CDF	<1.0E-37	Significant Effect

Auxiliary Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:5%)
Control Trend	Mann-Kendall Trend Test			0.1855	Non-Significant Trend in Controls

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	120578	17225.5	7	760.1	<1.0E-37	Significant Effect
Error	634.5	22.6607	28			
Total	121213		35			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance Test	8.057	18.48	0.3276	Equal Variances
Distribution	Shapiro-Wilk W Normality Test	0.9849	0.9166	0.8942	Normal Distribution

Cell Yield Summary

Conc-%	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	N	8	31	28.86	33.14	31	28	34	0.9063	8.27%	0.00%
1.5		4	32.75	28.99	36.51	32	31	36	1.181	7.21%	-5.65%
3		4	47.5	39.65	55.35	47.5	42	53	2.466	10.39%	-53.23%
6		4	85.75	76.62	94.88	86.5	79	91	2.869	6.69%	-176.61%
11.9		4	133.5	125.2	141.8	133	128	140	2.598	3.89%	-330.65%
23.8		4	164.5	154.2	174.8	163	159	173	3.227	3.92%	-430.65%
47.6		4	175	170	180	174.5	172	179	1.581	1.81%	-464.52%
95.2		4	150	138.2	161.8	150	141	159	3.697	4.93%	-383.87%

CETIS Analytical Report

Report Date: 09 Nov-18 16:50 (p 2 of 2)
Test Code/ID: 181675 / 12-8863-8116

EC Alga Growth Inhibition Test

Nautilus Environmental

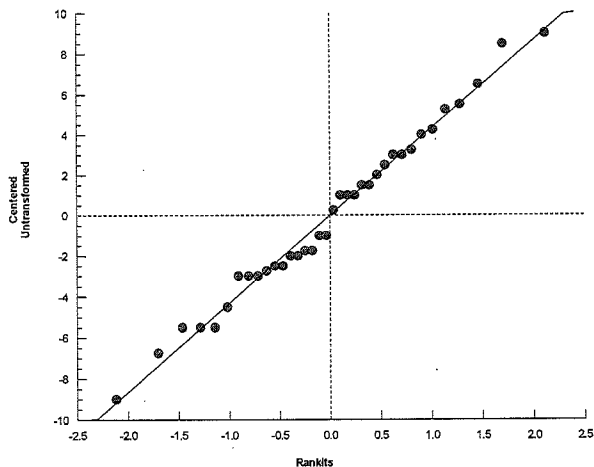
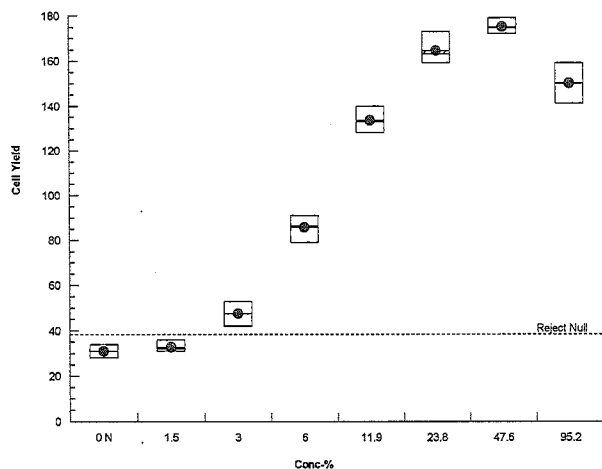
Analysis ID: 04-3656-0472 Endpoint: Cell Yield
Analyzed: 09 Nov-18 16:50 Analysis: Parametric-Control vs Treatments

CETIS Version: CETISv1.9.4
Status Level: 1

Cell Yield Detail

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	N	29	34	34	33	28	32	28	30
1.5		31	33	31	36				
3		45	53	50	42				
6		83	90	79	91				
11.9		131	128	140	135				
23.8		160	166	173	159				
47.6		172	173	179	176				
95.2		149	141	151	159				

Graphics



APPENDIX E – Chain-of-Custody Form

**L2175227**

VANCOUVER

Subcontract Request Form**Subcontract To:****NAUTILUS ENVIRONMENTAL**8664 COMMERCE COURT
BURNABY, BC V5A 4N7**NOTES:** Please reference on final report and invoice: PO# L2175227
ALS requires QC data to be provided with your final results.Please see enclosed 1 sample(s) in 8 Container(s)

SAMPLE NUMBER	ANALYTICAL REQUIRED	DATE SAMPLED	Priority Flag
		DUE DATE	
L2175227-1 W3		10/2/2018	
	Special Request- Nautilus Environmental (SPECIAL REQUEST-NL 14)	11/5/2018	

Subcontract Info Contact: Walter Lin (604) 253-4188

Analysis and reporting info contact: Shane Stack
8081 LOUGHEED HWY
SUITE 100
BURNABY, BC V5A 1W9
Phone: (604) 253-4188

Email: Shane.Stack@alsglobal.com

Please email confirmation of receipt to: **Shane.Stack@alsglobal.com**

Shipped By: <u>me</u>	Date Shipped: <u>Oct 04 2018</u>
Received By: <u>Nautilus</u>	Date Received: <u>Oct 04/18 @ 13:30</u>
Verified By: <u>Tyrene Hamilton</u>	Date Verified: _____
	Temperature: <u>5.0°C</u>
Sample Integrity Issues: _____	<u>7x20L + 3x1L</u>



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2175227-COFC

COC Number: 2018-10-03 C

Page 1 of 1

www.alsglobal.com

Contact and company name below will appear on the final report

Report Format / Distribution

Select Service Level Below - Please confirm all EAP TATs with your AM - surcharges will apply

Company: Minto Explorations Ltd.

Select Report Format: ☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)

Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply

Contact: Minto Environment - Coordinator

Quality Control (QC) Report with Report ☒ YES ☐ NO

1 Business day [E-1] ☐

Phone: 1-804-759-4656

☒ Compare Results to Criteria on Report - provide details below if box checked

3 day [P3] ☐ Same Day, Weekend or Statutory holiday [E0] ☐

Company address below will appear on the final report

Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX

Street: 2100-510 West Georgia St.

Email 1 or Fax: mintoenviroment@mintoenviroment.com

City/Province: Vancouver, British Columbia

Email 2

Postal Code: V6B 0M3

Email 3

Invoice To: Same as Report To

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Company: Minto Explorations Ltd.

Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX

Contact: Ruth Cayetano

Email 1 or Fax: ap@mintoenviroment.com

Project Information

Oil and Gas Required Fields (client use)

ALS Account # / Quote #:

AFCost Center:

Job #: 228101 (MMER)

Major/Minor Code:

PO / AFE: 228101 (MMER)

Requisitioner:

Location:

ALS Contact:

Sampler:

CR/EB

Number of Containers

ALS Sample # (tab use only)

Sample Identification and/or Coordinates (This description will appear on the report)

Date (dd-mm-yy) Time (hh:mm) Sample Type

W3

2-Oct-18

8:35

Water

96hr - LC50 Rainbow Trout

48hr - LC50 Daphnia

7day - Rainbow Trout Embryo Toxicity

7day - Ceriodaphnia

7day - Lemna minor

Alga 72-h Growth Inhibition

7day - Flathead Minnow

10

7x20L

3x1L

1

8

1

8

1

8

1

8

1

8

1

8

1

8

SAMPLE CONDITION AS RECEIVED (tab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C

FINAL COOLER TEMPERATURES °C

0.0

5

Released by: Corey Roberts

Date: 2018-10-03

Time:

Received by: EHF

Date: 03 Oct 2018

Time: 11:30

Received by: 11K

Date: 10/11

Time: 12:00

Received by: 12:00

Date: 10/11

Time: 12:00

Received by: 12:00

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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an authorized DW COC form.

END OF REPORT



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OCTOBER 2016 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

RISS - SITDR

Page 2 of 2

If effluent was non-compliant with the authorized limits set out in Schedule 4, indicate the cause(s) of non-compliance and remedial measures planned or implemented in response to the failure of acute lethality tests.

Q4 Ra226 sample was lost enroute to the lab. EC Inspector was notified upon discovery of the error and the mine will increase Ra226 sampling for 10 consecutive weeks as per the MDMER para 13(4)(a). on the next scheduled sampling day - March 19, 2019.

Notes:

During the 2018 winter flow estimates at the FDP - W3 were required due to ice and flows backing up. This phenomena and required estimation was discussed with the EC Inspector. The following is the summary of the flow estimates.

2018 Notes for the Annual MMER Report regarding flow estimates

As discussed with the EC Inspector - Total effluent volume was an estimate based on the first two weeks of January, on January 16th the flume froze and backed up.

As discussed with the EC Inspector - The W3 station was iced over and flume readings were inaccurate, an average of February 2018 (220.4 m3/day), March 2017 (186.3 m3/day) and April 2017 (216 m3/day) were used to estimate total effluent volume in March 2018 (208 m3/day) multiplied by the number of days in March (31).

As discussed with the EC Inspector - The W3 station was iced over and flume readings were inaccurate, an average of February 2018 (220.4 m3/day), March 2017 (186.3 m3/day) and April 2017 (216 m3/day) were used to estimate total effluent volume in March 2018 (208 m3/day) multiplied by the number of days in March (31).

Since the flume was backed up the monthly flow is an estimate based on the averages of March 2018 (208 m3/day), April 2017 (216 m3/day) and May 2017 (1460 m3/day).

Since the flume was backed up the monthly flow is an estimate based on the averages of April 2018 (212 m3/day), May 2017 (1460 m3/day) and June 2017 (1544 m3/day).

Date Modified: 2019-01-02

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User: PYmmSCC469**Region:** Pacific-Yukon**Regulation:** MMER[Home](#)[Del. Sub. & pH Data](#)[Bioassay Data](#)[EEM](#)[Annual Report](#)[Submission](#)[Regulatory Data - Quarterly Report](#)[EEM - Annual Report](#)[Regulatory Data - Annual Report](#)[Queries & Downloads](#)[Graphs & Tables](#)[Company Information](#)[Password Change](#)[Comments: Submit](#)[Publications](#)[RISS Web Service](#)[Logout](#)**Data Submitted****Your EEM data has been successfully submitted.**

Facility Name:	Minto Explorations Limited - Minto Mine (Pelly Crossing, YT)
Date and Time Submitted (GMT):	2019-03-16 14:59:58
Tracking ID:	PYmmSCC469-2019-03-16-14-59-58-88597
Reporting Period:	2018

*This is the official receipt of your submission.
You may wish to print and retain this receipt for your records.*

Signature:

Station Name		W3	W3	W3	W3	W3
Smpl Date		5/15/2018 9:55	7/3/2018 8:30	9/4/2018 8:50	10/2/2018 8:35	10/9/2018 9:20
Lab Report No		L2095920	L2123725	L2158985	L2175170	L2179645
Hard-D	mg/L	252	232	256	277	274
Alk-T	mg/L	221	183	235	258	253
Al-T	mg/L	0.158	0.0394	0.0057	0.0147	0.0816
Cd-T	mg/L	0.0000205	0.0000058	<0.0000050	0.0000078	0.0000055
Fe-T	mg/L	0.278	0.081	0.022	0.042	0.152
Hg-T	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Mo-T	mg/L	0.00447	0.00352	0.00493	0.0049	0.00484
N-NH3	mg/L	0.0126	0.0083	<0.0050	0.0063	0.016
N-NO3	mg/L	0.155	1.08	0.126	0.146	0.153
As-T	mg/L	0.00039	0.00037	0.00025	0.00029	0.00029
Cu-T	mg/L	0.0367	0.0179	0.00347	0.00424	0.00802
Pb-T	mg/L	0.000055	<0.000050	<0.000050	<0.000050	0.00009
Ni-T	mg/L	0.00155	0.00119	0.00102	0.00105	0.00133
Zn-T	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
TSS	mg/L	8.9	4.1	<3.0	4.7	4.8
pH-F	pH units	7.79	7.73	7.79	7.51	7.36
Temp-F	C	0.4	10.4	2.4	-0.1	0
O-DO	mg/L	11.31	9.49	11.96	10.99	6.62
Se-T	mg/L	0.000266	0.000819	0.000247	0.000286	0.000366
Cond-F	µS/cm	269.4	338.4	232.2	256	306.7
Ca-T	mg/L	53.1	51.4	58.9	57.1	58.9
Chlord	mg/L	4.76	4.94	4.56	4.5	4.58
Mg-T	mg/L	26.00	21.4	28.9	28.3	31.3
Mn-T	mg/L	0.1400	0.0186	0.0357	0.044	0.0731
Na-T	mg/L	16.5	14.4	19.2	19.0	19.7
Ti-T	mg/L	0.00634	0.00166	<0.00030	0.00123	0.00396
C-DOC	mg/L	14.8	13.7	6.95	6.05	5.61
P-T	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050
U-T	mg/L	0.00273	0.0016	0.00264	0.0029	0.00289

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Study Number or Year

Select Report Type

Report(s)

Version	Study Number or Year	Report Type	Organization Name	Facility Name	Report Progress	Actions
1	2018	Other effluent and water quality monitoring information (i.e., laboratory certificates)	Minto Explorations Limited	Minto Mine	Submitted (16/03/2019 11:28:16 AM)	 ▾

Version: 1.2.1

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Station Name		W7	W7	W7	W7
Smpl Date		5/15/2018 10:30	7/3/2018 11:45	9/3/2018 16:50	10/8/2018 15:15
Lab Report No		L2095920	L2123725	L2158985	L2179645
Hard-D	mg/L	74.7	97.3	128	155
Alk-T	mg/L	70.5	105	138	163
Al-T	mg/L	0.537	1.25	0.0339	0.103
Cd-T	mg/L	0.000016	0.000026	<0.0000050	0.0000074
Fe-T	mg/L	1.38	1.86	0.191	0.326
Hg-T	mg/L	0.0000067	<0.0000050	<0.0000050	<0.0000050
Mo-T	mg/L	0.000731	0.00124	0.00154	0.00122
N-NH3	mg/L	0.0117	0.0098	0.0143	0.0271
N-NO3	mg/L	0.0104	0.0794	0.0888	0.172
As-T	mg/L	0.00084	0.00097	<0.00080	0.00058
Cu-T	mg/L	0.00722	0.00474	0.00121	0.00236
Pb-T	mg/L	0.000207	0.000504	<0.000050	<0.000050
Ni-T	mg/L	0.00267	0.00392	0.00111	0.00117
Zn-T	mg/L	0.0031	0.0054	<0.0030	<0.0030
TSS	mg/L	20.7	61.4	7.1	5.2
pH-F	pH units	8.1	7.82	7.67	7.52
Temp-F	C	0.1	3.6	3.2	0.1
O-DO	mg/L	15.39	10.93	11.98	10.33
Se-T	mg/L	0.000148	0.000165	0.00015	0.000207
Cond-F	µS/cm	73.9	120.5	167.1	171.5
Ca-T	mg/L	19.2	24.8	32.4	39
Chlord	mg/L	<0.50	0.21	<0.50	0.58
Mg-T	mg/L	7.03	9.72	12.7	14.6
Mn-T	mg/L	0.0746	0.0646	0.0351	0.0728
Na-T	mg/L	4.64	6.36	7.88	8.74
Ti-T	mg/L	0.02	0.0459	0.00178	0.00435
C-DOC	mg/L	23.4	16.5	10.9	7.25
P-T	mg/L	0.088	0.081	<0.050	<0.050
U-T	mg/L	0.000440	0.00085	0.0012	0.0015

Station Name		W2	W2	W2	W2
Smpl Date		5/15/2018 8:50	7/3/2018 9:50	9/4/2018 10:45	9/25/2018 14:30
Lab Report No		L2095920	L2123725	L2158985	L2171436
Hard-D	mg/L	100	149	163	167
Alk-T	mg/L	91.1	146	169	163
Al-T	mg/L	0.0566	0.4820	0.0165	0.0146
Cd-T	mg/L	0.0000113	0.0000105	<0.0000050	<0.0000050
Fe-T	mg/L	0.235	0.851	0.066	0.045
Hg-T	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Mo-T	mg/L	0.000802	0.00189	0.00141	0.00129
N-NH3	mg/L	0.0102	0.0077	<0.0050	<0.0050
N-NO3	mg/L	<0.0050	0.205	0.0791	<0.0050
As-T	mg/L	0.00062	0.00089	0.00043	0.00037
Cu-T	mg/L	0.00578	0.00459	0.00205	0.00187
Pb-T	mg/L	<0.000050	0.000223	<0.000050	<0.000050
Ni-T	mg/L	0.0018	0.00205	0.00092	0.00093
Zn-T	mg/L	<0.0030	<0.0030	<0.0030	<0.0030
TSS	mg/L	<3.0	17.7	<3.0	4.2
pH-F	pH units	8.1	7.98	7.81	8.12
Temp-F	C	0.5	6.1	3.5	1.5
O-DO	mg/L	15.19	8.68	12.31	14.33
Se-T	mg/L	0.000132	0.000183	0.000116	0.000137
Cond-F	µS/cm	104.2	202.7	220.6	201.5
Ca-T	mg/L	24.2	37.8	43.6	44
Chlord	mg/L	1.25	1.83	1.9	1.88
Mg-T	mg/L	8.5	13.6	16.6	15.2
Mn-T	mg/L	0.0196	0.0488	0.009	0.00753
Na-T	mg/L	5.84	9.2	10.3	10.2
Ti-T	mg/L	0.00247	0.0209	0.00069	<0.0012
C-DOC	mg/L	22.2	12.9	9.47	8.11
P-T	mg/L	<0.050	<0.050	<0.050	<0.050
U-T	mg/L	0.000588	0.00146	0.00172	0.0019



Minto Mine
MMER – EEM Annual Report
SWIM Upload

Prepared by:
Minto Explorations Ltd.
Minto Mine
March, 2019

Data Summary

Station Name		W3	W3	W3	W3	W3
Smpl Date		5/15/2018 9:55	7/3/2018 8:30	9/4/2018 8:50	10/2/2018 8:35	10/9/2018 9:20
Lab Report No		L2095920	L2123725	L2158985	L2175170	L2179645
Hard-D	mg/L	252	232	256	277	274
Alk-T	mg/L	221	183	235	258	253
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Cd-T	mg/L	0.0000205	0.0000058	<0.0000050	0.0000078	0.0000055
Fe-T	mg/L	0.278	0.081	0.022	0.042	0.152
Hg-T	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Mo-T	mg/L	0.00447	0.00352	0.00493	0.0049	0.00484
N-NH3	mg/L	0.0126	0.0083	<0.0050	0.0063	0.016
N-NO3	mg/L	0.155	1.08	0.126	0.146	0.153
As-T	mg/L	0.00039	0.00037	0.00025	0.00029	0.00029
Cu-T	mg/L	0.0367	0.0179	0.00347	0.00424	0.00802
Pb-T	mg/L	0.000055	<0.000050	<0.000050	<0.000050	0.00009
Ni-T	mg/L	0.00155	0.00119	0.00102	0.00105	0.00133
Zn-T	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
TSS	mg/L	8.9	4.1	<3.0	4.7	4.8
pH-F	pH units	7.79	7.73	7.79	7.51	7.36
Temp-F	C	0.4	10.4	2.4	-0.1	0
O-DO	mg/L	11.31	9.49	11.96	10.99	6.62
Se-T	mg/L	0.000266	0.000819	0.000247	0.000286	0.000366
Cond-F	µS/cm	269.4	338.4	232.2	256	306.7
Ca-T	mg/L	53.1	51.4	58.9	57.1	58.9
Chlord	mg/L	4.76	4.94	4.56	4.5	4.58
Mg-T	mg/L	26.00	21.4	28.9	28.3	31.3
Mn-T	mg/L	0.1400	0.0186	0.0357	0.044	0.0731
Na-T	mg/L	16.5	14.4	19.2	19.0	19.7
Ti-T	mg/L	0.00634	0.00166	<0.00030	0.00123	0.00396
C-DOC	mg/L	14.8	13.7	6.95	6.05	5.61
P-T	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050
U-T	mg/L	0.00273	0.0016	0.00264	0.0029	0.00289

Station Name		W7	W7	W7	W7
Smpl Date		5/15/2018 10:30	7/3/2018 11:45	9/3/2018 16:50	10/8/2018 15:15
Lab Report No		L2095920	L2123725	L2158985	L2179645
Hard-D	mg/L	74.7	97.3	128	155
Alk-T	mg/L	70.5	105	138	163
Al-T	mg/L	0.537	1.25	0.0339	0.103
Cd-T	mg/L	0.000016	0.000026	<0.0000050	0.0000074
Fe-T	mg/L	1.38	1.86	0.191	0.326
Hg-T	mg/L	0.0000067	<0.0000050	<0.0000050	<0.0000050
Mo-T	mg/L	0.000731	0.00124	0.00154	0.00122
N-NH3	mg/L	0.0117	0.0098	0.0143	0.0271
N-NO3	mg/L	0.0104	0.0794	0.0888	0.172
As-T	mg/L	0.00084	0.00097	<0.00080	0.00058
Cu-T	mg/L	0.00722	0.00474	0.00121	0.00236
Pb-T	mg/L	0.000207	0.000504	<0.000050	<0.000050
Ni-T	mg/L	0.00267	0.00392	0.00111	0.00117
Zn-T	mg/L	0.0031	0.0054	<0.0030	<0.0030
TSS	mg/L	20.7	61.4	7.1	5.2
pH-F	pH units	8.1	7.82	7.67	7.52
Temp-F	C	0.1	3.6	3.2	0.1
O-DO	mg/L	15.39	10.93	11.98	10.33
Se-T	mg/L	0.000148	0.000165	0.00015	0.000207
Cond-F	µS/cm	73.9	120.5	167.1	171.5
Ca-T	mg/L	19.2	24.8	32.4	39
Chlord	mg/L	<0.50	0.21	<0.50	0.58
Mg-T	mg/L	7.03	9.72	12.7	14.6
Mn-T	mg/L	0.0746	0.0646	0.0351	0.0728
Na-T	mg/L	4.64	6.36	7.88	8.74
Ti-T	mg/L	0.02	0.0459	0.00178	0.00435
C-DOC	mg/L	23.4	16.5	10.9	7.25
P-T	mg/L	0.088	0.081	<0.050	<0.050
U-T	mg/L	0.000440	0.00085	0.0012	0.0015

Station Name		W2	W2	W2	W2
Smpl Date		5/15/2018 8:50	7/3/2018 9:50	9/4/2018 10:45	9/25/2018 14:30
Lab Report No		L2095920	L2123725	L2158985	L2171436
Hard-D	mg/L	100	149	163	167
Alk-T	mg/L	91.1	146	169	163
Al-T	mg/L	0.0566	0.4820	0.0165	0.0146
Cd-T	mg/L	0.0000113	0.0000105	<0.0000050	<0.0000050
Fe-T	mg/L	0.235	0.851	0.066	0.045
Hg-T	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Mo-T	mg/L	0.000802	0.00189	0.00141	0.00129
N-NH3	mg/L	0.0102	0.0077	<0.0050	<0.0050
N-NO3	mg/L	<0.0050	0.205	0.0791	<0.0050
As-T	mg/L	0.00062	0.00089	0.00043	0.00037
Cu-T	mg/L	0.00578	0.00459	0.00205	0.00187
Pb-T	mg/L	<0.000050	0.000223	<0.000050	<0.000050
Ni-T	mg/L	0.0018	0.00205	0.00092	0.00093
Zn-T	mg/L	<0.0030	<0.0030	<0.0030	<0.0030
TSS	mg/L	<3.0	17.7	<3.0	4.2
pH-F	pH units	8.1	7.98	7.81	8.12
Temp-F	C	0.5	6.1	3.5	1.5
O-DO	mg/L	15.19	8.68	12.31	14.33
Se-T	mg/L	0.000132	0.000183	0.000116	0.000137
Cond-F	µS/cm	104.2	202.7	220.6	201.5
Ca-T	mg/L	24.2	37.8	43.6	44
Chlord	mg/L	1.25	1.83	1.9	1.88
Mg-T	mg/L	8.5	13.6	16.6	15.2
Mn-T	mg/L	0.0196	0.0488	0.009	0.00753
Na-T	mg/L	5.84	9.2	10.3	10.2
Ti-T	mg/L	0.00247	0.0209	0.00069	<0.0012
C-DOC	mg/L	22.2	12.9	9.47	8.11
P-T	mg/L	<0.050	<0.050	<0.050	<0.050
U-T	mg/L	0.000588	0.00146	0.00172	0.0019

Effluent Characterization
Certificates of Analysis (COA's)



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 16-MAY-18
Report Date: 31-MAY-18 16:56 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2095920

Project P.O. #: 229096

Job Reference:

C of C Numbers: 2018-05-16 A 1 of 2, 2018-05-16 A 2 of 2

Legal Site Desc:

Shane Stack
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2095920-1 Water 12-MAY-18 09:55 W55	L2095920-2 Water 12-MAY-18 10:25 W14	L2095920-3 Water 12-MAY-18 11:00 W30	L2095920-4 Water 12-MAY-18 13:15 W10	L2095920-5 Water 14-MAY-18 09:00 W17
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	184	3410	411	50.6	511
	Hardness (as CaCO3) (mg/L)	108	1710	195	131	260
	pH (pH)	7.98	8.04	8.27	7.00	8.39
	Total Suspended Solids (mg/L)	17.7	15.3	<3.0	<3.0	<3.0
	TDS (Calculated) (mg/L)	105	3030	246	68.3	301
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	86.2	86.4	124	20.4	211
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	7.2
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	86.2	86.4	124	20.4	218
	Ammonia, Total (as N) (mg/L)	0.0474	12.3	0.0272	0.0152	0.0114
	Bromide (Br) (mg/L)	<0.050	<1.0 ^{DLDS}	<0.050	<0.050	<0.050
	Chloride (Cl) (mg/L)	0.66	28	1.39	<0.50	6.86
	Fluoride (F) (mg/L)	0.165	2.24	0.465	0.046	0.374
	Nitrate and Nitrite (as N) (mg/L)	0.383	43.2	3.07	<0.0051	0.104
	Nitrate (as N) (mg/L)	0.378	40.0	3.01	<0.0050	0.104
	Nitrite (as N) (mg/L)	0.0057	3.14	0.0538	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	7.26	1870	76.7	<0.30	54.1
	Anion Sum (meq/L)	1.93	44.7	4.36	0.41	5.71
	Cation Sum (meq/L)	2.38	43.8	4.43	2.95	5.94
	Cation - Anion Balance (%)	10.4	-0.9	0.8	75.6	2.0
	Organic / Inorganic Carbon					9.14
Total Metals	Aluminum (Al)-Total (mg/L)	0.292		0.171	0.383	3.73
	Antimony (Sb)-Total (mg/L)	0.00012		0.00013	<0.00010	0.00031
	Arsenic (As)-Total (mg/L)	0.00102		0.00070	0.00042	0.00265
	Barium (Ba)-Total (mg/L)	0.0600		0.0630	0.0731	0.451
	Beryllium (Be)-Total (mg/L)	0.000046		<0.000020	0.000025	0.000141
	Bismuth (Bi)-Total (mg/L)	<0.000050		<0.000050	<0.000050	0.000086
	Boron (B)-Total (mg/L)	<0.017 ^{DLAI}		0.019 ^{DLAI}	<0.010	0.026
	Cadmium (Cd)-Total (mg/L)	0.0000489		0.0000201	0.0000278	0.000387
	Calcium (Ca)-Total (mg/L)	29.9		46.0	11.6	66.4
	Chromium (Cr)-Total (mg/L)	0.00053		0.00031	0.00066	0.00433
	Cobalt (Co)-Total (mg/L)	0.00051		0.00021	0.00046	0.00559
	Copper (Cu)-Total (mg/L)	0.126		0.0451	0.0431	0.572
	Iron (Fe)-Total (mg/L)	0.538		0.321	0.436	23.8
	Lead (Pb)-Total (mg/L)	0.000219		0.000127	0.000057	0.0206
	Lithium (Li)-Total (mg/L)	0.0013		0.0024	<0.0010	0.0036

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2095920-6 Water 14-MAY-18 09:35 W8A	L2095920-7 Water 14-MAY-18 14:10 W16	L2095920-8 Water 14-MAY-18 15:15 W33S	L2095920-9 Water 15-MAY-18 08:10 MC1	L2095920-10 Water 15-MAY-18 08:50 W2
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	1220	339	109	191	194
	Hardness (as CaCO3) (mg/L)	621	169	63.6	99.2	100
	pH (pH)	8.13	8.20	7.75	8.12	8.17
	Total Suspended Solids (mg/L)	45.1	13.5	<3.0	<3.0	<3.0
	TDS (Calculated) (mg/L)	831	198	60.4	107	108
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	385	125	48.3	89.7	91.1
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	385	125	48.3	89.7	91.1
	Ammonia, Total (as N) (mg/L)	0.181	0.0161	0.0199	0.0085	0.0102
	Bromide (Br) (mg/L)	<0.25 ^{DLDS}	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl) (mg/L)	9.9	5.16	<0.50	1.18	1.25
	Fluoride (F) (mg/L)	0.65	0.209	0.082	0.248	0.245
	Nitrate and Nitrite (as N) (mg/L)	8.63	0.722	0.162	<0.0051	<0.0051
	Nitrate (as N) (mg/L)	8.42	0.717	0.157	<0.0050	<0.0050
	Nitrite (as N) (mg/L)	0.214	0.0049	0.0053	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	285	43.8	4.69	10.5	10.8
	Anion Sum (meq/L)	14.5	3.62	1.08	2.06	2.09
	Cation Sum (meq/L)	14.4	3.85	1.42	2.28	2.29
	Cation - Anion Balance (%)	-0.6	3.1	13.5	5.1	4.5
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)		21.8		23.6	22.2
Total Metals	Aluminum (Al)-Total (mg/L)	0.553	0.838	0.146	0.0487	0.0566
	Antimony (Sb)-Total (mg/L)	0.00017	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00093	0.00068	0.00047	0.00064	0.00062
	Barium (Ba)-Total (mg/L)	0.141	0.0768	0.0340	0.0463	0.0414
	Beryllium (Be)-Total (mg/L)	0.000045	0.000046	0.000027	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.035	0.015	<0.010	<0.010	<0.010
	Cadmium (Cd)-Total (mg/L)	0.000523	0.0000281	0.0000166	0.0000116	0.0000113
	Calcium (Ca)-Total (mg/L)	175	42.4	17.3	23.6	24.2
	Chromium (Cr)-Total (mg/L)	0.00116	0.00082	0.00052	0.00051	0.00048
	Cobalt (Co)-Total (mg/L)	0.00147	0.00066	0.00020	0.00020	0.00018
	Copper (Cu)-Total (mg/L)	0.296	0.0731	0.0328	0.00618	0.00578
	Iron (Fe)-Total (mg/L)	2.01	1.50	0.290	0.236	0.235
	Lead (Pb)-Total (mg/L)	0.000396	0.000326	0.000053	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	0.0043	0.0016	<0.0010	<0.0010	<0.0010

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2095920-11 Water 15-MAY-18 09:55 W3	L2095920-12 Water 15-MAY-18 10:30 W7	L2095920-13 Water 12-MAY-18 F-BL	L2095920-14 Water 14-MAY-18 DUP	L2095920-15 Water 14-MAY-18 10:15 W55	
Grouping	Analyte						
WATER							
Physical Tests	Conductivity (uS/cm)	502	142	<2.0	508	173	
	Hardness (as CaCO3) (mg/L)	252	74.7	<0.50	256	92.2	
	pH (pH)	8.39	8.00	5.41	8.38	7.88	
	Total Suspended Solids (mg/L)	8.9	20.7	<3.0	4.5	4.5	
	TDS (Calculated) (mg/L)	293	77.4	<1.0	298	98.4	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	213	70.5	<1.0	210	66.3	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	7.4	<1.0	<1.0	6.6	<1.0	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Total (as CaCO3) (mg/L)	221	70.5	<1.0	216	66.3	
	Ammonia, Total (as N) (mg/L)	0.0126	0.0117	<0.0050	0.0082	0.0239	
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050	
	Chloride (Cl) (mg/L)	4.76	<0.50	<0.50	6.80	0.55	
	Fluoride (F) (mg/L)	0.499	0.158	<0.020	0.373	0.132	
	Nitrate and Nitrite (as N) (mg/L)	0.158	0.0104	<0.0051	0.103	1.67	
	Nitrate (as N) (mg/L)	0.155	0.0104	<0.0050	0.103	1.66	
	Nitrite (as N) (mg/L)	0.0022	<0.0010	<0.0010	<0.0010	0.0121	
	Sulfate (SO4) (mg/L)	53.2	3.80	<0.30	54.2	12.5	
	Anion Sum (meq/L)	5.69	1.50	<0.10	5.67	1.73	
	Cation Sum (meq/L)	5.79	1.73	<0.10	5.84	2.06	
	Cation - Anion Balance (%)	0.9	7.3	0.0	1.6	8.7	
	Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	14.8	23.4	0.51	9.15	
	Total Metals	Aluminum (Al)-Total (mg/L)	0.158	0.537	<0.0030	0.0117	0.268
Antimony (Sb)-Total (mg/L)		0.00011	<0.00010	<0.00010	<0.00010	<0.00010	
Arsenic (As)-Total (mg/L)		0.00039	0.00084	<0.00010	0.00036	0.00062	
Barium (Ba)-Total (mg/L)		0.0660	0.0522	<0.00010	0.0752	0.0514	
Beryllium (Be)-Total (mg/L)		<0.000020	0.000033	<0.000020	<0.000020	0.000033	
Bismuth (Bi)-Total (mg/L)		<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
Boron (B)-Total (mg/L)		0.021	<0.010	<0.010	0.025	<0.010	
Cadmium (Cd)-Total (mg/L)		0.0000205	0.0000160	<0.0000050	0.0000059	0.0000223	
Calcium (Ca)-Total (mg/L)		53.1	19.2	<0.050	66.8	25.7	
Chromium (Cr)-Total (mg/L)		0.00027	0.00143	<0.00010	0.00013	0.00050	
Cobalt (Co)-Total (mg/L)		0.00016	0.00055	<0.00010	<0.00010	0.00021	
Copper (Cu)-Total (mg/L)		0.0367	0.00722	<0.00050	0.0104	0.102	
Iron (Fe)-Total (mg/L)		0.278	1.38	<0.010	0.071	0.467	
Lead (Pb)-Total (mg/L)		0.000055	0.000207	<0.000050	0.000068	0.000148	
Lithium (Li)-Total (mg/L)		0.0031	<0.0010	<0.0010	0.0018	<0.0010	

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ALS ENVIRONMENTAL ANALYTICAL REPORT

31-MAY-18 16:56 (MT)

Version: FINAL

Sample ID Description Sampled Date Sampled Time Client ID		L2095920-1 Water 12-MAY-18 09:55 W55	L2095920-2 Water 12-MAY-18 10:25 W14	L2095920-3 Water 12-MAY-18 11:00 W30	L2095920-4 Water 12-MAY-18 13:15 W10	L2095920-5 Water 14-MAY-18 09:00 W17
Grouping	Analyte					
WATER						
Total Metals	Magnesium (Mg)-Total (mg/L)	7.88		17.5	2.60	23.3
	Manganese (Mn)-Total (mg/L)	0.112		0.0761	0.124	9.62
	Mercury (Hg)-Total (mg/L)	0.0000115		0.0000054	0.0000071	0.0000055
	Molybdenum (Mo)-Total (mg/L)	0.00166		0.00763	0.000155	0.0127
	Nickel (Ni)-Total (mg/L)	0.00185		0.00069	0.00176	0.0121
	Phosphorus (P)-Total (mg/L)	0.169		<0.050	0.113	0.346
	Potassium (K)-Total (mg/L)	2.14		4.14	1.15	4.89
	Selenium (Se)-Total (mg/L)	0.000492		0.00478	0.000114	0.000576
	Silicon (Si)-Total (mg/L)	4.51		3.30	2.79	13.4
	Silver (Ag)-Total (mg/L)	0.000026		0.000020	0.000012	0.000214
	Sodium (Na)-Total (mg/L)	3.74		10.0	1.33	16.2
	Strontium (Sr)-Total (mg/L)	0.232		0.761	0.0731	0.811
	Sulfur (S)-Total (mg/L)	2.98		28.2	<0.50	20.6
	Thallium (Tl)-Total (mg/L)	<0.000010		<0.000010	<0.000010	0.000055
	Tin (Sn)-Total (mg/L)	<0.00010		<0.00010	<0.00010	0.00020
	Titanium (Ti)-Total (mg/L)	0.0114		0.00672	<0.0060 ^{DLM}	0.179
	Uranium (U)-Total (mg/L)	0.000142		0.00195	0.000034	0.00299
	Vanadium (V)-Total (mg/L)	0.00139		0.00106	0.00105	0.0158
	Zinc (Zn)-Total (mg/L)	0.0067		<0.0030	0.0108	0.347
	Zirconium (Zr)-Total (mg/L)	0.00058		<0.00030	0.00055	0.00071
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0577	0.0355	0.0065	0.102	0.0024
	Antimony (Sb)-Dissolved (mg/L)	0.00011	0.00064	0.00012	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00084	0.00036	0.00046	0.00046	0.00042
	Barium (Ba)-Dissolved (mg/L)	0.0520	0.177	0.0591	0.178 ^{DTC}	0.0744
	Beryllium (Be)-Dissolved (mg/L)	0.000029	<0.000040 ^{DLA}	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.00010 ^{DLA}	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	<0.010	0.367 ^{DLM}	0.014	<0.010	0.023
	Cadmium (Cd)-Dissolved (mg/L)	0.0000270	<0.000030 ^{DLA}	0.0000132	0.0000137 ^{DTC}	0.0000281
	Calcium (Ca)-Dissolved (mg/L)	30.4	552	46.9	36.9	68.0
	Chromium (Cr)-Dissolved (mg/L)	0.00040	<0.00020 ^{DLA}	<0.00010	0.00020	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	0.00035	<0.00020 ^{DLA}	<0.00010	0.00026	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.0877	0.00454 ^{DLA}	0.0332	0.0261	0.00848
	Iron (Fe)-Dissolved (mg/L)	0.174	<0.020 ^{DLA}	0.031	0.145	0.031
	Lead (Pb)-Dissolved (mg/L)	0.000058	<0.00010 ^{DLA}	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0012	0.0175	0.0022	<0.0010	0.0016

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2095920-6	L2095920-7	L2095920-8	L2095920-9	L2095920-10
		Water	Water	Water	Water	Water
		14-MAY-18	14-MAY-18	14-MAY-18	15-MAY-18	15-MAY-18
		09:35	14:10	15:15	08:10	08:50
		W8A	W16	W33S	MC1	W2
Grouping	Analyte					
WATER						
Total Metals	Magnesium (Mg)-Total (mg/L)	47.0	13.2	4.64	8.83	8.50
	Manganese (Mn)-Total (mg/L)	2.18	0.191	0.0197	0.0456	0.0196
	Mercury (Hg)-Total (mg/L)	0.0000073	<0.0000050	0.0000069	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.0131	0.00214	0.000565	0.000846	0.000802
	Nickel (Ni)-Total (mg/L)	0.00199	0.00162	0.00186	0.00197	0.00180
	Phosphorus (P)-Total (mg/L)	0.133	0.072	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	7.52	2.54	0.80	1.25	1.26
	Selenium (Se)-Total (mg/L)	0.00672	0.000428	0.000162	0.000168	0.000132
	Silicon (Si)-Total (mg/L)	8.25	5.27	3.56	4.89	4.72
	Silver (Ag)-Total (mg/L)	0.000070	0.000018	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	44.2	9.32	2.74	6.05	5.84
	Strontium (Sr)-Total (mg/L)	2.20	0.397	0.0896	0.205	0.210
	Sulfur (S)-Total (mg/L)	114	15.9	2.05	3.88	4.22
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	0.0278	0.0448	0.00354	<0.0018	0.00247
	Uranium (U)-Total (mg/L)	0.00344	0.000969	0.000037	0.000608	0.000588
	Vanadium (V)-Total (mg/L)	0.00368	0.00339	0.00076	0.00099	0.00091
	Zinc (Zn)-Total (mg/L)	0.0998	0.0069	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	0.00039	0.00035	0.00044	0.00033	0.00031
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0075	0.0289	0.0525	0.0255	0.0241
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00052	0.00037	0.00033	0.00056	0.00054
	Barium (Ba)-Dissolved (mg/L)	0.121	0.0677	0.0305	0.0437	0.0414
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.030	0.013	<0.010	<0.010	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	0.000439	0.0000218	0.0000144	0.0000069	0.0000084
	Calcium (Ca)-Dissolved (mg/L)	174	44.6	17.8	24.8	25.8
	Chromium (Cr)-Dissolved (mg/L)	0.00028	0.00018	0.00040	0.00039	0.00033
	Cobalt (Co)-Dissolved (mg/L)	0.00101	0.00013	0.00011	0.00020	0.00014
	Copper (Cu)-Dissolved (mg/L)	0.118	0.0464	0.0253	0.00599	0.00570
	Iron (Fe)-Dissolved (mg/L)	0.287	0.165	0.124	0.173	0.153
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0039	0.0011	<0.0010	<0.0010	<0.0010

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ALS ENVIRONMENTAL ANALYTICAL REPORT

31-MAY-18 16:56 (MT)

Version: FINAL

Sample ID Description Sampled Date Sampled Time Client ID		L2095920-11 Water 15-MAY-18 09:55 W3	L2095920-12 Water 15-MAY-18 10:30 W7	L2095920-13 Water 12-MAY-18 F-BL	L2095920-14 Water 14-MAY-18 DUP	L2095920-15 Water 14-MAY-18 10:15 W55
Grouping	Analyte					
WATER						
Total Metals	Magnesium (Mg)-Total (mg/L)	26.0	7.03	<0.10	21.0	7.09
	Manganese (Mn)-Total (mg/L)	0.140	0.0746	<0.00010 ^{DTMF}	0.0996	0.0197
	Mercury (Hg)-Total (mg/L)	<0.0000050	0.0000067	<0.0000050	<0.0000050	0.0000087
	Molybdenum (Mo)-Total (mg/L)	0.00447	0.000731	<0.000050	0.00633	0.00145
	Nickel (Ni)-Total (mg/L)	0.00155	0.00267	<0.00050	0.00081	0.00166
	Phosphorus (P)-Total (mg/L)	<0.050	0.088	<0.050	<0.050	0.065
	Potassium (K)-Total (mg/L)	2.37	0.79	<0.10	3.84	1.80
	Selenium (Se)-Total (mg/L)	0.000266	0.000148	<0.000050	0.000314	0.000297
	Silicon (Si)-Total (mg/L)	6.35	5.73	<0.10	5.81	4.22
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	0.000013
	Sodium (Na)-Total (mg/L)	16.5	4.64	<0.050	15.5	4.09
	Strontium (Sr)-Total (mg/L)	0.695	0.155	<0.00020	0.691	0.206
	Sulfur (S)-Total (mg/L)	19.7	1.45	<0.50	20.8	5.10
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010 ^{DLM}	<0.00010
	Titanium (Ti)-Total (mg/L)	0.00634	0.0200	<0.00030	<0.00060	0.0102
	Uranium (U)-Total (mg/L)	0.00273	0.000440	<0.000010	0.00255	0.000183
	Vanadium (V)-Total (mg/L)	0.00087	0.00283	<0.00050	<0.00050	0.00129
	Zinc (Zn)-Total (mg/L)	<0.0030	0.0031	<0.0030	<0.0030	0.0034
	Zirconium (Zr)-Total (mg/L)	<0.00030	0.00048	<0.00030	<0.00030	0.00042
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0213	0.0389	0.0047 ^{RRV}	0.0024	0.0353
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00032	0.00061	<0.00010 ^{RRV}	0.00038	0.00049
	Barium (Ba)-Dissolved (mg/L)	0.0673	0.0417	0.00019	0.0748	0.0425
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.019	<0.010	<0.010	0.022	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	0.0000095	0.0000075	<0.0000050	<0.0000050	0.0000175
	Calcium (Ca)-Dissolved (mg/L)	55.2	18.5	<0.050	67.0	26.0
	Chromium (Cr)-Dissolved (mg/L)	0.00011	0.00041	<0.00010	<0.00010	0.00037
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00024	<0.00010 ^{RRV}	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.0104	0.00671	0.00056	0.00823	0.0826
	Iron (Fe)-Dissolved (mg/L)	0.069	0.601	<0.010	0.027	0.096
	Lead (Pb)-Dissolved (mg/L)	0.000080	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0029	<0.0010	<0.0010	0.0016	<0.0010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2095920-1 Water 12-MAY-18 09:55 W55	L2095920-2 Water 12-MAY-18 10:25 W14	L2095920-3 Water 12-MAY-18 11:00 W30	L2095920-4 Water 12-MAY-18 13:15 W10	L2095920-5 Water 14-MAY-18 09:00 W17
Grouping	Analyte					
WATER						
Dissolved Metals	Magnesium (Mg)-Dissolved (mg/L)	7.83	79.4	18.8	9.39 ^{DTC}	22.0
	Manganese (Mn)-Dissolved (mg/L)	0.0876	0.468	0.0482	0.268 ^{DTC}	0.0646
	Mercury (Hg)-Dissolved (mg/L)	0.0000083	<0.000050 ^{DLM}	<0.0000050	0.0000082	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00155	0.103	0.00724	0.000218	0.00610
	Nickel (Ni)-Dissolved (mg/L)	0.00154	0.0027	<0.00050	0.00063	0.00073
	Phosphorus (P)-Dissolved (mg/L)	0.077	<0.10 ^{DLA}	<0.050	0.062	<0.050
	Potassium (K)-Dissolved (mg/L)	1.93	94.7	4.15	5.01 ^{DTC}	3.79
	Selenium (Se)-Dissolved (mg/L)	0.000491	0.00788	0.00481	0.000092	0.000323
	Silicon (Si)-Dissolved (mg/L)	3.90	1.65 ^{DLA}	2.72	7.82 ^{DTC}	5.05
	Silver (Ag)-Dissolved (mg/L)	0.000014	<0.000020 ^{DLA}	0.000012	<0.000010 ^{DTC}	<0.000010
	Sodium (Na)-Dissolved (mg/L)	3.31	148	9.83	4.15 ^{DTC}	14.6
	Strontium (Sr)-Dissolved (mg/L)	0.239	6.05	0.735	0.244 ^{DTC}	0.728
	Sulfur (S)-Dissolved (mg/L)	2.82	766	25.3	0.64	17.6
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000020 ^{DLA}	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00020 ^{DLA}	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00272	<0.00060 ^{DLA}	0.00068	0.00089	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.000120	0.00553 ^{DLA}	0.00175	0.000045	0.00240
	Vanadium (V)-Dissolved (mg/L)	0.00053	<0.0010 ^{DLA}	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0047	<0.0020 ^{DLA}	<0.0010	0.0048	0.0017
	Zirconium (Zr)-Dissolved (mg/L)	0.00063	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2095920-6 Water 14-MAY-18 09:35 W8A	L2095920-7 Water 14-MAY-18 14:10 W16	L2095920-8 Water 14-MAY-18 15:15 W33S	L2095920-9 Water 15-MAY-18 08:10 MC1	L2095920-10 Water 15-MAY-18 08:50 W2
Grouping	Analyte					
WATER						
Dissolved Metals	Magnesium (Mg)-Dissolved (mg/L)	45.5	13.9	4.66	9.05	8.74
	Manganese (Mn)-Dissolved (mg/L)	1.98	0.145	0.0103	0.0373	0.0123
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.0121	0.00207	0.000564	0.000791	0.000798
	Nickel (Ni)-Dissolved (mg/L)	0.00126	0.00109	0.00163	0.00168	0.00164
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	6.84	2.29	0.74	1.21	1.21
	Selenium (Se)-Dissolved (mg/L)	0.00636	0.000464	0.000121	0.000156	0.000147
	Silicon (Si)-Dissolved (mg/L)	6.06	3.30	3.03	4.34	4.28
	Silver (Ag)-Dissolved (mg/L)	0.000014	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	38.2	9.11	2.53	5.74	5.55
	Strontium (Sr)-Dissolved (mg/L)	2.11	0.407	0.0937	0.219	0.220
	Sulfur (S)-Dissolved (mg/L)	96.6	14.3	1.74	3.57	3.56
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00056	0.00127	0.00129	0.00088	0.00111
	Uranium (U)-Dissolved (mg/L)	0.00312	0.000879	0.000032	0.000567	0.000561
	Vanadium (V)-Dissolved (mg/L)	0.00080	<0.00050	<0.00050	0.00083	0.00074
	Zinc (Zn)-Dissolved (mg/L)	0.0467	0.0024	0.0014	0.0070	0.0010
	Zirconium (Zr)-Dissolved (mg/L)	0.00031	<0.00030	0.00047	0.00038	0.00036

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2095920-11 Water 15-MAY-18 09:55 W3	L2095920-12 Water 15-MAY-18 10:30 W7	L2095920-13 Water 12-MAY-18 F-BL	L2095920-14 Water 14-MAY-18 DUP	L2095920-15 Water 14-MAY-18 10:15 W55
Grouping	Analyte					
WATER						
Dissolved Metals	Magnesium (Mg)-Dissolved (mg/L)	27.7	6.91	<0.10 ^{RRV}	21.6	6.64
	Manganese (Mn)-Dissolved (mg/L)	0.106	0.0422	0.00033	0.0575	0.00731
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	0.0000076
	Molybdenum (Mo)-Dissolved (mg/L)	0.00429	0.000699	<0.000050	0.00598	0.00134
	Nickel (Ni)-Dissolved (mg/L)	0.00140	0.00174	<0.00050	0.00070	0.00137
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	2.23	0.70	<0.10	3.81	1.56
	Selenium (Se)-Dissolved (mg/L)	0.000305	0.000137	<0.000050	0.000338	0.000323
	Silicon (Si)-Dissolved (mg/L)	5.44	4.26	<0.050	5.27	3.30
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	15.7	4.22	<0.050	14.4	3.69
	Strontium (Sr)-Dissolved (mg/L)	0.703	0.157	<0.00020	0.710	0.208
	Sulfur (S)-Dissolved (mg/L)	15.9	1.37	<0.50	18.0	4.37
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00079	0.00131	0.00040 ^{RRV}	<0.00030	0.00163
	Uranium (U)-Dissolved (mg/L)	0.00262	0.000375	<0.000010	0.00234	0.000174
	Vanadium (V)-Dissolved (mg/L)	<0.00050	0.00128	<0.00050	<0.00050	0.00053
	Zinc (Zn)-Dissolved (mg/L)	0.0029	<0.0010	<0.0010	0.0026	0.0016
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	0.00048	<0.00030	<0.00030	0.00046

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Aluminum (Al)-Total	MB-LOR	L2095920-13, -4
Laboratory Control Sample	Aluminum (Al)-Total	MES	L2095920-13, -4
Laboratory Control Sample	Boron (B)-Total	MES	L2095920-1, -10, -11, -12, -13, -14, -15, -3, -5, -6, -7, -8, -9
Laboratory Control Sample	Iron (Fe)-Total	MES	L2095920-1, -10, -11, -12, -13, -14, -15, -3, -5, -6, -7, -8, -9
Matrix Spike	Dissolved Organic Carbon	MS-B	L2095920-10, -11, -12, -13, -14, -5, -7, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2095920-1, -10, -11, -12, -13, -14, -15, -2, -3, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2095920-4
Matrix Spike	Boron (B)-Dissolved	MS-B	L2095920-1, -10, -11, -12, -13, -14, -15, -2, -3, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2095920-1, -10, -11, -12, -13, -14, -15, -2, -3, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2095920-4
Matrix Spike	Copper (Cu)-Dissolved	MS-B	L2095920-1, -10, -11, -12, -13, -14, -15, -2, -3, -5, -6, -7, -8, -9
Matrix Spike	Copper (Cu)-Dissolved	MS-B	L2095920-4
Matrix Spike	Lithium (Li)-Dissolved	MS-B	L2095920-1, -10, -11, -12, -13, -14, -15, -2, -3, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2095920-1, -10, -11, -12, -13, -14, -15, -2, -3, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2095920-4
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2095920-1, -10, -11, -12, -13, -14, -15, -2, -3, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2095920-4
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2095920-1, -10, -11, -12, -13, -14, -15, -2, -3, -5, -6, -7, -8, -9
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2095920-4
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2095920-1, -10, -11, -12, -13, -14, -15, -2, -3, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2095920-4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2095920-1, -10, -11, -12, -13, -14, -15, -2, -3, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2095920-4
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2095920-1, -10, -11, -12, -13, -14, -15, -2, -3, -5, -6, -7, -8, -9
Matrix Spike	Boron (B)-Total	MS-B	L2095920-13
Matrix Spike	Calcium (Ca)-Total	MS-B	L2095920-13
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2095920-13
Matrix Spike	Manganese (Mn)-Total	MS-B	L2095920-13
Matrix Spike	Sodium (Na)-Total	MS-B	L2095920-13
Matrix Spike	Strontium (Sr)-Total	MS-B	L2095920-13
Matrix Spike	Sulfur (S)-Total	MS-B	L2095920-13
Matrix Spike	Uranium (U)-Total	MS-B	L2095920-13

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLAI	Detection limit raised due to low level analytical interference or background.
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DTC	Dissolved concentration exceeds total. Results were confirmed by re-analysis.
DTMF	Dissolved concentration exceeds total for field-filtered metals sample. Metallic contaminants may have been introduced to dissolved sample during field filtration.
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter

Reference Information

MS-B Scan (considered acceptable as per OMOE & CCME).
 Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
 RRV Reported Result Verified By Repeat Analysis

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
BR-L-IC-N-VA	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
F-IC-N-VA	Water	Fluoride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			

Reference Information

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)
 Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
 This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)
 Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)
 Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value
 This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode
 It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)
 Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)
 This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
 The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC
 This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-05-16 A 1 of 2 2018-05-16 A 2 of 2

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com



L2095920-COFC

COC Number: 2018-05-16 A

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Report To		Report Format / Distribution		Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply													
Company:	Minto Explorations Ltd.	Select Report Format:	☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)	Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply													
Contact:	Minto Environment - Coordinator	Quality Control (QC) Report with Report	☒ YES ☐ NO	PRIORITY (Business Days)	4 day [P4] ☐				1 Business day [E1] ☐				EMERGENCY	Same Day, Weekend or Statutory holiday [E0] ☐			
Phone:	1-804-759-4659	☒ Compare Results to Criteria on Report - provide details below if box checked	3 day [P3] ☐														
Company address below will appear on the final report		Select Distribution:	☒ EMAIL ☐ MAIL ☐ FAX		2 day [P2] ☐												
Street:	2100-510 West Georgia St.	Email 1 or Fax	minto_environment@mintomine.com	Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm													
City/Province:	Vancouver, British Columbia	Email 2		For tests that can not be performed according to the service level selected, you will be contacted.													
Postal Code:	V6B 0M3	Email 3		Analysis Request													
Invoice To	Same as Report To ☐ YES ☒ NO	Invoice Distribution		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below													
Copy of Invoice with Report ☐ YES ☒ NO		Select Invoice Distribution:	☒ EMAIL ☐ MAIL ☐ FAX														
Company:	Minto Explorations Ltd.	Email 1 or Fax	ap@mintomine.com														
Contact:	Ruth Cayetano	Email 2															
Project Information		Oil and Gas Required Fields (client use)															
ALS Account # / Quote #:		AFE/Cost Center:	PO#														
Job #:		Major/Minor Code:	Routing Code:														
PO / AFE:	229098 (WUL)	Requisitioner:															
LSD:		Location:															
ALS Lab Work Order # (lab use only)		ALS Contact:	Shane Stack	Sampler:	CR/CP/EB												
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	pH / Conductivity / Alkalinity / Anions	Total Suspended Solids (TSS)	Total Dissolved Solids (TDS)	Total Metals (TM), Hardness	Dissolved Metals (DM) (Filtered and preserved)	Total Mercury, Hardness	Dissolved Mercury [1] (Filtered + preserved)	Total Nutrients (Ammonia)	Dissolved Organic Carbon (DOC)	Number of Containers			
	W3	15-May-18	9:55	Water	R	R	R	R	R	R	R	R	R		7		
	W7	15-May-18	10:30	Water	R	R	R	R	R	R	R	R	R		7		
	F-BL	12-May-18		Water	R	R	R	R	R	R	R	R	R		7		
	Dup	14-May-18		Water	R	R	R	R	R	R	R	R	R		7		
	W55	14-May-18	10:15	Water	R	R	R	R	R	R	R	R	R		6		
Drinking Water (DW) Samples ¹ (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)			SAMPLE CONDITION AS RECEIVED (lab use only)												
Are samples taken from a Regulated DW System? ☐ YES ☒ NO					Frozen ☐ SIF Observations Yes ☐ No ☐												
Are samples for human drinking water use? ☐ YES ☒ NO					Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐												
					Cooling Initiated ☒												
					INITIAL COOLER TEMPERATURES °C: 7.0 FINAL COOLER TEMPERATURES °C: 10												
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)												
Released by:	Corey Roberts	Date:	2018-05-16	Time:	Received by:	16 May 2018	Date:	16 May 2018	Time:	Received by:	11A	Date:	5/17	Time:	2:00p		

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

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Report To Contact and company name below will appear on the final report		Report Format / Distribution		Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply											
Company: Minto Explorations Ltd.		Select Report Format: ☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)		Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply											
Contact: Minto Environment - Coordinator		Quality Control (QC) Report with Report ☒ YES ☐ NO		PRIORITY (Business Days) 4 day [P4] ☐ 3 day [P3] ☐ 2 day [P2] ☐		EMERGENCY 1 Business day [E1] ☐ Same Day, Weekend or Statutory holiday [E0] ☐									
Phone: 1-804-759-4659		☒ Compare Results to Criteria on Report - provide details below if box checked													
Company address below will appear on the final report		Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX		Date and Time Required for all E&P TATs: dd-mm-yy hh:mm											
Street: 2100-510 West Georgia St.		Email 1 or Fax: minto_environment@mintomine.com		For tests that can not be performed according to the service level selected, you will be contacted.											
City/Province: Vancouver, British Columbia		Email 2		Analysis Request											
Postal Code: V6B 0M3		Email 3		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below											
Invoice To: Same as Report To ☐ YES ☒ NO		Invoice Distribution													
Copy of Invoice with Report ☐ YES ☒ NO		Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX													
Company: Minto Explorations Ltd.		Email 1 or Fax: ap@mintomine.com													
Contact: Ruth Cayetano		Email 2													
Project Information		Oil and Gas Required Fields (client use)													
ALS Account # / Quote #:		AFE/Cost Center:		PO#								Number of Containers			
Job #:		Major/Minor Code:		Routing Code:											
PO / AFE: 229096 (WUL)		Requisitioner:													
LSD:		Location:													
ALS Lab Work Order # (lab use only)		ALS Contact: Shane Stack		Sampler: CR/CP/EB/DF											
ALS Sample # (lab use only)		Sample Identification and/or Coordinates (This description will appear on the report)		Date (dd-mm-yy)		Time (hh:mm)		Sample Type							
W55				12-May-18		9:55		Water							
W14				12-May-18		10:25		Water							
W30				12-May-18		11:00		Water							
W10				12-May-18		13:15		Water							
W17				14-May-18		9:00		Water							
W8A				14-May-18		9:35		Water							
W16				14-May-18		14:10		Water							
W33S				14-May-18		15:15		Water							
MC1				15-May-18		8:10		Water							
W2				15-May-18		8:50		Water							
Drinking Water (DW) Samples¹ (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)													
Are samples taken from a Regulated DW System? ☐ YES ☒ NO															
Are samples for human drinking water use? ☐ YES ☒ NO															
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)													
Released by: Corey Roberts		Date: 2018-05-16		Time:		Received by: [Signature]		Date: 16 May 2018		Time: 15:50		FINAL SHIPMENT RECEPTION (lab use only)			
												Received by: [Signature]			
												Date: 5/17			
												Time: 2:00p			

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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 04-JUL-18
Report Date: 17-JUL-18 17:49 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2123725

Project P.O. #: 229096

Job Reference:

C of C Numbers: 2018-07-04 B 2 of 3, 2018-07-04 B 3 of 3,
2018-07-04 B 1 of 3

Legal Site Desc:

Comments: ADDITIONAL 17-JUL-18 17:27

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2123725-1 Water 30-JUN-18 15:10 UG4	L2123725-2 Water 02-JUL-18 07:45 W17	L2123725-3 Water 02-JUL-18 08:00 W16	L2123725-4 Water 02-JUL-18 10:30 W8A	L2123725-5 Water 02-JUL-18 09:25 W10
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	2180	469	420	544	209
	Hardness (as CaCO3) (mg/L)	1090	230	206	276	104
	pH (pH)	7.96	8.29	8.24	7.95	7.67
	Total Suspended Solids (mg/L)	995	<3.0	123	42.1	<3.0
	TDS (Calculated) (mg/L)	1830	276	253	340	118
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	147	192	152	226	96.9
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	147	192	152	226	96.9
	Ammonia, Total (as N) (mg/L)	15.1	<0.0050	0.0354	0.0390	0.0207
	Chloride (Cl) (mg/L)	19.9	5.86	4.87	2.76	0.11
	Nitrate and Nitrite (as N) (mg/L)	26.5	0.194	2.00	1.94	2.60
	Nitrate (as N) (mg/L)	25.9	0.194	1.99	1.93	2.59
	Nitrite (as N) (mg/L)	0.642	<0.0010	0.0088	0.0127	0.0095
	Sulfate (SO4) (mg/L)	1060	57.3	62.7	72.1	4.43
	Anion Sum (meq/L)	27.4	5.20	4.62	6.24	2.22
	Cation Sum (meq/L)	27.8	5.29	4.69	6.48	2.38
	Cation - Anion Balance (%)	0.7	0.8	0.8	1.9	3.6
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	3.33	9.84	18.6		
Total Metals	Aluminum (Al)-Total (mg/L)	20.0	<0.0030	0.396	1.69	0.0979
	Antimony (Sb)-Total (mg/L)	0.00095	<0.00010	<0.00010	0.00025	<0.00010
	Arsenic (As)-Total (mg/L)	0.00363	0.00036	0.00053	0.00181	0.00038
	Barium (Ba)-Total (mg/L)	0.417	0.0706	0.0806	0.116	0.167
	Beryllium (Be)-Total (mg/L)	0.000593	<0.000020	<0.000020	0.000082	<0.000020
	Bismuth (Bi)-Total (mg/L)	0.00141	<0.000050	<0.000050	0.000071	<0.000050
	Boron (B)-Total (mg/L)	0.551	0.026	0.014	0.019	<0.010
	Cadmium (Cd)-Total (mg/L)	0.00195	<0.0000050	0.0000168	0.000191	<0.0000050
	Calcium (Ca)-Total (mg/L)	403	59.0	54.5	72.1	32.1
	Chromium (Cr)-Total (mg/L)	0.00707	0.00014	0.00052	0.00371	0.00040
	Cobalt (Co)-Total (mg/L)	0.0152	<0.00010	0.00034	0.00158	0.00015
	Copper (Cu)-Total (mg/L)	10.1	0.00740	0.0491	0.559	0.0302
	Iron (Fe)-Total (mg/L)	50.5	0.014	0.692	5.42	0.549
	Lead (Pb)-Total (mg/L)	0.0399	<0.000050	0.000166	0.00101	<0.000050
	Lithium (Li)-Total (mg/L)	0.0236	0.0015	0.0014	0.0034	<0.0010
	Magnesium (Mg)-Total (mg/L)	49.6	17.9	17.3	21.5	7.50
	Manganese (Mn)-Total (mg/L)	1.19	0.00473	0.0594	0.722	0.0621

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2123725-6 Water 02-JUL-18 10:20 W30	L2123725-7 Water 02-JUL-18 10:50 W15	L2123725-8 Water 02-JUL-18 11:10 W12	L2123725-9 Water 02-JUL-18 13:40 W55	L2123725-10 Water 02-JUL-18 14:05 W35
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	423	437	2540	221	215
	Hardness (as CaCO3) (mg/L)	192	225	1210	109	109
	pH (pH)	8.35	8.25	8.06	8.17	8.09
	Total Suspended Solids (mg/L)	<3.0	<3.0	9.3	<3.0	<3.0
	TDS (Calculated) (mg/L)	254	266	2120	125	126
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	116	148	188	91.9	87.3
	Alkalinity, Carbonate (as CaCO3) (mg/L)	2.8	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	119	148	188	91.9	87.3
	Ammonia, Total (as N) (mg/L)	0.0238	0.0298	4.59	0.0114	0.0097
	Chloride (Cl) (mg/L)	1.25	1.01	31.0	0.63	0.64
	Nitrate and Nitrite (as N) (mg/L)	0.0949	2.71	12.1	2.61	3.22
	Nitrate (as N) (mg/L)	0.0924	2.70	4.86	2.61	3.21
	Nitrite (as N) (mg/L)	0.0025	0.0104	7.23	0.0030	0.0033
	Sulfate (SO4) (mg/L)	103	74.2	1310	12.4	13.9
	Anion Sum (meq/L)	4.55	4.73	32.7	2.30	2.28
	Cation Sum (meq/L)	4.48	4.95	31.5	2.46	2.46
	Cation - Anion Balance (%)	-0.7	2.3	-1.9	3.4	3.8
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)		23.6			25.7
Total Metals	Aluminum (Al)-Total (mg/L)	0.0206	0.0654	0.0862	0.0497	0.0437
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	0.00038	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00082	0.00044	0.00047	0.00045	0.00040
	Barium (Ba)-Total (mg/L)	0.0651	0.0601	0.0876	0.0578	0.0564
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000040 ^{DLA}	0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.00010 ^{DLA}	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.017	<0.010	0.288	0.011	<0.010
	Cadmium (Cd)-Total (mg/L)	0.0000107	<0.0000050	<0.000090 ^{DLM}	0.0000095	0.0000072
	Calcium (Ca)-Total (mg/L)	40.9	59.0	384	28.8	28.7
	Chromium (Cr)-Total (mg/L)	<0.00010	0.00036	<0.00020 ^{DLA}	0.00044	0.00055
	Cobalt (Co)-Total (mg/L)	<0.00010	0.00015	0.00150	<0.00010	<0.00010
	Copper (Cu)-Total (mg/L)	0.0303	0.0225	0.0565	0.0649	0.0344
	Iron (Fe)-Total (mg/L)	0.367	0.241	0.311	0.075	0.079
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.00010 ^{DLA}	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	0.0027	<0.0010	0.0198	<0.0010	<0.0010
	Magnesium (Mg)-Total (mg/L)	22.2	17.5	74.3	8.52	8.51
	Manganese (Mn)-Total (mg/L)	0.0360	0.0385	1.22	0.00241	0.00594

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2123725-11 Water 02-JUL-18 DUP	L2123725-12 Water 02-JUL-18 14:05 F-BL	L2123725-13 Water 02-JUL-18 14:30 W33S	L2123725-14 Water 02-JUL-18 15:00 W62	L2123725-15 Water 02-JUL-18 15:35 W14
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	215	<2.0	165	785	3280
	Hardness (as CaCO3) (mg/L)	104	<0.50	87.8	386	1680
	pH (pH)	8.17	5.57	7.95	8.30	8.16
	Total Suspended Solids (mg/L)	<3.0	<3.0	5.9	5.1	31.5
	TDS (Calculated) (mg/L)	124	<1.0	93.5	495	3060
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	92.2	<1.0	77.8	268	133
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	2.6	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	92.2	<1.0	77.8	271	133
	Ammonia, Total (as N) (mg/L)	0.0114	<0.0050	0.0163	0.0090	7.88
	Chloride (Cl) (mg/L)	0.63	<0.10	0.14	14.8	40.3
	Nitrate and Nitrite (as N) (mg/L)	2.66	<0.0051	1.05	5.60	22.8
	Nitrate (as N) (mg/L)	2.65	<0.0050	1.01	5.58	15.3
	Nitrite (as N) (mg/L)	0.0029	<0.0010	0.0353	0.0272	7.47
	Sulfate (SO4) (mg/L)	12.6	<0.30	6.36	131	1970
	Anion Sum (meq/L)	2.31	<0.10	1.77	8.96	46.4
	Cation Sum (meq/L)	2.37	<0.10	1.97	8.84	44.3
	Cation - Anion Balance (%)	1.2	0.0	5.3	-0.7	-2.3
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)		0.52			
Total Metals	Aluminum (Al)-Total (mg/L)	0.0480	0.0161 ^{RRV}	0.0330	0.0978	
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	0.00034	
	Arsenic (As)-Total (mg/L)	0.00046	<0.00010	0.00041	0.00050	
	Barium (Ba)-Total (mg/L)	0.0589	0.00049 ^{RRV}	0.0390	0.0823	
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Total (mg/L)	<0.010	<0.010	<0.010	0.023	
	Cadmium (Cd)-Total (mg/L)	0.0000114	0.0000429 ^{RRV}	0.0000118	0.0000799	
	Calcium (Ca)-Total (mg/L)	29.3	0.227 ^{RRV}	23.1	102	
	Chromium (Cr)-Total (mg/L)	0.00049	<0.00010	0.00056	0.00033	
	Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	<0.00010	0.00014	
	Copper (Cu)-Total (mg/L)	0.0676	0.00259 ^{RRV}	0.0302	0.0814	
	Iron (Fe)-Total (mg/L)	0.076	0.030 ^{RRV}	0.067	0.206	
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	0.000090	
	Lithium (Li)-Total (mg/L)	<0.0010	<0.0010	<0.0010	0.0028	
	Magnesium (Mg)-Total (mg/L)	8.77	<0.10	6.84	31.7	
	Manganese (Mn)-Total (mg/L)	0.00228	0.00156 ^{RRV}	0.0106	0.0321	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2123725-16 Water 03-JUL-18 08:30 W3	L2123725-17 Water 03-JUL-18 08:50 W50	L2123725-18 Water 03-JUL-18 09:05 W16A	L2123725-19 Water 03-JUL-18 09:50 W2	L2123725-20 Water 03-JUL-18 DUP
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	465	423	423	307	308
	Hardness (as CaCO3) (mg/L)	232	207	205	149	157
	pH (pH)	8.36	8.33	8.33	8.36	8.35
	Total Suspended Solids (mg/L)	4.1	<3.0	<3.0	17.7	15.9
	TDS (Calculated) (mg/L)	276	255	252	177	179
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	179	154	150	143	141
	Alkalinity, Carbonate (as CaCO3) (mg/L)	4.8	2.8	2.6	3.4	3.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	183	157	152	146	144
	Ammonia, Total (as N) (mg/L)	0.0083	0.0230	0.0363	0.0077	0.0079
	Chloride (Cl) (mg/L)	4.94	4.78	4.74	1.83	1.84
	Nitrate and Nitrite (as N) (mg/L)	1.08	1.91	1.97	0.206	0.207
	Nitrate (as N) (mg/L)	1.08	1.90	1.96	0.205	0.206
	Nitrite (as N) (mg/L)	0.0022	0.0081	0.0090	0.0014	0.0014
	Sulfate (SO4) (mg/L)	60.1	62.0	62.4	24.8	24.8
	Anion Sum (meq/L)	5.13	4.69	4.61	3.50	3.46
	Cation Sum (meq/L)	5.31	4.69	4.66	3.43	3.60
	Cation - Anion Balance (%)	1.7	0.0	0.5	-1.0	2.0
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	13.7	17.8	18.5	12.9	12.5
Total Metals	Aluminum (Al)-Total (mg/L)	0.0394	0.0309	0.0658	0.482	0.474
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	0.00013	0.00013
	Arsenic (As)-Total (mg/L)	0.00037	0.00044	0.00050	0.00089	0.00081
	Barium (Ba)-Total (mg/L)	0.0721	0.0739	0.0763	0.0723	0.0717
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.017	0.014	0.013	<0.010	<0.010
	Cadmium (Cd)-Total (mg/L)	0.0000058	0.0000095	0.0000100	0.0000105	0.0000122
	Calcium (Ca)-Total (mg/L)	51.4	53.4	53.3	37.8	35.3
	Chromium (Cr)-Total (mg/L)	0.00025	0.00025	0.00048	0.00118	0.00109
	Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	0.00012	0.00034	0.00033
	Copper (Cu)-Total (mg/L)	0.0179	0.0303	0.0357	0.00459	0.00454
	Iron (Fe)-Total (mg/L)	0.081	0.093	0.168	0.851	0.816
	Lead (Pb)-Total (mg/L)	<0.000050	0.000131	0.000160	0.000223	0.000209
	Lithium (Li)-Total (mg/L)	0.0017	0.0012	0.0012	0.0018	0.0016
	Magnesium (Mg)-Total (mg/L)	21.4	17.3	17.2	13.6	13.5
	Manganese (Mn)-Total (mg/L)	0.0186	0.0149	0.0454	0.0488	0.0474

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID	L2123725-21	L2123725-22		
		Description	Water	Water		
		Sampled Date	03-JUL-18	03-JUL-18		
		Sampled Time	10:45	11:45		
		Client ID	MC1	W7		
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)		302	199		
	Hardness (as CaCO3) (mg/L)		152	97.3		
	pH (pH)		8.35	8.22		
	Total Suspended Solids (mg/L)		86.2	61.4		
	TDS (Calculated) (mg/L)		175	110		
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)		141	105		
	Alkalinity, Carbonate (as CaCO3) (mg/L)		3.0	<1.0		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)		<1.0	<1.0		
	Alkalinity, Total (as CaCO3) (mg/L)		144	105		
	Ammonia, Total (as N) (mg/L)		0.0144	0.0098		
	Chloride (Cl) (mg/L)		1.66	0.21		
	Nitrate and Nitrite (as N) (mg/L)		0.199	0.0794		
	Nitrate (as N) (mg/L)		0.198	0.0794		
	Nitrite (as N) (mg/L)		0.0019	<0.0010		
	Sulfate (SO4) (mg/L)		23.4	6.52		
	Anion Sum (meq/L)		3.42	2.24		
	Cation Sum (meq/L)		3.48	2.25		
	Cation - Anion Balance (%)		1.0	0.1		
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)		13.2	16.5		
Total Metals	Aluminum (Al)-Total (mg/L)		1.91	1.25		
	Antimony (Sb)-Total (mg/L)		0.00018	0.00014		
	Arsenic (As)-Total (mg/L)		0.00176	0.00097		
	Barium (Ba)-Total (mg/L)		0.0982	0.0815		
	Beryllium (Be)-Total (mg/L)		0.000073	0.000049		
	Bismuth (Bi)-Total (mg/L)		<0.000050	<0.000050		
	Boron (B)-Total (mg/L)		<0.010	<0.010		
	Cadmium (Cd)-Total (mg/L)		0.0000282	0.0000260		
	Calcium (Ca)-Total (mg/L)		37.7	24.8		
	Chromium (Cr)-Total (mg/L)		0.00366	0.00285		
	Cobalt (Co)-Total (mg/L)		0.00124	0.00092		
	Copper (Cu)-Total (mg/L)		0.00880	0.00474		
	Iron (Fe)-Total (mg/L)		3.00	1.86		
	Lead (Pb)-Total (mg/L)		0.000828	0.000504		
	Lithium (Li)-Total (mg/L)		0.0026	0.0015		
	Magnesium (Mg)-Total (mg/L)		13.9	9.72		
	Manganese (Mn)-Total (mg/L)		0.124	0.0646		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2123725-1 Water 30-JUN-18 15:10 UG4	L2123725-2 Water 02-JUL-18 07:45 W17	L2123725-3 Water 02-JUL-18 08:00 W16	L2123725-4 Water 02-JUL-18 10:30 W8A	L2123725-5 Water 02-JUL-18 09:25 W10
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.00010 ^{DLM}	<0.0000050	<0.0000050	0.0000178	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.0228	0.00642	0.00272	0.00548	0.000344
	Nickel (Ni)-Total (mg/L)	0.00769	0.00061	0.00136	0.00328	0.00125
	Phosphorus (P)-Total (mg/L)	0.789	<0.050	<0.050	0.235	<0.050
	Potassium (K)-Total (mg/L)	15.9	3.57	2.78	4.44	0.80
	Selenium (Se)-Total (mg/L)	0.0123	0.000614	0.00102	0.00224	0.000242
	Silicon (Si)-Total (mg/L)	41.7	5.18	4.21	8.88	2.64
	Silver (Ag)-Total (mg/L)	0.00473	<0.000010	<0.000020 ^{DLAI}	0.000263	<0.000010
	Sodium (Na)-Total (mg/L)	111	13.9	11.7	18.3	6.03
	Strontium (Sr)-Total (mg/L)	6.02	0.632	0.519	0.937	0.208
	Sulfur (S)-Total (mg/L)	391	18.7	20.9	24.5	2.00
	Thallium (Tl)-Total (mg/L)	0.000237	<0.000010	<0.000010	0.000026	<0.000010
	Tin (Sn)-Total (mg/L)	0.00148	<0.00010	<0.00010	0.00016	<0.00010
	Titanium (Ti)-Total (mg/L)	1.37	<0.00030	0.0205	<0.11 ^{DLM}	0.00090
	Uranium (U)-Total (mg/L)	0.00930	0.00191	0.00126	0.00121	0.000091
	Vanadium (V)-Total (mg/L)	0.0825	<0.00050	0.00190	0.00838	<0.00050
	Zinc (Zn)-Total (mg/L)	0.319	<0.0030	0.0035	0.761	<0.0030
	Zirconium (Zr)-Total (mg/L)	0.00076	<0.00030	0.00032	0.00039	0.00050
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0105	0.0036	0.0167	0.0138	0.135 ^{DTMF}
	Antimony (Sb)-Dissolved (mg/L)	0.00079	<0.00010	<0.00010	0.00011	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00134	0.00037	0.00046	0.00067	0.00046
	Barium (Ba)-Dissolved (mg/L)	0.0367	0.0731	0.0729	0.0706	0.145
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	0.000031	0.000023
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.456	0.026	0.014	0.019	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	0.0000437	<0.0000050	0.0000085	0.000143	0.0000052
	Calcium (Ca)-Dissolved (mg/L)	376	61.3	54.4	75.1	30.2
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00031	0.00050
	Cobalt (Co)-Dissolved (mg/L)	0.00058	<0.00010	<0.00010	0.00047	0.00022
	Copper (Cu)-Dissolved (mg/L)	0.00167	0.0100	0.0329	0.167	0.0360
	Iron (Fe)-Dissolved (mg/L)	0.037	<0.010	0.082	0.188	0.890 ^{DTMF}
	Lead (Pb)-Dissolved (mg/L)	0.000103	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0116	0.0014	0.0011	0.0025	<0.0010
	Magnesium (Mg)-Dissolved (mg/L)	37.8	18.6	17.1	21.6	6.93
	Manganese (Mn)-Dissolved (mg/L)	0.0715	0.00519	0.0400	0.753	0.0913 ^{DTMF}

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2123725-6 Water 02-JUL-18 10:20 W30	L2123725-7 Water 02-JUL-18 10:50 W15	L2123725-8 Water 02-JUL-18 11:10 W12	L2123725-9 Water 02-JUL-18 13:40 W55	L2123725-10 Water 02-JUL-18 14:05 W35
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.00709	0.00216	0.0773	0.00130	0.00107
	Nickel (Ni)-Total (mg/L)	0.00050	0.00116	0.0050	0.00145	0.00156
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.10 ^{DLA}	<0.050	<0.050
	Potassium (K)-Total (mg/L)	3.58	1.92	48.6	1.52	0.75
	Selenium (Se)-Total (mg/L)	0.00203	0.00111	0.00801	0.000437	0.000356
	Silicon (Si)-Total (mg/L)	0.54	3.96	3.89	4.36	4.67
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000020 ^{DLA}	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	13.2	9.51	136	5.57	5.92
	Strontium (Sr)-Total (mg/L)	0.707	0.521	6.25	0.231	0.209
	Sulfur (S)-Total (mg/L)	35.9	25.3	467	4.43	4.90
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000020 ^{DLA}	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010 ^{DLM}	<0.00020 ^{DLA}	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	0.00096	<0.0030	0.00293	0.00146	0.00144
	Uranium (U)-Total (mg/L)	0.00131	0.00110	0.00740	0.000211	0.000145
	Vanadium (V)-Total (mg/L)	0.00060	0.00080	<0.0010 ^{DLA}	0.00080	0.00050
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0060 ^{DLA}	<0.0030	0.0034
	Zirconium (Zr)-Total (mg/L)	<0.00030	0.00040	<0.00030	0.00037	0.00040
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0094	0.0245	0.0064	0.0266	0.0270
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	0.00036	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00069	0.00043	0.00042	0.00045	0.00033
	Barium (Ba)-Dissolved (mg/L)	0.0580	0.0569	0.0844	0.0547	0.0529
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000040 ^{DLA}	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.00010 ^{DLA}	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.015	<0.010	0.261 ^{DLM}	<0.010	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.000080	0.0000079	0.0000063
	Calcium (Ca)-Dissolved (mg/L)	40.9	61.1	368 ^{DLA}	29.8	29.9
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00033	<0.00020	0.00043	0.00041
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00012	0.00135	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.0224	0.0178	0.0378	0.0628	0.0331
	Iron (Fe)-Dissolved (mg/L)	0.141	0.166	0.067	0.046	0.052
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	0.00016	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0025	<0.0010	0.0180	<0.0010	<0.0010
	Magnesium (Mg)-Dissolved (mg/L)	21.8	17.5	70.1	8.44	8.44
	Manganese (Mn)-Dissolved (mg/L)	0.0232	0.0370	1.17	0.00181	0.00529

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2123725-11 Water 02-JUL-18 DUP	L2123725-12 Water 02-JUL-18 14:05 F-BL	L2123725-13 Water 02-JUL-18 14:30 W33S	L2123725-14 Water 02-JUL-18 15:00 W62	L2123725-15 Water 02-JUL-18 15:35 W14
Grouping	Analyte						
WATER							
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Total (mg/L)	0.00124	<0.000050	0.000943	0.00649		
	Nickel (Ni)-Total (mg/L)	0.00139	<0.00050	0.00155	0.00091		
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050		
	Potassium (K)-Total (mg/L)	1.56	<0.10	0.46	4.86		
	Selenium (Se)-Total (mg/L)	0.000455	<0.000050	0.000312	0.00239		
	Silicon (Si)-Total (mg/L)	4.30	<0.10	4.74	6.68		
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000020 ^{DLAI}		
	Sodium (Na)-Total (mg/L)	5.66	<0.050	4.30	23.4		
	Strontium (Sr)-Total (mg/L)	0.233	0.00365 ^{RRV}	0.157	1.15		
	Sulfur (S)-Total (mg/L)	4.58	<0.50	2.28	45.4		
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010		
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010		
	Titanium (Ti)-Total (mg/L)	0.00169	0.00131 ^{RRV}	0.00072	0.00460		
	Uranium (U)-Total (mg/L)	0.000215	<0.000010	0.000054	0.00363		
	Vanadium (V)-Total (mg/L)	0.00081	<0.00050	<0.00050	0.00095		
	Zinc (Zn)-Total (mg/L)	<0.0030	0.0044 ^{RRV}	<0.0030	0.0617		
	Zirconium (Zr)-Total (mg/L)	0.00039	<0.00030	0.00043	<0.00030		
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0251	<0.0010	0.0837 ^{DTMF}	0.0049	0.0273	
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	0.00063	
	Arsenic (As)-Dissolved (mg/L)	0.00046	<0.00010	0.00039	0.00043	0.00041	
	Barium (Ba)-Dissolved (mg/L)	0.0558	<0.00010	0.0369	0.0727	0.174 ^{DLA}	
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000040 ^{DLA}	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.00010	
	Boron (B)-Dissolved (mg/L)	<0.010	<0.010	<0.010	0.021	0.372 ^{DLM}	
	Cadmium (Cd)-Dissolved (mg/L)	0.0000077	<0.0000050	0.0000112	0.0000798	<0.000030	
	Calcium (Ca)-Dissolved (mg/L)	27.5	<0.050	24.1	103	482 ^{DLA}	
	Chromium (Cr)-Dissolved (mg/L)	0.00043	<0.00010	0.00056	0.00017	<0.00020	
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	0.00012	<0.00010	0.00032	
	Copper (Cu)-Dissolved (mg/L)	0.0661	0.00038 ^{RRV}	0.0340	0.0656	0.00268 ^{DLA}	
	Iron (Fe)-Dissolved (mg/L)	0.045	<0.010	0.131 ^{DTMF}	0.030	<0.020 ^{DLA}	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.00010 ^{DLA}	
	Lithium (Li)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	0.0026	0.0357	
	Magnesium (Mg)-Dissolved (mg/L)	8.63	<0.10	6.68	31.2	115	
	Manganese (Mn)-Dissolved (mg/L)	0.00143	0.00027 ^{RRV}	0.0119	0.0271	0.612	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2123725-16 Water 03-JUL-18 08:30 W3	L2123725-17 Water 03-JUL-18 08:50 W50	L2123725-18 Water 03-JUL-18 09:05 W16A	L2123725-19 Water 03-JUL-18 09:50 W2	L2123725-20 Water 03-JUL-18 DUP
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.00352	0.00272	0.00280	0.00189	0.00175
	Nickel (Ni)-Total (mg/L)	0.00119	0.00105	0.00115	0.00205	0.00202
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	2.61	2.62	2.65	1.44	1.41
	Selenium (Se)-Total (mg/L)	0.000819	0.000939	0.00121	0.000183	0.000199
	Silicon (Si)-Total (mg/L)	5.28	3.59	3.65	6.40	6.32
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	14.4	11.7	11.6	9.20	9.07
	Strontium (Sr)-Total (mg/L)	0.551	0.511	0.513	0.391	0.364
	Sulfur (S)-Total (mg/L)	24.0	21.5	22.2	8.47	8.94
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	0.00166	0.00118	0.00313	0.0209	0.0207
	Uranium (U)-Total (mg/L)	0.00160	0.00122	0.00125	0.00146	0.00139
	Vanadium (V)-Total (mg/L)	0.00056	0.00053	0.00069	0.00249	0.00243
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	0.0037
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	0.00033
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0045	0.0126	0.0126	0.0111	0.0097
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00033	0.00040	0.00044	0.00054	0.00053
	Barium (Ba)-Dissolved (mg/L)	0.0730	0.0732	0.0757	0.0672	0.0699
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.017	0.013	0.013	<0.010	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	0.0000237 ^{DTMF}	0.0000077	0.0000080	<0.0000050	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	58.3	55.1	54.9	36.7	39.4
	Chromium (Cr)-Dissolved (mg/L)	0.00011	0.00014	0.00014	0.00023	0.00018
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.0150	0.0294	0.0325	0.00356	0.00324
	Iron (Fe)-Dissolved (mg/L)	0.032	0.068	0.079	0.074	0.064
	Lead (Pb)-Dissolved (mg/L)	<0.000050	0.000105	0.000096	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0019	0.0012	0.0012	0.0014	0.0015
	Magnesium (Mg)-Dissolved (mg/L)	21.0	16.8	16.6	13.8	14.2
	Manganese (Mn)-Dissolved (mg/L)	0.0123	0.0126	0.0426	0.00367	0.00372

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2123725-21 Water 03-JUL-18 10:45 MC1	L2123725-22 Water 03-JUL-18 11:45 W7		
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050			
	Molybdenum (Mo)-Total (mg/L)	0.00195	0.00124			
	Nickel (Ni)-Total (mg/L)	0.00476	0.00392			
	Phosphorus (P)-Total (mg/L)	0.104	0.081			
	Potassium (K)-Total (mg/L)	1.52	0.82			
	Selenium (Se)-Total (mg/L)	0.000212	0.000165			
	Silicon (Si)-Total (mg/L)	9.44	7.88			
	Silver (Ag)-Total (mg/L)	0.000016	0.000010			
	Sodium (Na)-Total (mg/L)	8.94	6.36			
	Strontium (Sr)-Total (mg/L)	0.395	0.251			
	Sulfur (S)-Total (mg/L)	8.16	1.97			
	Thallium (Tl)-Total (mg/L)	0.000016	0.000011			
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010			
	Titanium (Ti)-Total (mg/L)	0.0822	0.0459			
	Uranium (U)-Total (mg/L)	0.00154	0.000854			
	Vanadium (V)-Total (mg/L)	0.00678	0.00477			
	Zinc (Zn)-Total (mg/L)	0.0081	0.0054			
	Zirconium (Zr)-Total (mg/L)	0.00050	0.00039			
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD			
	Dissolved Metals Filtration Location	FIELD	FIELD			
	Aluminum (Al)-Dissolved (mg/L)	0.0098	0.0197			
	Antimony (Sb)-Dissolved (mg/L)	0.00011	<0.00010			
	Arsenic (As)-Dissolved (mg/L)	0.00056	0.00044			
	Barium (Ba)-Dissolved (mg/L)	0.0681	0.0573			
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020			
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050			
	Boron (B)-Dissolved (mg/L)	<0.010	<0.010			
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050			
	Calcium (Ca)-Dissolved (mg/L)	37.8	23.8			
	Chromium (Cr)-Dissolved (mg/L)	0.00023	0.00041			
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010			
	Copper (Cu)-Dissolved (mg/L)	0.00317	0.00251			
	Iron (Fe)-Dissolved (mg/L)	0.092	0.103			
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050			
	Lithium (Li)-Dissolved (mg/L)	0.0013	<0.0010			
	Magnesium (Mg)-Dissolved (mg/L)	13.9	9.19			
	Manganese (Mn)-Dissolved (mg/L)	0.0146	0.0141			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2123725-1 Water 30-JUN-18 15:10 UG4	L2123725-2 Water 02-JUL-18 07:45 W17	L2123725-3 Water 02-JUL-18 08:00 W16	L2123725-4 Water 02-JUL-18 10:30 W8A	L2123725-5 Water 02-JUL-18 09:25 W10
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	0.0000087	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.0240	0.00611	0.00265	0.00522	0.000387
	Nickel (Ni)-Dissolved (mg/L)	0.00253	0.00060	0.00097	0.00119	0.00127
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	8.29	3.58	2.59	3.96	0.74
	Selenium (Se)-Dissolved (mg/L)	0.00855	0.000448	0.000894	0.00183	0.000128
	Silicon (Si)-Dissolved (mg/L)	7.29	5.29	3.39	5.62	3.52
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	0.000030	<0.000010
	Sodium (Na)-Dissolved (mg/L)	106	13.9	11.3	18.5	5.01
	Strontium (Sr)-Dissolved (mg/L)	5.72	0.643	0.507	0.952	0.197
	Sulfur (S)-Dissolved (mg/L)	372	19.0	20.8	25.5	1.43
	Thallium (Tl)-Dissolved (mg/L)	0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	0.00075	0.00054	0.00151 ^{DTMF}
	Uranium (U)-Dissolved (mg/L)	0.00871	0.00190	0.00123	0.00132	0.000109
	Vanadium (V)-Dissolved (mg/L)	0.00075	<0.00050 ^{DTC}	0.00052	0.00074	0.00060
	Zinc (Zn)-Dissolved (mg/L)	0.0070	0.0245	<0.0010	0.217	0.0019
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	0.00062

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2123725-6 Water 02-JUL-18 10:20 W30	L2123725-7 Water 02-JUL-18 10:50 W15	L2123725-8 Water 02-JUL-18 11:10 W12	L2123725-9 Water 02-JUL-18 13:40 W55	L2123725-10 Water 02-JUL-18 14:05 W35
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00684	0.00208	0.0769	0.00120	0.00102
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	0.00104	0.0048	0.00138	0.00142
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.10 ^{DLA}	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	3.47	1.87	48.5	1.49	0.75
	Selenium (Se)-Dissolved (mg/L)	0.00195	0.00112	0.00829	0.000272	0.000195
	Silicon (Si)-Dissolved (mg/L)	0.465	4.02	3.63	4.17	4.59
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000020 ^{DLA}	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	12.6	9.23	131	5.34	5.66
	Strontium (Sr)-Dissolved (mg/L)	0.673	0.519	5.93	0.229	0.207
	Sulfur (S)-Dissolved (mg/L)	35.1	26.1	482	4.29	4.59
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000020 ^{DLA}	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00020 ^{DLA}	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00052	0.00113	<0.00060 ^{DLA}	0.00099	0.00076
	Uranium (U)-Dissolved (mg/L)	0.00133	0.00111	0.00722	0.000200	0.000151
	Vanadium (V)-Dissolved (mg/L)	<0.00050	0.00058	<0.0010 ^{DLA}	0.00069	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	0.0040	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	0.00037	<0.00030	0.00038	0.00038

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2123725-11 Water 02-JUL-18 DUP	L2123725-12 Water 02-JUL-18 14:05 F-BL	L2123725-13 Water 02-JUL-18 14:30 W33S	L2123725-14 Water 02-JUL-18 15:00 W62	L2123725-15 Water 02-JUL-18 15:35 W14
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00110	<0.000050	0.000905	0.00628	0.131
	Nickel (Ni)-Dissolved (mg/L)	0.00132	<0.00050	0.00151	0.00075	0.0105
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.10 ^{DLA}
	Potassium (K)-Dissolved (mg/L)	1.55	<0.10	0.45	4.63	86.0
	Selenium (Se)-Dissolved (mg/L)	0.000295	<0.000050	0.000158	0.00235	0.0115
	Silicon (Si)-Dissolved (mg/L)	4.12	<0.050	4.65	6.56	2.26
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020 ^{DLA}
	Sodium (Na)-Dissolved (mg/L)	5.48	<0.050	4.16	22.7	184
	Strontium (Sr)-Dissolved (mg/L)	0.212	0.00082 ^{RRV}	0.156	1.14	8.36
	Sulfur (S)-Dissolved (mg/L)	4.33	<0.50	2.26	45.2	689
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020 ^{DLA}
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020 ^{DLA}
	Titanium (Ti)-Dissolved (mg/L)	0.00099	<0.00030	0.00239 ^{DTMF}	<0.00030	<0.00060 ^{DLA}
	Uranium (U)-Dissolved (mg/L)	0.000198	<0.000010	0.000057	0.00366	0.00837
	Vanadium (V)-Dissolved (mg/L)	0.00068	<0.00050	0.00056	0.00058	<0.0010 ^{DLA}
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	0.0014	0.0545	0.0023
	Zirconium (Zr)-Dissolved (mg/L)	0.00034	<0.00030	0.00044	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2123725-16 Water 03-JUL-18 08:30 W3	L2123725-17 Water 03-JUL-18 08:50 W50	L2123725-18 Water 03-JUL-18 09:05 W16A	L2123725-19 Water 03-JUL-18 09:50 W2	L2123725-20 Water 03-JUL-18 DUP
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00379	0.00259	0.00266	0.00178	0.00190
	Nickel (Ni)-Dissolved (mg/L)	0.00122	0.00086	0.00096	0.00126	0.00127
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	2.67	2.66	2.68	1.49	1.52
	Selenium (Se)-Dissolved (mg/L)	0.000478	0.000809	0.000925	0.000158	0.000215
	Silicon (Si)-Dissolved (mg/L)	4.50	3.60	3.54	5.48	5.70
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	13.8	11.1	10.9	9.52	9.70
	Strontium (Sr)-Dissolved (mg/L)	0.631	0.531	0.525	0.378	0.405
	Sulfur (S)-Dissolved (mg/L)	20.2	21.4	21.8	8.24	8.51
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	0.00056	0.00047	0.00052	<0.00060 ^{DLM}
	Uranium (U)-Dissolved (mg/L)	0.00180	0.00124	0.00128	0.00137	0.00147
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	0.00050	0.00093	0.00097
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2123725-21 Water 03-JUL-18 10:45 MC1	L2123725-22 Water 03-JUL-18 11:45 W7			
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050			
	Molybdenum (Mo)-Dissolved (mg/L)	0.00192	0.00122			
	Nickel (Ni)-Dissolved (mg/L)	0.00144	0.00163			
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050			
	Potassium (K)-Dissolved (mg/L)	1.40	0.70			
	Selenium (Se)-Dissolved (mg/L)	0.000182	0.000137			
	Silicon (Si)-Dissolved (mg/L)	5.50	5.73			
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010			
	Sodium (Na)-Dissolved (mg/L)	9.44	6.38			
	Strontium (Sr)-Dissolved (mg/L)	0.393	0.242			
	Sulfur (S)-Dissolved (mg/L)	7.87	2.06			
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010			
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010			
	Titanium (Ti)-Dissolved (mg/L)	0.00059	0.00100			
	Uranium (U)-Dissolved (mg/L)	0.00146	0.000705			
	Vanadium (V)-Dissolved (mg/L)	0.00103	0.00104			
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010			
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	0.00035			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Conductivity	B	L2123725-1
Laboratory Control Sample	Strontium (Sr)-Dissolved	MES	L2123725-1, -10, -11, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Dissolved Organic Carbon	MS-B	L2123725-1, -10, -2, -3, -7
Matrix Spike	Dissolved Organic Carbon	MS-B	L2123725-12
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2123725-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2123725-16, -17, -18, -19, -20, -21, -22
Matrix Spike	Boron (B)-Dissolved	MS-B	L2123725-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2123725-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2123725-16, -17, -18, -19, -20, -21, -22
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2123725-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2123725-16, -17, -18, -19, -20, -21, -22
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2123725-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Molybdenum (Mo)-Dissolved	MS-B	L2123725-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2123725-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2123725-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2123725-16, -17, -18, -19, -20, -21, -22
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2123725-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2123725-16, -17, -18, -19, -20, -21, -22
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2123725-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2123725-16, -17, -18, -19, -20, -21, -22
Matrix Spike	Uranium (U)-Dissolved	MS-B	L2123725-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Aluminum (Al)-Total	MS-B	L2123725-1, -10, -11, -13, -14, -16, -17, -18, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Aluminum (Al)-Total	MS-B	L2123725-19, -20, -21, -22
Matrix Spike	Barium (Ba)-Total	MS-B	L2123725-1, -10, -11, -13, -14, -16, -17, -18, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Total	MS-B	L2123725-19, -20, -21, -22
Matrix Spike	Barium (Ba)-Total	MS-B	L2123725-12, -2
Matrix Spike	Boron (B)-Total	MS-B	L2123725-1, -10, -11, -13, -14, -16, -17, -18, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L2123725-1, -10, -11, -13, -14, -16, -17, -18, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L2123725-19, -20, -21, -22
Matrix Spike	Calcium (Ca)-Total	MS-B	L2123725-12, -2
Matrix Spike	Copper (Cu)-Total	MS-B	L2123725-1, -10, -11, -13, -14, -16, -17, -18, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Iron (Fe)-Total	MS-B	L2123725-1, -10, -11, -13, -14, -16, -17, -18, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Lead (Pb)-Total	MS-B	L2123725-1, -10, -11, -13, -14, -16, -17, -18, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Lithium (Li)-Total	MS-B	L2123725-12, -2
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2123725-1, -10, -11, -13, -14, -16, -17, -18, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2123725-19, -20, -21, -22
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2123725-12, -2
Matrix Spike	Manganese (Mn)-Total	MS-B	L2123725-1, -10, -11, -13, -14, -16, -17, -18, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Total	MS-B	L2123725-19, -20, -21, -22

Reference Information

	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Manganese (Mn)-Total	MS-B	L2123725-12, -2
Matrix Spike	Molybdenum (Mo)-Total	MS-B	L2123725-1, -10, -11, -13, -14, -16, -17, -18, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Nickel (Ni)-Total	MS-B	L2123725-12, -2
Matrix Spike	Potassium (K)-Total	MS-B	L2123725-1, -10, -11, -13, -14, -16, -17, -18, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Potassium (K)-Total	MS-B	L2123725-12, -2
Matrix Spike	Silicon (Si)-Total	MS-B	L2123725-1, -10, -11, -13, -14, -16, -17, -18, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Silver (Ag)-Total	MS-B	L2123725-1, -10, -11, -13, -14, -16, -17, -18, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Total	MS-B	L2123725-1, -10, -11, -13, -14, -16, -17, -18, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Total	MS-B	L2123725-19, -20, -21, -22
Matrix Spike	Sodium (Na)-Total	MS-B	L2123725-12, -2
Matrix Spike	Strontium (Sr)-Total	MS-B	L2123725-1, -10, -11, -13, -14, -16, -17, -18, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L2123725-19, -20, -21, -22
Matrix Spike	Strontium (Sr)-Total	MS-B	L2123725-12, -2
Matrix Spike	Sulfur (S)-Total	MS-B	L2123725-1, -10, -11, -13, -14, -16, -17, -18, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sulfur (S)-Total	MS-B	L2123725-12, -2
Matrix Spike	Titanium (Ti)-Total	MS-B	L2123725-1, -10, -11, -13, -14, -16, -17, -18, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Uranium (U)-Total	MS-B	L2123725-1, -10, -11, -13, -14, -16, -17, -18, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Uranium (U)-Total	MS-B	L2123725-12, -2

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
DLA	Detection Limit adjusted for required dilution
DLAI	Detection limit raised due to low level analytical interference or background.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DTC	Dissolved concentration exceeds total. Results were confirmed by re-analysis.
DTMF	Dissolved concentration exceeds total for field-filtered metals sample. Metallic contaminants may have been introduced to dissolved sample during field filtration.
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-WR	Water	Nitrite & Nitrate Nitrogen	EPA 300.1
Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance.			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			

Reference Information

CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-L-IC-N-WR	Water	Chloride in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NO2-L-IC-N-WR	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-WR	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
SO4-IC-WR	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)

Reference Information

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-07-04 B 1 of 3 2018-07-04 B 2 of 3 2018-07-04 B 3 of 3

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form

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L2123725-COFC

COC Number: 2018-07-04 B

Page 1 of 2

Report To Contact and company name below will appear on the final report		Report Format / Distribution		Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply															
Company: Minto Explorations Ltd.		Select Report Format: ☒ PDF ☐ EXCEL ☒ EOD (DIGITAL)		Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply															
Contact: Minto Environment - Coordinator		Quality Control (QC) Report with Report ☒ YES ☐ NO		PRIORITY (Business Days) 4 day [P4] ☐ 3 day [P3] ☐ 2 day [P2] ☐				EMERGENCY 1 Business day [E1] ☐ Same Day, Weekend or Statutory holiday [E0] ☐											
Phone: 1-804-759-4659		Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX		Date and Time Required for all E&P TATs: dd-mm-yy hh:mm															
Company address below will appear on the final report		Email 1 or Fax minto_environment@mintomine.com		For tests that can not be performed according to the service level selected, you will be contacted.															
Street: 2100-510 West Georgia St.		Email 2		Analysis Request															
City/Province: Vancouver, British Columbia		Email 3		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below															
Postal Code: V6B 0M3		Invoice Distribution		Number of Containers															
Invoice To: Same as Report To ☐ YES ☒ NO		Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX																	
Copy of Invoice with Report ☐ YES ☒ NO		Email 1 or Fax ap@mintomine.com																	
Company: Minto Explorations Ltd.		Email 2																	
Contact: Ruth Cayetano		Project Information																	
ALS Account # / Quote #:		Oil and Gas Required Fields (client use)																	
Job #:		AFE/Cost Center:																	
PO / AFE: 229096 (WUL)		Major/Minor Code:																	
LSD:		Requisitioner:																	
ALS Lab Work Order # (lab use only)		Location:																	
ALS Contact: Shane Stack		Sampler: CH/EB/SB																	
Sample Identification and/or Coordinates (This description will appear on the report)		Date (dd-mm-yy)		Time (hh:mm)		Sample Type													
UG4		30-Jun-18		15:10		Water		7											
W17		2-Jul-18		7:45		Water		7											
W16		2-Jul-18		8:00		Water		7											
W8A		2-Jul-18		10:30		Water		6											
W10		2-Jul-18		9:25		Water		6											
W30		2-Jul-18		10:20		Water		6											
W15		2-Jul-18		10:50		Water		7											
W12		2-Jul-18		11:10		Water		6											
W55		2-Jul-18		13:40		Water		6											
W35		2-Jul-18		14:05		Water		7											
Drinking Water (DW) Samples ¹ (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)		SAMPLE CONDITION AS RECEIVED (lab use only)															
Are samples taken from a Regulated DW System? ☐ YES ☒ NO				Frozen ☐ SIF Observations Yes ☐ No ☐ Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐ Cooling Initiated ☐															
Are samples for human drinking water use? ☐ YES ☒ NO				INITIAL COOLER TEMPERATURES °C: 7.5 7.6 7.3 1.2 FINAL COOLER TEMPERATURES °C:															
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)		FINAL SHIPMENT RECEPTION (lab use only)															
Released by: Chris Harry		Date: 2018-07-04 7:00		Time: 3:45		Received by: H A		Date: 7/6		Time: 3:50p									

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Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



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L2123725-COFC

COC Number: 2018-07-04 B

Page 2 of 3

Report To		Report Format / Distribution		Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply													
Contact and company name below will appear on the final report		Select Report Format: ☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)		Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply													
Company:	Minto Explorations Ltd.	Quality Control (QC) Report with Report ☒ YES ☐ NO		PRIORITY (Business Days)	4 day [P4] ☐				EMERGENCY	1 Business day [E1] ☐							
Contact:	Minto Environment - Coordinator	☒ Compare Results to Criteria on Report - provide details below if box checked			3 day [P3] ☐					Same Day, Weekend or Statutory holiday [E0] ☐							
Phone:	1-604-759-4659	Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX			2 day [P2] ☐												
Company address below will appear on the final report		Email 1 or Fax minto_environment@mintomine.com		Date and Time Required for all E&P TATs: dd-mm-yy hh:mm													
Street:	2100-510 West Georgia St.	Email 2		For tests that can not be performed according to the service level selected, you will be contacted.													
City/Province:	Vancouver, British Columbia	Email 3		Analysis Request													
Postal Code:	V6B 0M3	Invoice Distribution		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below													
Invoice To	Same as Report To ☐ YES ☒ NO	Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX															
Copy of Invoice with Report ☐ YES ☒ NO		Email 1 or Fax ap@mintomine.com															
Company:	Minto Explorations Ltd.	Email 2															
Contact:	Ruth Cayetano	Oil and Gas Required Fields (client use)															
Project Information		AFE/Cost Center:															
Job #:		Major/Minor Code:															
PO / AFE: 229096 (WUL)		Requisitioner:															
LSD:		Location:															
ALS Lab Work Order # (lab use only)		ALS Contact: Shane Stack		Sampler: CH/EB/SB													
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mm-yy)	Time (hh:mm)	Sample Type	pH / Conductivity / Alkalinity / Anions	Total Suspended Solids (TSS)	Total Dissolved Solids (TDS)	Total Metals (TM), Hardness	Dissolved Metals (DM) (Filtered and preserved)	Total Mercury, Hardness	Dissolved Mercury [1] (Filtered + preserved)	Total Nutrients (Ammonia)	Dissolved Organic Carbon (DOC)	Number of Containers			
DUP		2-Jul-18		Water	R	R	R	R	R	R	R	R	R			6	
F-BL		2-Jul-18	14:05	Water	R	R	R	R	R	R	R	R	R			7	
W33S		2-Jul-18	14:30	Water	R	R	R	R	R	R	R	R	R			6	
W62		2-Jul-18	15:00	Water	R	R	R	R	R	R	R	R	R			6	
W14		2-Jul-18	15:35	Water	R	R	R		R		R	R				4	
W3		3-Jul-18	8:30	Water	R	R	R	R	R	R	R	R	R			7	
W50		3-Jul-18	8:50	Water	R	R	R	R	R	R	R	R	R			7	
W16A		3-Jul-18	9:05	Water	R	R	R	R	R	R	R	R	R			7	
W2		3-Jul-18	9:50	Water	R	R	R	R	R	R	R	R	R			7	
DUP		3-Jul-18		Water	R	R	R	R	R	R	R	R	R			7	
Drinking Water (DW) Samples ¹ (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)				SAMPLE CONDITION AS RECEIVED (lab use only)											
Are samples taken from a Regulated DW System? ☐ YES ☒ NO						Frozen ☐ SIF Observations Yes ☐ No ☐											
Are samples for human drinking water use? ☐ YES ☒ NO						Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐											
						Cooling Initiated ☐											
						INITIAL COOLER TEMPERATURES °C: 7.8 9.6 7.3 10 FINAL COOLER TEMPERATURES °C:											
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)				FINAL SHIPMENT RECEPTION (lab use only)											
Released by: Chris Harry		Date: 2018-07-04 7:00		Time:		Received by: 6456/18		Date: 3/18		Time:		Received by: HA		Date: 7/16		Time: 3:50P	

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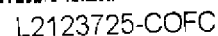
Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



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1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

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OCTOBER 2016 601



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 05-SEP-18
Report Date: 14-SEP-18 16:27 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2158985
Project P.O. #: 229096 (WUL)
Job Reference:
C of C Numbers: 2018-09-05 D
Legal Site Desc:

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2158985-1 Water 03-SEP-18 15:15 C4	L2158985-2 Water 03-SEP-18 15:45 W46	L2158985-3 Water 03-SEP-18 16:15 W6	L2158985-4 Water 03-SEP-18 16:50 W7	L2158985-5 Water 03-SEP-18 DUP
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	275	332	204	267	269
	Hardness (as CaCO3) (mg/L)	139	157	99.2	128	129
	pH (pH)	8.13	8.17	8.04	8.12	8.13
	Total Suspended Solids (mg/L)	<3.0	3.5	<3.0	7.1	6.3
	TDS (Calculated) (mg/L)	155	184	108	145	143
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	142	159	109	138	136
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	142	159	109	138	136
	Ammonia, Total (as N) (mg/L)	0.0064	0.0097	<0.0050	0.0143	0.0126
	Chloride (Cl) (mg/L)	0.58	1.78	0.97	<0.50	<0.50
	Nitrate and Nitrite (as N) (mg/L)	0.0151	0.0843	<0.0051	0.0888	0.0879
	Nitrate (as N) (mg/L)	0.0151	0.0843	<0.0050	0.0888	0.0879
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	12.6	21.9	1.91	8.87	8.86
	Anion Sum (meq/L)	3.12	3.70	2.24	2.95	2.91
	Cation Sum (meq/L)	3.10	3.60	2.20	2.93	2.93
	Cation - Anion Balance (%)	-0.2	-1.3	-1.0	-0.3	0.3
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	13.2	9.51	11.8	10.9	10.4
Total Metals	Aluminum (Al)-Total (mg/L)	0.0163	0.0489	0.0120	0.0339	0.0859
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00095	<0.00070 ^{DLB}	<0.00070 ^{DLB}	<0.00080 ^{DLB}	0.00053
	Barium (Ba)-Total (mg/L)	0.0681	0.0702	0.0493	0.0708	0.0728
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Calcium (Ca)-Total (mg/L)	38.2	40.5	29.7	32.4	32.8
	Chromium (Cr)-Total (mg/L)	0.00039	0.00028	0.00027	0.00034	0.00039
	Cobalt (Co)-Total (mg/L)	0.00022	0.00011	<0.00010	0.00011	0.00017
	Copper (Cu)-Total (mg/L)	0.00112	0.00213	0.00114	0.00121	0.00133
	Iron (Fe)-Total (mg/L)	0.544	0.174	0.098	0.191	0.289
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	0.000075
	Lithium (Li)-Total (mg/L)	0.0013	0.0015	<0.0010	0.0011	0.0010
	Magnesium (Mg)-Total (mg/L)	12.2	16.2	7.89	12.7	13.0
	Manganese (Mn)-Total (mg/L)	0.104	0.0450	0.0240	0.0351	0.0407

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2158985-6 Water 04-SEP-18 10:45 W2	L2158985-7 Water 04-SEP-18 08:50 W3	L2158985-8 Water 04-SEP-18 11:30 MC1	L2158985-9 Water 04-SEP-18 DUP	
Grouping	Analyte						
WATER							
Physical Tests	Conductivity (uS/cm)		351	533	339	336	
	Hardness (as CaCO3) (mg/L)		163	256	167	167	
	pH (pH)		8.16	8.20	8.26	8.27	
	Total Suspended Solids (mg/L)		<3.0	<3.0	3.5	7.5	
	TDS (Calculated) (mg/L)		195	308	192	191	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)		169	235	168	167	
	Alkalinity, Carbonate (as CaCO3) (mg/L)		<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)		<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Total (as CaCO3) (mg/L)		169	235	168	167	
	Ammonia, Total (as N) (mg/L)		<0.0050	<0.0050	<0.0050	<0.0050	
	Chloride (Cl) (mg/L)		1.90	4.56	1.47	1.48	
	Nitrate and Nitrite (as N) (mg/L)		0.0791	0.126	0.0643	0.0652	
	Nitrate (as N) (mg/L)		0.0791	0.126	0.0643	0.0652	
	Nitrite (as N) (mg/L)		<0.0010	<0.0010	<0.0010	<0.0010	
	Sulfate (SO4) (mg/L)		23.7	56.6	20.3	20.3	
	Anion Sum (meq/L)		3.93	6.02	3.83	3.80	
	Cation Sum (meq/L)		3.72	5.95	3.80	3.81	
	Cation - Anion Balance (%)		-2.8	-0.6	-0.4	0.0	
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)		9.47	6.95	10.2	10.3	
Total Metals	Aluminum (Al)-Total (mg/L)		0.0165	0.0057	0.0758	0.0845	
	Antimony (Sb)-Total (mg/L)		<0.00010	<0.00010	<0.00010	<0.00010	
	Arsenic (As)-Total (mg/L)		0.00043	0.00025	0.00058	0.00060	
	Barium (Ba)-Total (mg/L)		0.0646	0.0649	0.0633	0.0648	
	Beryllium (Be)-Total (mg/L)		<0.000020	<0.000020	<0.000020	<0.000020	
	Bismuth (Bi)-Total (mg/L)		<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Total (mg/L)		<0.010	0.023	<0.010	<0.010	
	Cadmium (Cd)-Total (mg/L)		<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Calcium (Ca)-Total (mg/L)		43.6	58.9	44.6	43.5	
	Chromium (Cr)-Total (mg/L)		0.00021	0.00018	0.00034	0.00036	
	Cobalt (Co)-Total (mg/L)		<0.00010	<0.00010	0.00011	0.00012	
	Copper (Cu)-Total (mg/L)		0.00205	0.00347	0.00198	0.00207	
	Iron (Fe)-Total (mg/L)		0.066	0.022	0.229	0.246	
	Lead (Pb)-Total (mg/L)		<0.000050	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Total (mg/L)		0.0017	0.0029	0.0015	0.0015	
	Magnesium (Mg)-Total (mg/L)		16.6	28.9	15.7	16.4	
	Manganese (Mn)-Total (mg/L)		0.00900	0.0357	0.0244	0.0244	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2158985-1 Water 03-SEP-18 15:15 C4	L2158985-2 Water 03-SEP-18 15:45 W46	L2158985-3 Water 03-SEP-18 16:15 W6	L2158985-4 Water 03-SEP-18 16:50 W7	L2158985-5 Water 03-SEP-18 DUP
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.000785	0.00199	0.000436	0.00154	0.00140
	Nickel (Ni)-Total (mg/L)	0.00163	0.00153	0.00137	0.00111	0.00127
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	0.99	1.27	0.39	0.94	0.91
	Selenium (Se)-Total (mg/L)	0.000092	0.000165	0.000083	0.000150	0.000151
	Silicon (Si)-Total (mg/L)	6.64	6.30	7.24	6.24	6.10
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	6.64	10.4	4.77	7.88	7.66
	Strontium (Sr)-Total (mg/L)	0.274	0.454	0.136	0.372	0.346
	Sulfur (S)-Total (mg/L)	5.26	7.89	0.90	3.52	2.94
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	0.00090	0.00234	0.00088	0.00178	0.00316
	Uranium (U)-Total (mg/L)	0.000733	0.00152	0.000176	0.00120	0.00109
	Vanadium (V)-Total (mg/L)	<0.00050	0.00083	0.00056	0.00087	0.00118
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0084	0.0050	0.0107	0.0077	0.0292
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00072	0.00044	0.00046	0.00044	0.00044
	Barium (Ba)-Dissolved (mg/L)	0.0643	0.0661	0.0473	0.0652	0.0679
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	0.0000063
	Calcium (Ca)-Dissolved (mg/L)	37.0	39.5	27.7	32.5	31.8
	Chromium (Cr)-Dissolved (mg/L)	0.00020	0.00017	0.00024	0.00022	0.00028
	Cobalt (Co)-Dissolved (mg/L)	0.00021	<0.00010	<0.00010	<0.00010	0.00011
	Copper (Cu)-Dissolved (mg/L)	0.00125	0.00186	0.00128	0.00132	0.00158
	Iron (Fe)-Dissolved (mg/L)	0.458	0.103	0.085	0.131	0.170
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0012	0.0014	<0.0010	0.0010	0.0010
	Magnesium (Mg)-Dissolved (mg/L)	11.2	14.3	7.30	11.4	12.0
	Manganese (Mn)-Dissolved (mg/L)	0.107	0.0421	0.0237	0.0335	0.0347

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2158985-6 Water 04-SEP-18 10:45 W2	L2158985-7 Water 04-SEP-18 08:50 W3	L2158985-8 Water 04-SEP-18 11:30 MC1	L2158985-9 Water 04-SEP-18 DUP	
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Total (mg/L)	0.00141	0.00493	0.00181	0.00177	
	Nickel (Ni)-Total (mg/L)	0.00092	0.00102	0.00114	0.00118	
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Potassium (K)-Total (mg/L)	1.40	2.21	1.22	1.26	
	Selenium (Se)-Total (mg/L)	0.000116	0.000247	0.000140	0.000133	
	Silicon (Si)-Total (mg/L)	5.54	6.01	6.19	6.26	
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Sodium (Na)-Total (mg/L)	10.3	19.2	10.4	10.8	
	Strontium (Sr)-Total (mg/L)	0.445	0.765	0.442	0.435	
	Sulfur (S)-Total (mg/L)	7.97	19.8	7.15	7.25	
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Total (mg/L)	0.00069	<0.00030	0.00346	0.00396	
	Uranium (U)-Total (mg/L)	0.00172	0.00264	0.00153	0.00156	
	Vanadium (V)-Total (mg/L)	0.00070	<0.00050	0.00102	0.00106	
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0104	0.0087	0.0065	0.0060	
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Arsenic (As)-Dissolved (mg/L)	0.00039	0.00023	0.00049	0.00051	
	Barium (Ba)-Dissolved (mg/L)	0.0634	0.0620	0.0592	0.0588	
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	<0.010	0.021	<0.010	<0.010	
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	0.0000051	<0.0000050	<0.0000050	
	Calcium (Ca)-Dissolved (mg/L)	42.1	56.9	42.9	41.8	
	Chromium (Cr)-Dissolved (mg/L)	0.00020	<0.00010	0.00018	0.00020	
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Copper (Cu)-Dissolved (mg/L)	0.00289	0.00360	0.00234	0.00180	
	Iron (Fe)-Dissolved (mg/L)	0.054	0.027	0.120	0.114	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.0017	0.0030	0.0014	0.0014	
	Magnesium (Mg)-Dissolved (mg/L)	14.0	27.6	14.5	15.2	
	Manganese (Mn)-Dissolved (mg/L)	0.00784	0.0359	0.0160	0.0159	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2158985-1 Water 03-SEP-18 15:15 C4	L2158985-2 Water 03-SEP-18 15:45 W46	L2158985-3 Water 03-SEP-18 16:15 W6	L2158985-4 Water 03-SEP-18 16:50 W7	L2158985-5 Water 03-SEP-18 DUP
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.000757	0.00188	0.000399	0.00145	0.00142
	Nickel (Ni)-Dissolved (mg/L)	0.00167	0.00106	0.00141	0.00108	0.00106
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	1.03	1.25	0.38	0.94	0.94
	Selenium (Se)-Dissolved (mg/L)	0.000065	0.000176	0.000065	0.000197	0.000156
	Silicon (Si)-Dissolved (mg/L)	6.15	5.97	7.09	6.03	6.09
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	6.33	9.72	4.58	7.71	7.41
	Strontium (Sr)-Dissolved (mg/L)	0.232	0.409	0.121	0.326	0.306
	Sulfur (S)-Dissolved (mg/L)	3.58	6.74	<0.50	2.56	2.42
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00052	<0.00030	0.00115	0.00046	0.00355
	Uranium (U)-Dissolved (mg/L)	0.000694	0.00143	0.000167	0.00114	0.00114
	Vanadium (V)-Dissolved (mg/L)	<0.00050	0.00062	0.00053	0.00070	0.00078
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2158985-6 Water 04-SEP-18 10:45 W2	L2158985-7 Water 04-SEP-18 08:50 W3	L2158985-8 Water 04-SEP-18 11:30 MC1	L2158985-9 Water 04-SEP-18 DUP	
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Dissolved (mg/L)	0.00134	0.00440	0.00159	0.00158	
	Nickel (Ni)-Dissolved (mg/L)	0.00153	0.00096	0.00122	0.00103	
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Potassium (K)-Dissolved (mg/L)	1.41	2.33	1.25	1.28	
	Selenium (Se)-Dissolved (mg/L)	0.000142	0.000319	0.000144	0.000112	
	Silicon (Si)-Dissolved (mg/L)	5.50	5.96	6.05	6.02	
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Sodium (Na)-Dissolved (mg/L)	9.81	18.0	9.89	9.93	
	Strontium (Sr)-Dissolved (mg/L)	0.415	0.668	0.390	0.392	
	Sulfur (S)-Dissolved (mg/L)	7.35	18.5	6.32	6.36	
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Dissolved (mg/L)	0.00092	0.00109 ^{DTMF}	0.00035	0.00036	
	Uranium (U)-Dissolved (mg/L)	0.00185	0.00277	0.00152	0.00159	
	Vanadium (V)-Dissolved (mg/L)	0.00058	<0.00050	0.00068	0.00068	
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Arsenic (As)-Total	MB-LOR	L2158985-1, -2, -3, -4
Laboratory Control Sample	Sulfur (S)-Dissolved	MES	L2158985-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Dissolved Organic Carbon	MS-B	L2158985-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2158985-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2158985-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2158985-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2158985-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2158985-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2158985-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2158985-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Total	MS-B	L2158985-1, -2, -3, -4
Matrix Spike	Barium (Ba)-Total	MS-B	L2158985-5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L2158985-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Total	MS-B	L2158985-5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2158985-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2158985-5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Total	MS-B	L2158985-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Total	MS-B	L2158985-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Total	MS-B	L2158985-5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L2158985-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Total	MS-B	L2158985-5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLB	Detection Limit Raised. Analyte detected at comparable level in Method Blank.
DTMF	Dissolved concentration exceeds total for field-filtered metals sample. Metallic contaminants may have been introduced to dissolved sample during field filtration.
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

Reference Information

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-SCREEN-VA Water Conductivity Screen (Internal Use Only) APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 µm), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

Reference Information

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-09-05 D

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com



L2158985-COFC

COC Number: 2018-09-05 D

Page 1 of 1

Report To		Report Format / Distribution		Select Service Level Below - Please confirm all E&P TATs with your AM - Surcharges will apply															
Company:	Minto Explorations Ltd.	Select Report Format:	☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)	Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply															
Contact:	Minto Environment - Coordinator	Quality Control (QC) Report with Report	☒ YES ☐ NO	PRIORITY (Business Day)		4 day [P4] ☐		3 day [P3] ☐		2 day [P2] ☐		EMERGENCY		1 Business day [E1] ☐					
Phone:	1-604-759-4659	☒ Compare Results to Criteria on Report - provide details below if box checked		Select Distribution:		☒ EMAIL ☐ MAIL ☐ FAX								Same Day, Weekend or Statutory holiday [E0] ☐					
Company address below will appear on the final report		Select Distribution:		Email 1 or Fax		mintoenvironment@mintomine.com		Date and Time Required for all E&P TATs:						dd-mm-yy hh:mm					
Street:	2100-510 West Georgia St.	Email 1 or Fax		Email 2				For tests that can not be performed according to the service level selected, you will be contacted.											
City/Province:	Vancouver, British Columbia	Email 3																	
Postal Code:	V6B 0M3																		
Invoice To	Same as Report To ☐ YES ☒ NO	Invoice Distribution		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below															
Copy of Invoice with Report	☐ YES ☒ NO	Select Invoice Distribution:		☒ EMAIL ☐ MAIL ☐ FAX															
Company:	Minto Explorations Ltd.	Email 1 or Fax		ap@mintomine.com															
Contact:	Ruth Cayetano	Email 2																	
Project Information		Oil and Gas Required Fields (client use)																	
ALS Account # / Quote #:		AFE/Cost Center:		PO#															
Job #:		Major/Minor Code:		Routing Code:															
PO / AFE:	229096 (WUL)	Requisitioner:																	
LSD:		Location:																	
ALS Lab Work Order # (lab use only)		ALS Contact:		Shane Stack		Sampler:													
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mm-yy)	Time (hh:mm)	Sample Type	pH / Conductivity / Alkalinity / Anions	Total Suspended Solids (TSS)	Total Dissolved Solids (TDS)	Total Metals (TM), Hardness	Dissolved Metals (DM) (Filtered and preserved)	Total Mercury, Hardness	Dissolved Mercury (1) (Filtered + preserved)	Total Nutrients (Ammonia)	Dissolved Organic Carbon (DOC)	Number of Containers					
C4		3-Sep-18	15:15	Water	R	R	R	R	R	R	R	R	R		7				
W46		3-Sep-18	15:45	Water	R	R	R	R	R	R	R	R	R		7				
W6		3-Sep-18	16:15	Water	R	R	R	R	R	R	R	R	R		7				
W7		3-Sep-18	16:50	Water	R	R	R	R	R	R	R	R	R		7				
DUP		3-Sep-18		Water	R	R	R	R	R	R	R	R	R		7				
W2		4-Sep-18	10:45	Water	R	R	R	R	R	R	R	R	R		7				
W3		4-Sep-18	8:50	Water	R	R	R	R	R	R	R	R	R		7				
MC1		4-Sep-18	11:30	Water	R	R	R	R	R	R	R	R	R		7				
Dup		4-Sep-18		Water	R	R	R	R	R	R	R	R	R		7				
Drinking Water (DW) Samples ¹ (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)		SAMPLE CONDITION AS RECEIVED (lab use only)															
Are samples taken from a Regulated DW System?				Frozen ☐ SIF Observations Yes ☐ No ☐															
☐ YES ☒ NO				Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐															
Are samples for human drinking water use?				Cooling Initiated ☐															
☐ YES ☒ NO				INITIAL COOLER TEMPERATURES °C 8/8/8 FINAL COOLER TEMPERATURES °C 7 7 8															
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)		FINAL SHIPMENT RECEPTION (lab use only)															
Released by: Emilie Bouchard	Date: Sept 5, 2018	Time:	Received by: (Signature)	Date: Sept 5/18	Time: 14:42	Received by: (Signature)	Date: SEP 06 2018	Time: 12pm											

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

C



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 26-SEP-18
Report Date: 12-OCT-18 20:25 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2171436
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-09-26 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2171436-1 Water 24-SEP-18 09:50 W8A	L2171436-2 Water 24-SEP-18 10:40 W16	L2171436-3 Water 24-SEP-18 14:20 UG1	L2171436-4 Water 24-SEP-18 15:05 UG4	L2171436-5 Water 25-SEP-18 09:30 W3
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	1150	470	1980	2080	541
	Hardness (as CaCO3) (mg/L)	562	236	1030	1210	263
	pH (pH)	7.56	8.23	7.89	7.94	8.16
	Total Suspended Solids (mg/L)	26.1	5.3	182	438	7.6
	TDS (Calculated) (mg/L)	786	255	1670	1830	311
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	348	128	174	177	234
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	348	128	174	177	234
	Ammonia, Total (as N) (mg/L)	0.190	0.0162	3.49	2.78	0.0341
	Chloride (Cl) (mg/L)	8.9	5.88	17.9	23.0	4.44
	Nitrate and Nitrite (as N) (mg/L)	6.51	1.34	7.07	5.75	0.131
	Nitrate (as N) (mg/L)	6.41	1.33	6.44	5.23	0.131
	Nitrite (as N) (mg/L)	0.0975	0.0055	0.631	0.517	<0.0010
	Sulfate (SO4) (mg/L)	293	68.9	1040	1120	58.2
	Anion Sum (meq/L)	13.8	4.25	26.1	27.8	6.03
	Cation Sum (meq/L)	13.2	5.36	24.4	28.4	6.09
	Cation - Anion Balance (%)	-1.9	11.5	-3.3	1.1	0.5
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)		14.8			5.99
Total Metals	Aluminum (Al)-Total (mg/L)	0.431	0.0450	5.51	17.8	0.0049
	Antimony (Sb)-Total (mg/L)	0.00019	<0.00010	0.00027	0.00028	<0.00010
	Arsenic (As)-Total (mg/L)	0.00078	0.00043	0.00128	0.00224	0.00028
	Barium (Ba)-Total (mg/L)	0.135	0.0778	0.139	0.378	0.0720
	Beryllium (Be)-Total (mg/L)	0.000028	<0.000020	0.000118	0.000399	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.00010 ^{DLA}	0.00047	<0.000050
	Boron (B)-Total (mg/L)	0.030	0.016	0.327	0.282	0.025
	Cadmium (Cd)-Total (mg/L)	0.000292	0.0000095	0.000406	0.000895	<0.0000050
	Calcium (Ca)-Total (mg/L)	157	59.7	358	401	58.1
	Chromium (Cr)-Total (mg/L)	0.00093	0.00016	0.00200	0.00621	<0.00010
	Cobalt (Co)-Total (mg/L)	0.00091	<0.00010	0.00292	0.0102	<0.00010
	Copper (Cu)-Total (mg/L)	0.189	0.0338	0.555	5.63	0.00348
	Iron (Fe)-Total (mg/L)	1.52	0.094	7.42	31.3	0.024
	Lead (Pb)-Total (mg/L)	0.000415	<0.000050	0.00295	0.00892	<0.000050
	Lithium (Li)-Total (mg/L)	0.0040	0.0013	0.0123	0.0181	0.0032
	Magnesium (Mg)-Total (mg/L)	44.5	18.6	45.1	52.6	28.4
	Manganese (Mn)-Total (mg/L)	1.61	0.118	0.346	1.01	0.0441

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2171436-6 Water 25-SEP-18 10:20 W17	L2171436-7 Water 25-SEP-18 14:30 W2	L2171436-8 Water 25-SEP-18 15:20 MC1	L2171436-9 Water 25-SEP-18 16:10 MN	L2171436-10 Water 25-SEP-18 DUP
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	492	349	335	481	546
	Hardness (as CaCO3) (mg/L)	244	167	173	179	263
	pH (pH)	8.14	8.16	8.27	7.84	8.23
	Total Suspended Solids (mg/L)	<3.0	4.2	6.6	14.8	<3.0
	TDS (Calculated) (mg/L)	288	192	190	299	320
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	190	163	161	89.0	250
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	190	163	161	89.0	250
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	1.47	<0.0050
	Chloride (Cl) (mg/L)	5.93	1.88	1.51	1.66	4.45
	Nitrate and Nitrite (as N) (mg/L)	0.231	<0.0051	0.0663	15.2	0.127
	Nitrate (as N) (mg/L)	0.231	<0.0050	0.0663	14.9	0.127
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	0.303	<0.0010
	Sulfate (SO4) (mg/L)	65.5	23.9	21.7	85.3	58.2
	Anion Sum (meq/L)	5.34	3.81	3.72	4.69	6.34
	Cation Sum (meq/L)	5.56	3.79	3.92	4.65	6.10
	Cation - Anion Balance (%)	2.0	-0.3	2.5	-0.4	-2.0
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	9.69	8.11	8.54		5.87
Total Metals	Aluminum (Al)-Total (mg/L)	<0.0030	0.0146	0.0399	0.205	0.0056
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	0.00055	<0.00010
	Arsenic (As)-Total (mg/L)	0.00041	0.00037	0.00050	0.00053	0.00026
	Barium (Ba)-Total (mg/L)	0.0691	0.0669	0.0609	0.0331	0.0685
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.023	<0.010	<0.010	0.075	0.026
	Cadmium (Cd)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	0.0000744	<0.0000050
	Calcium (Ca)-Total (mg/L)	64.4	44.0	42.1	57.6	58.9
	Chromium (Cr)-Total (mg/L)	0.00011	0.00020	0.00029	0.00014	0.00011
	Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	<0.00010	0.00017	<0.00010
	Copper (Cu)-Total (mg/L)	0.00757	0.00187	0.00201	0.0475	0.00329
	Iron (Fe)-Total (mg/L)	<0.010	0.045	0.139	0.467	0.026
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	0.000180	<0.000050
	Lithium (Li)-Total (mg/L)	0.0015	0.0018	0.0015	0.0046	0.0033
	Magnesium (Mg)-Total (mg/L)	19.6	15.2	15.1	8.54	29.7
	Manganese (Mn)-Total (mg/L)	0.00589	0.00753	0.0168	0.0340	0.0437

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2171436-1 Water 24-SEP-18 09:50 W8A	L2171436-2 Water 24-SEP-18 10:40 W16	L2171436-3 Water 24-SEP-18 14:20 UG1	L2171436-4 Water 24-SEP-18 15:05 UG4	L2171436-5 Water 25-SEP-18 09:30 W3
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	0.0000093	<0.0000050	0.0000059	0.000054	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.0133	0.00296	0.0199	0.0236	0.00472
	Nickel (Ni)-Total (mg/L)	0.00174	0.00091	0.0027	0.0077	0.00099
	Phosphorus (P)-Total (mg/L)	0.065	<0.050	0.14	0.55	<0.050
	Potassium (K)-Total (mg/L)	7.17	2.78	11.4	16.1	2.40
	Selenium (Se)-Total (mg/L)	0.00611	0.000663	0.00162	0.00263	0.000313
	Silicon (Si)-Total (mg/L)	7.17	3.43	15.4	32.3	5.76
	Silver (Ag)-Total (mg/L)	0.000045	<0.000010	0.000247	0.00209	<0.000010
	Sodium (Na)-Total (mg/L)	41.6	12.8	81.5	89.6	18.4
	Strontium (Sr)-Total (mg/L)	2.24	0.594	7.09	6.54	0.760
	Sulfur (S)-Total (mg/L)	96.7	21.9	347	370	18.8
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	0.000066	0.000196	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	0.00023	0.00119	<0.00010
	Titanium (Ti)-Total (mg/L)	0.0216	<0.0030 ^{DLM}	0.370	1.17	<0.00030
	Uranium (U)-Total (mg/L)	0.00292	0.00134	0.00921	0.00795	0.00271
	Vanadium (V)-Total (mg/L)	0.00316	0.00054	0.0179	0.0592	<0.00050
	Zinc (Zn)-Total (mg/L)	0.451	<0.0030	0.0627	0.163	<0.0030
	Zirconium (Zr)-Total (mg/L)	0.00045	<0.00030	0.00037	0.00059	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0087	0.0029	0.0133	0.0154	0.0018
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	0.00024	0.00021	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00047	0.00041	0.00084	0.00101	0.00022
	Barium (Ba)-Dissolved (mg/L)	0.115	0.0743	0.0304	0.0383	0.0651
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000040 ^{DLA}	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.00010 ^{DLA}	<0.000050
	Boron (B)-Dissolved (mg/L)	0.031	0.016	0.326	0.275	0.026
	Cadmium (Cd)-Dissolved (mg/L)	0.000239	0.0000051	0.000121	0.000041	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	154	63.0	347	411	57.5
	Chromium (Cr)-Dissolved (mg/L)	0.00042	<0.00010	<0.00010	0.00023	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	0.00056	<0.00010	0.00051	0.00072	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.0805	0.0264	0.0165	0.00288	0.00274
	Iron (Fe)-Dissolved (mg/L)	0.410	0.014	<0.010	<0.020 ^{DLA}	0.020
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.00010 ^{DLA}	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0038	0.0013	0.0102	0.0113	0.0033
	Magnesium (Mg)-Dissolved (mg/L)	43.0	19.2	41.0	45.0	28.9
	Manganese (Mn)-Dissolved (mg/L)	1.51	0.00378	0.121	0.145	0.0413

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2171436-6 Water 25-SEP-18 10:20 W17	L2171436-7 Water 25-SEP-18 14:30 W2	L2171436-8 Water 25-SEP-18 15:20 MC1	L2171436-9 Water 25-SEP-18 16:10 MN	L2171436-10 Water 25-SEP-18 DUP
Grouping	Analyte						
WATER							
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	0.0000088	<0.0000050	
	Molybdenum (Mo)-Total (mg/L)	0.00611	0.00129	0.00147	0.0193	0.00474	
	Nickel (Ni)-Total (mg/L)	0.00066	0.00093	0.00103	<0.00050	0.00100	
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	0.192	<0.050	
	Potassium (K)-Total (mg/L)	3.72	1.57	1.24	4.41	2.40	
	Selenium (Se)-Total (mg/L)	0.000478	0.000137	0.000102	0.0140	0.000298	
	Silicon (Si)-Total (mg/L)	4.99	5.57	5.72	2.74	6.19	
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	
	Sodium (Na)-Total (mg/L)	14.0	10.2	9.87	20.8	19.1	
	Strontium (Sr)-Total (mg/L)	0.666	0.442	0.410	1.46	0.746	
	Sulfur (S)-Total (mg/L)	20.6	7.68	6.53	27.4	20.1	
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Total (mg/L)	<0.00030	<0.0012 ^{DLM}	0.00201	0.0108	<0.00030	
	Uranium (U)-Total (mg/L)	0.00199	0.00190	0.00150	0.000840	0.00282	
	Vanadium (V)-Total (mg/L)	<0.00050	0.00057	0.00077	0.00128	<0.00050	
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	0.0067	<0.0030	
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0042	0.0038	0.0053	0.0039	0.0022	
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00050	<0.00010	
	Arsenic (As)-Dissolved (mg/L)	0.00037	0.00034	0.00045	0.00047	0.00021	
	Barium (Ba)-Dissolved (mg/L)	0.0679	0.0611	0.0568	0.0294	0.0647	
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	0.023	<0.010	<0.010	0.075	0.025	
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	0.0000713	<0.0000050	
	Calcium (Ca)-Dissolved (mg/L)	65.3	42.5	43.2	57.5	57.7	
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
	Copper (Cu)-Dissolved (mg/L)	0.00718	0.00163	0.00167	0.0117	0.00271	
	Iron (Fe)-Dissolved (mg/L)	<0.010	0.032	0.082	<0.010	0.019	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.0015	0.0018	0.0015	0.0045	0.0032	
	Magnesium (Mg)-Dissolved (mg/L)	19.8	14.7	15.8	8.54	29.0	
Manganese (Mn)-Dissolved (mg/L)	0.00306	0.00662	0.0120	0.0192	0.0404		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2171436-1 Water 24-SEP-18 09:50 W8A	L2171436-2 Water 24-SEP-18 10:40 W16	L2171436-3 Water 24-SEP-18 14:20 UG1	L2171436-4 Water 24-SEP-18 15:05 UG4	L2171436-5 Water 25-SEP-18 09:30 W3
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.0133	0.00304	0.0204	0.0241	0.00475
	Nickel (Ni)-Dissolved (mg/L)	0.00125	0.00089	0.00139	0.0032	0.00098
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.10 ^{DLA}	<0.050
	Potassium (K)-Dissolved (mg/L)	6.69	2.96	8.30	8.88	2.36
	Selenium (Se)-Dissolved (mg/L)	0.00592	0.000670	0.00138	0.00135	0.000283
	Silicon (Si)-Dissolved (mg/L)	6.76	3.67	6.90	6.72	6.05
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000020 ^{DLA}	<0.000010
	Sodium (Na)-Dissolved (mg/L)	40.0	12.8	75.5	87.8	17.9
	Strontium (Sr)-Dissolved (mg/L)	2.00	0.595	7.06	6.30	0.753
	Sulfur (S)-Dissolved (mg/L)	99.7	23.2	382	398	19.0
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	0.000015	<0.000020 ^{DLA}	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010 ^{DLM}	<0.00010	<0.00010	<0.00020 ^{DLA}	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00060	<0.00030	<0.00030	<0.00060 ^{DLA}	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00283	0.00135	0.00904	0.00716	0.00268
	Vanadium (V)-Dissolved (mg/L)	0.00113	<0.00050	0.00056	<0.0010 ^{DLA}	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.255	<0.0010	0.0096	0.0040	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	0.00033	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2171436-6 Water 25-SEP-18 10:20 W17	L2171436-7 Water 25-SEP-18 14:30 W2	L2171436-8 Water 25-SEP-18 15:20 MC1	L2171436-9 Water 25-SEP-18 16:10 MN	L2171436-10 Water 25-SEP-18 DUP
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00607	0.00133	0.00155	0.0193	0.00477
	Nickel (Ni)-Dissolved (mg/L)	0.00063	0.00083	0.00095	<0.00050	0.00101
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	0.159	<0.050
	Potassium (K)-Dissolved (mg/L)	3.70	1.57	1.28	4.30	2.27
	Selenium (Se)-Dissolved (mg/L)	0.000532	0.000115	0.000114	0.0129	0.000313
	Silicon (Si)-Dissolved (mg/L)	5.41	5.66	6.05	2.50	6.02
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	13.4	9.54	9.77	19.8	17.8
	Strontium (Sr)-Dissolved (mg/L)	0.658	0.426	0.424	1.38	0.746
	Sulfur (S)-Dissolved (mg/L)	22.0	7.67	6.91	27.8	18.7
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	0.00038	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00196	0.00180	0.00149	0.000816	0.00268
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	0.00061	<0.00050 ^{DTC}	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	0.0170	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Laboratory Control Sample	Sulfur (S)-Total	MES	L2171436-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Dissolved Organic Carbon	MS-B	L2171436-10, -2, -5, -6, -7, -8
Matrix Spike	Dissolved Organic Carbon	MS-B	L2171436-10, -2, -5, -6, -7, -8
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2171436-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2171436-9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2171436-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2171436-9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2171436-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2171436-9
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2171436-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2171436-9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2171436-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2171436-9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2171436-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2171436-9
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2171436-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2171436-9
Matrix Spike	Uranium (U)-Dissolved	MS-B	L2171436-1, -10, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DTC	Dissolved concentration exceeds total. Results were confirmed by re-analysis.
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-WR	Water	Nitrite & Nitrate Nitrogen	EPA 300.1
Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance.			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-WR	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			

Reference Information

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NO2-L-IC-N-WR	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-WR	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
SO4-IC-WR	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)
This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.			
TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA

Reference Information

VA

ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-09-26 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

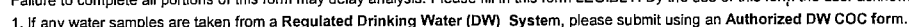
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.





Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 03-OCT-18
Report Date: 15-OCT-18 14:49 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2175170
Project P.O. #: 229096
Job Reference:
C of C Numbers: 2018-10-03 A
Legal Site Desc:

Shane Stack
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2175170-1 Water 01-OCT-18 09:25 W16	L2175170-2 Water 01-OCT-18 10:05 W8A	L2175170-3 Water 02-OCT-18 08:35 W3	L2175170-4 Water 02-OCT-18 09:15 W17	L2175170-5 Water 02-OCT-18 09:45 MC1
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	488	1300	578	517	393
	Hardness (as CaCO3) (mg/L)	228	653	277	244	187
	pH (pH)	8.19	8.00	8.25	8.28	8.31
	Total Suspended Solids (mg/L)	3.3	36.7	4.7	<3.0	29.3
	TDS (Calculated) (mg/L)	285	874	331	297	214
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	183	398	258	198	181
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	6.4	5.8
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	183	398	258	204	187
	Ammonia, Total (as N) (mg/L)	0.0110	0.245	0.0063	<0.0050	0.0052
	Chloride (Cl) (mg/L)	6.00	10.0	4.50	5.98	1.72
	Nitrate and Nitrite (as N) (mg/L)	1.26	6.68	0.146	0.215	0.0793
	Nitrate (as N) (mg/L)	1.25	6.51	0.146	0.215	0.0782
	Nitrite (as N) (mg/L)	0.0056	0.177	<0.0010	<0.0010	0.0011
	Sulfate (SO4) (mg/L)	67.8	310	58.3	63.9	23.3
	Anion Sum (meq/L)	5.33	15.2	6.51	5.59	4.27
	Cation Sum (meq/L)	5.22	15.4	6.47	5.64	4.26
	Cation - Anion Balance (%)	-1.1	0.8	-0.4	0.4	-0.1
	Organic / Inorganic Carbon					
	Dissolved Organic Carbon (mg/L)	14.8		6.05	9.76	8.31
Total Metals	Aluminum (Al)-Total (mg/L)	0.0176	0.293	0.0147	0.0041	0.0114
	Antimony (Sb)-Total (mg/L)	<0.00010	0.00020	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00044	0.00075	0.00029	0.00041	0.00046
	Barium (Ba)-Total (mg/L)	0.0763	0.131	0.0662	0.0639	0.0646
	Beryllium (Be)-Total (mg/L)	<0.000020	0.000029	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.016	0.032	0.025	0.022	<0.010
	Cadmium (Cd)-Total (mg/L)	0.0000070	0.000295	0.0000078	<0.0000050	<0.0000050
	Calcium (Ca)-Total (mg/L)	58.3	173	57.1	61.4	43.8
	Chromium (Cr)-Total (mg/L)	0.00017	0.00078	0.00015	0.00013	0.00022
	Cobalt (Co)-Total (mg/L)	<0.00010	0.00082	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Total (mg/L)	0.0270	0.152	0.00424	0.00686	0.00155
	Iron (Fe)-Total (mg/L)	0.063	1.65	0.042	<0.010	0.079
	Lead (Pb)-Total (mg/L)	<0.000050	0.000449	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	0.0012	0.0041	0.0033	0.0015	0.0015
	Magnesium (Mg)-Total (mg/L)	18.0	46.7	28.3	18.4	15.9
	Manganese (Mn)-Total (mg/L)	0.148	1.68	0.0440	0.00965	0.0127

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2175170-6 Water 01-OCT-18 DUP				
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	493				
	Hardness (as CaCO3) (mg/L)	239				
	pH (pH)	8.26				
	Total Suspended Solids (mg/L)	3.3				
	TDS (Calculated) (mg/L)	289				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	184				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Total (as CaCO3) (mg/L)	184				
	Ammonia, Total (as N) (mg/L)	0.0116				
	Chloride (Cl) (mg/L)	5.96				
	Nitrate and Nitrite (as N) (mg/L)	1.25				
	Nitrate (as N) (mg/L)	1.25				
	Nitrite (as N) (mg/L)	0.0057				
	Sulfate (SO4) (mg/L)	67.4				
	Anion Sum (meq/L)	5.34				
	Cation Sum (meq/L)	5.44				
	Cation - Anion Balance (%)	1.0				
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	14.8				
Total Metals	Aluminum (Al)-Total (mg/L)	0.0160				
	Antimony (Sb)-Total (mg/L)	<0.00010				
	Arsenic (As)-Total (mg/L)	0.00044				
	Barium (Ba)-Total (mg/L)	0.0736				
	Beryllium (Be)-Total (mg/L)	<0.000020				
	Bismuth (Bi)-Total (mg/L)	<0.000050				
	Boron (B)-Total (mg/L)	0.016				
	Cadmium (Cd)-Total (mg/L)	0.0000075				
	Calcium (Ca)-Total (mg/L)	60.6				
	Chromium (Cr)-Total (mg/L)	0.00017				
	Cobalt (Co)-Total (mg/L)	<0.00010				
	Copper (Cu)-Total (mg/L)	0.0260				
	Iron (Fe)-Total (mg/L)	0.059				
	Lead (Pb)-Total (mg/L)	<0.000050				
	Lithium (Li)-Total (mg/L)	0.0013				
	Magnesium (Mg)-Total (mg/L)	17.8				
	Manganese (Mn)-Total (mg/L)	0.145				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2175170-1 Water 01-OCT-18 09:25 W16	L2175170-2 Water 01-OCT-18 10:05 W8A	L2175170-3 Water 02-OCT-18 08:35 W3	L2175170-4 Water 02-OCT-18 09:15 W17	L2175170-5 Water 02-OCT-18 09:45 MC1
Grouping	Analyte						
WATER							
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.00287	0.0142	0.00490	0.00607	0.00158	0.00158
	Nickel (Ni)-Total (mg/L)	0.00082	0.00154	0.00105	0.00069	0.00090	0.00090
	Phosphorus (P)-Total (mg/L)	<0.050	0.072	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	2.75	7.15	2.48	3.44	1.38	1.38
	Selenium (Se)-Total (mg/L)	0.000633	0.00679	0.000286	0.000430	0.000124	0.000124
	Silicon (Si)-Total (mg/L)	3.84	7.43	6.55	5.33	6.56	6.56
	Silver (Ag)-Total (mg/L)	<0.000010	0.000033	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	12.6	44.1	19.0	13.6	10.8	10.8
	Strontium (Sr)-Total (mg/L)	0.569	2.40	0.782	0.675	0.462	0.462
	Sulfur (S)-Total (mg/L)	23.8	117	21.0	21.8	8.28	8.28
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	<0.00087 ^{DLM}	0.0118	0.00123	<0.00030	0.00055	0.00055
	Uranium (U)-Total (mg/L)	0.00141	0.00325	0.00290	0.00219	0.00176	0.00176
	Vanadium (V)-Total (mg/L)	0.00062	0.00291	0.00058	0.00058	0.00074	0.00074
	Zinc (Zn)-Total (mg/L)	<0.0030	0.340	<0.0030	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	<0.00030	0.00045	<0.00030	<0.00030	<0.00030	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0031	0.0125	0.0015	0.0017	0.0051	0.0051
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00044	0.00054	0.00025	0.00038	0.00041	0.00041
	Barium (Ba)-Dissolved (mg/L)	0.0714	0.126	0.0664	0.0685	0.0664	0.0664
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	0.000021	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.015	0.031	0.023	0.020	<0.010	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	0.000251	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	59.8	178	59.3	63.3	45.8	45.8
	Chromium (Cr)-Dissolved (mg/L)	0.00012	0.00042	<0.00010	0.00012	0.00017	0.00017
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00065	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.0240	0.0748	0.00249	0.00733	0.00149	0.00149
	Iron (Fe)-Dissolved (mg/L)	0.015	0.734	0.019	<0.010	0.062	0.062
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0013	0.0041	0.0033	0.0015	0.0016	0.0016
	Magnesium (Mg)-Dissolved (mg/L)	19.2	50.4	31.3	20.8	17.6	17.6
	Manganese (Mn)-Dissolved (mg/L)	0.0144	1.73	0.0418	0.00424	0.0114	0.0114

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID				
		L2175170-6 Water 01-OCT-18 DUP				
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050				
	Molybdenum (Mo)-Total (mg/L)	0.00288				
	Nickel (Ni)-Total (mg/L)	0.00081				
	Phosphorus (P)-Total (mg/L)	<0.050				
	Potassium (K)-Total (mg/L)	2.77				
	Selenium (Se)-Total (mg/L)	0.000618				
	Silicon (Si)-Total (mg/L)	3.81				
	Silver (Ag)-Total (mg/L)	<0.000010				
	Sodium (Na)-Total (mg/L)	12.6				
	Strontium (Sr)-Total (mg/L)	0.596				
	Sulfur (S)-Total (mg/L)	23.5				
	Thallium (Tl)-Total (mg/L)	<0.000010				
	Tin (Sn)-Total (mg/L)	<0.00010				
	Titanium (Ti)-Total (mg/L)	0.00091				
	Uranium (U)-Total (mg/L)	0.00144				
	Vanadium (V)-Total (mg/L)	0.00060				
	Zinc (Zn)-Total (mg/L)	<0.0030				
	Zirconium (Zr)-Total (mg/L)	<0.00030				
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD				
	Dissolved Metals Filtration Location	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	0.0159				
	Antimony (Sb)-Dissolved (mg/L)	<0.00010				
	Arsenic (As)-Dissolved (mg/L)	0.00043				
	Barium (Ba)-Dissolved (mg/L)	0.0763				
	Beryllium (Be)-Dissolved (mg/L)	<0.000020				
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050				
	Boron (B)-Dissolved (mg/L)	0.014				
	Cadmium (Cd)-Dissolved (mg/L)	0.0000064				
	Calcium (Ca)-Dissolved (mg/L)	63.2				
	Chromium (Cr)-Dissolved (mg/L)	0.00014				
	Cobalt (Co)-Dissolved (mg/L)	<0.00010				
	Copper (Cu)-Dissolved (mg/L)	0.0265				
	Iron (Fe)-Dissolved (mg/L)	0.039				
	Lead (Pb)-Dissolved (mg/L)	<0.000050				
	Lithium (Li)-Dissolved (mg/L)	0.0013				
	Magnesium (Mg)-Dissolved (mg/L)	19.8				
	Manganese (Mn)-Dissolved (mg/L)	0.0154				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2175170-1 Water 01-OCT-18 09:25 W16	L2175170-2 Water 01-OCT-18 10:05 W8A	L2175170-3 Water 02-OCT-18 08:35 W3	L2175170-4 Water 02-OCT-18 09:15 W17	L2175170-5 Water 02-OCT-18 09:45 MC1
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00278	0.0141	0.00473	0.00573	0.00146
	Nickel (Ni)-Dissolved (mg/L)	0.00077	0.00123	0.00094	0.00072	0.00083
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	2.73	7.20	2.32	3.71	1.31
	Selenium (Se)-Dissolved (mg/L)	0.000710	0.00844	0.000315	0.000445	0.000160
	Silicon (Si)-Dissolved (mg/L)	3.91	7.13	6.87	5.36	6.56
	Silver (Ag)-Dissolved (mg/L)	<0.000010	0.000012	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	13.3	47.0	20.1	15.3	11.2
	Strontium (Sr)-Dissolved (mg/L)	0.558	2.36	0.755	0.654	0.433
	Sulfur (S)-Dissolved (mg/L)	24.1	116	21.9	21.9	7.99
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.0015 ^{DLM}	<0.00030	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00121	0.00306	0.00259	0.00183	0.00148
	Vanadium (V)-Dissolved (mg/L)	<0.00050	0.00128	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	0.230	0.0022	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	0.00044	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2175170-6 Water 01-OCT-18 DUP				
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050				
	Molybdenum (Mo)-Dissolved (mg/L)	0.00285				
	Nickel (Ni)-Dissolved (mg/L)	0.00084				
	Phosphorus (P)-Dissolved (mg/L)	<0.050				
	Potassium (K)-Dissolved (mg/L)	2.76				
	Selenium (Se)-Dissolved (mg/L)	0.000670				
	Silicon (Si)-Dissolved (mg/L)	3.81				
	Silver (Ag)-Dissolved (mg/L)	<0.000010				
	Sodium (Na)-Dissolved (mg/L)	13.4				
	Strontium (Sr)-Dissolved (mg/L)	0.569				
	Sulfur (S)-Dissolved (mg/L)	23.3				
	Thallium (Tl)-Dissolved (mg/L)	<0.000010				
	Tin (Sn)-Dissolved (mg/L)	<0.00010				
	Titanium (Ti)-Dissolved (mg/L)	0.00156 ^{DTMF}				
	Uranium (U)-Dissolved (mg/L)	0.00125				
	Vanadium (V)-Dissolved (mg/L)	<0.00050				
	Zinc (Zn)-Dissolved (mg/L)	0.0012				
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Dissolved Organic Carbon	MS-B	L2175170-1, -3, -4, -5, -6
Matrix Spike	Barium (Ba)-Total	MS-B	L2175170-1, -2, -3, -4, -5, -6
Matrix Spike	Calcium (Ca)-Total	MS-B	L2175170-1, -2, -3, -4, -5, -6
Matrix Spike	Copper (Cu)-Total	MS-B	L2175170-1, -2, -3, -4, -5, -6
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2175170-1, -2, -3, -4, -5, -6
Matrix Spike	Manganese (Mn)-Total	MS-B	L2175170-1, -2, -3, -4, -5, -6
Matrix Spike	Sodium (Na)-Total	MS-B	L2175170-1, -2, -3, -4, -5, -6
Matrix Spike	Strontium (Sr)-Total	MS-B	L2175170-1, -2, -3, -4, -5, -6
Matrix Spike	Sulfur (S)-Total	MS-B	L2175170-1, -2, -3, -4, -5, -6

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DTMF	Dissolved concentration exceeds total for field-filtered metals sample. Metallic contaminants may have been introduced to dissolved sample during field filtration.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions)			

Reference Information

should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$\text{Ion Balance (\%)} = [\text{Cation Sum} - \text{Anion Sum}] / [\text{Cation Sum} + \text{Anion Sum}]$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-MAN-WR Water Total Suspended Solids by Gravimetric APHA 2540 D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids are determined by filtering a sample through a glass fibre filter and drying the filter at 104 degrees celsius.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-10-03 A

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lw - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2175170-COFC

COC Number: 2018-10-03 A

Page 1 of 1

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[illegible]

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

WHITE - LABORATORY COPY

YELLOW - CLIENT COPY

OCTOBER 2016 FRONT



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 11-OCT-18
Report Date: 23-OCT-18 17:57 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2179645
Project P.O. #: 229096 (WUL)
Job Reference:
C of C Numbers: 2018-10-10 C
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2179645-1 Water 08-OCT-18 14:40 W46	L2179645-2 Water 08-OCT-18 15:15 W7	L2179645-3 Water 08-OCT-18 09:30 W8A	L2179645-4 Water 08-OCT-18 10:30 W16	L2179645-5 Water 09-OCT-18 09:20 W3
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	415	312	1310	484	564
	Hardness (as CaCO3) (mg/L)	206	155	662	242	274
	pH (pH)	8.15	8.10	7.94	8.30	8.23
	Total Suspended Solids (mg/L)	3.0	5.2	52.2	5.2	4.8
	TDS (Calculated) (mg/L)	216	175	855	295	328
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	157	163	404	185	253
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	2.4	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	157	163	404	187	253
	Ammonia, Total (as N) (mg/L)	0.0196	0.0271	0.209	0.0127	0.0160
	Chloride (Cl) (mg/L)	2.91	0.58	9.6	6.33	4.58
	Nitrate and Nitrite (as N) (mg/L)	0.158	0.172	5.90	1.25	0.153
	Nitrate (as N) (mg/L)	0.157	0.172	5.73	1.24	0.153
	Nitrite (as N) (mg/L)	0.0011	<0.0010	0.170	0.0059	<0.0010
	Sulfate (SO4) (mg/L)	34.3	13.3	289	70.7	59.5
	Anion Sum (meq/L)	3.95	3.57	14.8	5.48	6.43
	Cation Sum (meq/L)	4.75	3.53	15.6	5.51	6.42
	Cation - Anion Balance (%)	9.2	-0.5	2.7	0.3	0.0
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	6.42	7.25		15.3	5.61
Total Metals	Aluminum (Al)-Total (mg/L)	0.0471	0.103	0.228	0.0377	0.0816
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	0.00017	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00044	0.00058	0.00073	0.00046	0.00029
	Barium (Ba)-Total (mg/L)	0.0800	0.0813	0.131	0.0769	0.0692
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	0.000034	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.011	<0.010	0.032	0.017	0.026
	Cadmium (Cd)-Total (mg/L)	<0.0000050	0.0000074	0.000287	0.0000055	0.0000055
	Calcium (Ca)-Total (mg/L)	48.2	39.0	179	64.3	58.9
	Chromium (Cr)-Total (mg/L)	<0.00070 ^{DLB}	<0.00080 ^{DLB}	0.00101	<0.00060 ^{DLB}	<0.00070 ^{DLB}
	Cobalt (Co)-Total (mg/L)	0.00013	0.00019	0.00072	<0.00010	0.00012
	Copper (Cu)-Total (mg/L)	0.00252	0.00236	0.132	0.0284	0.00802
	Iron (Fe)-Total (mg/L)	0.256	0.326	1.15	0.070	0.152
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	0.000821	<0.000050	0.000090
	Lithium (Li)-Total (mg/L)	0.0017	0.0012	0.0039	0.0014	0.0033
	Magnesium (Mg)-Total (mg/L)	21.3	14.6	52.6	20.9	31.3
	Manganese (Mn)-Total (mg/L)	0.0832	0.0728	1.83	0.0914	0.0731

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2179645-6 Water 09-OCT-18 10:15 W17	L2179645-7 Water 09-OCT-18 13:20 W12	L2179645-8 Water 09-OCT-18 DUP	L2179645-9 Water 08-OCT-18 DUP1	
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	497	2280	558	421	
	Hardness (as CaCO3) (mg/L)	241	1110	276	207	
	pH (pH)	8.26	8.17	8.26	8.20	
	Total Suspended Solids (mg/L)	<3.0	13.0	3.8	8.6	
	TDS (Calculated) (mg/L)	290	1920	332	243	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	197	215	257	201	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Total (as CaCO3) (mg/L)	197	215	257	201	
	Ammonia, Total (as N) (mg/L)	<0.0050	3.77	0.0061	0.0203	
	Chloride (Cl) (mg/L)	6.14	32	4.57	2.99	
	Nitrate and Nitrite (as N) (mg/L)	0.184	7.30	0.168	0.231	
	Nitrate (as N) (mg/L)	0.184	4.57	0.168	0.231	
	Nitrite (as N) (mg/L)	<0.0010	2.73	<0.0010	<0.0010	
	Sulfate (SO4) (mg/L)	63.8	1170	59.5	34.3	
	Anion Sum (meq/L)	5.45	30.0	6.52	4.83	
	Cation Sum (meq/L)	5.54	28.7	6.45	4.76	
	Cation - Anion Balance (%)	0.8	-2.2	-0.5	-0.7	
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	9.40		5.53	6.32	
Total Metals	Aluminum (Al)-Total (mg/L)	0.0036	0.125	0.0281	0.0056	
	Antimony (Sb)-Total (mg/L)	<0.00010	0.00031	<0.00010	<0.00010	
	Arsenic (As)-Total (mg/L)	0.00039	0.00051	0.00026	0.00046	
	Barium (Ba)-Total (mg/L)	0.0638	0.0697	0.0690	0.0792	
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000040 ^{DLA}	<0.000020	<0.000020	
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.00010 ^{DLA}	<0.000050	<0.000050	
	Boron (B)-Total (mg/L)	0.023	0.251 ^{DLM}	0.027	0.012	
	Cadmium (Cd)-Total (mg/L)	<0.0000050	<0.000090	0.0000059	<0.0000050	
	Calcium (Ca)-Total (mg/L)	63.7 ^{DLB}	338 ^{DLB}	58.9 ^{DLB}	48.8 ^{DLB}	
	Chromium (Cr)-Total (mg/L)	<0.00060	<0.00060	<0.00060	<0.00060	
	Cobalt (Co)-Total (mg/L)	<0.00010	0.00095	<0.00010	<0.00010	
	Copper (Cu)-Total (mg/L)	0.00724	0.0866	0.00386	0.00164	
	Iron (Fe)-Total (mg/L)	<0.010	0.306	0.065	0.170	
	Lead (Pb)-Total (mg/L)	<0.000050	0.00018	<0.000050	<0.000050	
	Lithium (Li)-Total (mg/L)	0.0014	0.0159	0.0033	0.0017	
	Magnesium (Mg)-Total (mg/L)	20.7	66.2	31.4	21.8	
	Manganese (Mn)-Total (mg/L)	0.0149	0.839	0.0604	0.0814	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2179645-1 Water 08-OCT-18 14:40 W46	L2179645-2 Water 08-OCT-18 15:15 W7	L2179645-3 Water 08-OCT-18 09:30 W8A	L2179645-4 Water 08-OCT-18 10:30 W16	L2179645-5 Water 09-OCT-18 09:20 W3
Grouping	Analyte						
WATER							
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	0.0000056	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Total (mg/L)	0.00202	0.00122	0.0142	0.00309	0.00484	
	Nickel (Ni)-Total (mg/L)	0.00115	0.00117	0.00168	0.00123	0.00133	
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	0.052	<0.050	<0.050	
	Potassium (K)-Total (mg/L)	1.55	1.20	7.20	2.75	2.25	
	Selenium (Se)-Total (mg/L)	0.000204	0.000207	0.00700	0.000707	0.000366	
	Silicon (Si)-Total (mg/L)	6.43	6.34	7.41	4.14	6.60	
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	0.000034	<0.000010	<0.000010	
	Sodium (Na)-Total (mg/L)	13.3	8.74	48.2	13.8	19.7	
	Strontium (Sr)-Total (mg/L)	0.560	0.410	2.48	0.607	0.793	
	Sulfur (S)-Total (mg/L)	11.6	4.82	117	25.8	20.4	
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Total (mg/L)	0.00214	0.00435	0.0114	0.00155	0.00396	
	Uranium (U)-Total (mg/L)	0.00192	0.00150	0.00359	0.00149	0.00289	
	Vanadium (V)-Total (mg/L)	0.00072	0.00082	0.00252	<0.00050	0.00061	
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	0.607	<0.0030	<0.0030	
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	0.00038	<0.00030	<0.00030	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0032	0.0037	0.0066	0.0021	0.0024	
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
	Arsenic (As)-Dissolved (mg/L)	0.00043	0.00053	0.00051	0.00042	0.00022	
	Barium (Ba)-Dissolved (mg/L)	0.0798	0.0831	0.137	0.0802	0.0734	
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	0.011	<0.010	0.029	0.015	0.023	
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	0.0000057	0.000225	0.0000060	0.0000050	
	Calcium (Ca)-Dissolved (mg/L)	47.1	36.7	177	62.5	56.0	
	Chromium (Cr)-Dissolved (mg/L)	0.00013	0.00017	0.00042	0.00012	0.00010	
	Cobalt (Co)-Dissolved (mg/L)	0.00011	0.00014	0.00058	<0.00010	<0.00010	
	Copper (Cu)-Dissolved (mg/L)	0.00167	0.00098	0.0689	0.0248	0.00290	
	Iron (Fe)-Dissolved (mg/L)	0.169	0.191	0.318	0.018	0.025	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.0016	0.0012	0.0038	0.0013	0.0031	
	Magnesium (Mg)-Dissolved (mg/L)	21.5	15.4	53.1	20.8	32.5	
Manganese (Mn)-Dissolved (mg/L)	0.0796	0.0677	1.75	0.00255	0.0528		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2179645-6 Water 09-OCT-18 10:15 W17	L2179645-7 Water 09-OCT-18 13:20 W12	L2179645-8 Water 09-OCT-18 DUP	L2179645-9 Water 08-OCT-18 DUP1	
Grouping	Analyte					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Total (mg/L)	0.00597	0.0605	0.00475	0.00210	
	Nickel (Ni)-Total (mg/L)	0.00097	0.0046	0.00122	0.00104	
	Phosphorus (P)-Total (mg/L)	<0.050	<0.10 ^{DLA}	<0.050	<0.050	
	Potassium (K)-Total (mg/L)	3.34	38.8	2.23	1.54	
	Selenium (Se)-Total (mg/L)	0.000412	0.00680	0.000297	0.000208	
	Silicon (Si)-Total (mg/L)	5.41	4.62	6.48	6.35	
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000020 ^{DLA}	<0.000010	<0.000010	
	Sodium (Na)-Total (mg/L)	14.5	116	19.5	13.2	
	Strontium (Sr)-Total (mg/L)	0.676	5.84	0.794	0.575	
	Sulfur (S)-Total (mg/L)	22.6	409	20.4	11.8	
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000020 ^{DLA}	<0.000010	<0.000010	
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00020 ^{DLA}	<0.00010	<0.00010	
	Titanium (Ti)-Total (mg/L)	<0.00030	<0.0060 ^{DLM}	0.00191	<0.00030	
	Uranium (U)-Total (mg/L)	0.00214	0.00672	0.00293	0.00206	
	Vanadium (V)-Total (mg/L)	<0.00050	<0.0010 ^{DLA}	<0.00050	0.00062	
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0060 ^{DLA}	<0.0030	<0.0030	
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0014	0.0054	0.0026	0.0253 ^{DTC}	
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	0.00030	<0.00010	<0.00010	
	Arsenic (As)-Dissolved (mg/L)	0.00037	0.00042	0.00023	0.00043	
	Barium (Ba)-Dissolved (mg/L)	0.0681	0.0720	0.0708	0.0829	
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000040 ^{DLA}	<0.000020	<0.000020	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.00010 ^{DLA}	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	0.021	0.237 ^{DLM}	0.024	0.011	
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.000090	0.0000055	<0.0000050	
	Calcium (Ca)-Dissolved (mg/L)	61.9 ^{DLB}	337 ^{DLB}	58.3	47.6	
	Chromium (Cr)-Dissolved (mg/L)	<0.0010	<0.00060	0.00013	0.00017	
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00089	<0.00010	0.00012	
	Copper (Cu)-Dissolved (mg/L)	0.00694	0.0533	0.00292	0.00198	
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.020 ^{DLA}	0.027	0.245 ^{DTC}	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.00010 ^{DLA}	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.0014	0.0155	0.0031	0.0016	
	Magnesium (Mg)-Dissolved (mg/L)	21.0	66.0	31.6	21.3	
	Manganese (Mn)-Dissolved (mg/L)	0.00333	0.823	0.0519	0.0794	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2179645-1 Water 08-OCT-18 14:40 W46	L2179645-2 Water 08-OCT-18 15:15 W7	L2179645-3 Water 08-OCT-18 09:30 W8A	L2179645-4 Water 08-OCT-18 10:30 W16	L2179645-5 Water 09-OCT-18 09:20 W3
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00215	0.00133	0.0154	0.00314	0.00502
	Nickel (Ni)-Dissolved (mg/L)	0.00080	0.00079	0.00115	0.00081	0.00097
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	1.58	1.23	7.23	2.89	2.52
	Selenium (Se)-Dissolved (mg/L)	0.000233	0.000212	0.00743	0.000710	0.000293
	Silicon (Si)-Dissolved (mg/L)	6.40	6.46	7.26	4.07	6.58
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	0.000012	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	13.2	9.02	47.7	13.8	20.3
	Strontium (Sr)-Dissolved (mg/L)	0.584	0.430	2.59	0.635	0.838
	Sulfur (S)-Dissolved (mg/L)	11.4	4.31	115	24.3	20.3
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00060 ^{DLM}	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00179	0.00134	0.00330	0.00131	0.00269
	Vanadium (V)-Dissolved (mg/L)	0.00052	0.00058	0.00115	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	0.555	0.0021	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	0.00040	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2179645-6 Water 09-OCT-18 10:15 W17	L2179645-7 Water 09-OCT-18 13:20 W12	L2179645-8 Water 09-OCT-18 DUP	L2179645-9 Water 08-OCT-18 DUP1	
Grouping	Analyte					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Dissolved (mg/L)	0.00619	0.0635	0.00515	0.00216	
	Nickel (Ni)-Dissolved (mg/L)	<0.0015 ^{DLB}	<0.0050 ^{DLB}	0.00099	0.00086	
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.10 ^{DLA}	<0.050	<0.050	
	Potassium (K)-Dissolved (mg/L)	3.53	39.8	2.44	1.54	
	Selenium (Se)-Dissolved (mg/L)	0.000459	0.00634	0.000333	0.000197	
	Silicon (Si)-Dissolved (mg/L)	5.47	4.35	6.32	6.34	
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000020 ^{DLA}	<0.000010	<0.000010	
	Sodium (Na)-Dissolved (mg/L)	14.6	118	20.1	13.2	
	Strontium (Sr)-Dissolved (mg/L)	0.719	6.03	0.850	0.595	
	Sulfur (S)-Dissolved (mg/L)	21.7	395	19.8	11.0	
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000020 ^{DLA}	<0.000010	<0.000010	
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00020 ^{DLA}	<0.00010	<0.00010	
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00060 ^{DLA}	<0.00030	0.00088	
	Uranium (U)-Dissolved (mg/L)	0.00192	0.00644	0.00264	0.00179	
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.0010 ^{DLA}	<0.00050	0.00059	
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	0.0030	<0.0010	0.0015	
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Chromium (Cr)-Dissolved	MB-LOR	L2179645-6, -7
Method Blank	Nickel (Ni)-Dissolved	MB-LOR	L2179645-6, -7
Method Blank	Chromium (Cr)-Total	MB-LOR	L2179645-1, -2, -3, -4, -5, -6, -7, -8, -9
Method Blank	Magnesium (Mg)-Total	MB-LOR	L2179645-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Dissolved Organic Carbon	MS-B	L2179645-1, -2, -4, -5, -6, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2179645-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2179645-1, -2, -3, -4, -5, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2179645-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2179645-1, -2, -3, -4, -5, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2179645-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2179645-1, -2, -3, -4, -5, -8, -9
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2179645-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2179645-1, -2, -3, -4, -5, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2179645-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2179645-1, -2, -3, -4, -5, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2179645-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2179645-1, -2, -3, -4, -5, -8, -9
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2179645-1, -2, -3, -4, -5, -8, -9
Matrix Spike	Barium (Ba)-Total	MS-B	L2179645-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L2179645-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2179645-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Total	MS-B	L2179645-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Total	MS-B	L2179645-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L2179645-1, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLB	Detection Limit Raised. Analyte detected at comparable level in Method Blank.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DTC	Dissolved concentration exceeds total. Results were confirmed by re-analysis.
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)

Reference Information

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

EC-PCT-VA Water Conductivity (Automated) APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-SCREEN-VA Water Conductivity Screen (Internal Use Only) APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 µm), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = \frac{[\text{Cation Sum} - \text{Anion Sum}]}{[\text{Cation Sum} + \text{Anion Sum}]}$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Reference Information

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2018-10-10 C

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



L2179645-COFC

COC Number: 2018-10-10 C

Page 1 of 1

Report To Contact and company name below will appear on the final report		Report Format / Distribution			Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply													
Company: Minto Explorations Ltd.		Select Report Format: ☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)			Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply													
Contact: Minto Environment - Coordinator		Quality Control (QC) Report with Report ☒ YES ☐ NO			PRIORITY (Business Days) 4 day [P4] ☐ 3 day [P3] ☐ 2 day [P2] ☐		EMERGENCY 1 Business day [E1] ☐ Same Day, Weekend or Statutory holiday [E0] ☐											
Phone: 1-604-759-4659		☒ Compare Results to Criteria on Report - provide details below if box checked																
Company address below will appear on the final report		Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX																
Street: 2100-510 West Georgia St.		Email 1 or Fax: mintoenvironment@mintomine.com			Date and Time Required for all E&P TATs: dd-mm-yy hh:mm													
City/Province: Vancouver, British Columbia		Email 2			For tests that can not be performed according to the service level selected, you will be contacted.													
Postal Code: V6B 0M3		Email 3			Analysis Request													
Invoice To: Same as Report To ☐ YES ☒ NO		Invoice Distribution			Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below													
Copy of Invoice with Report ☐ YES ☒ NO		Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX																
Company: Minto Explorations Ltd.		Email 1 or Fax: ap@mintomine.com																
Contact: Ruth Cayetano		Email 2																
Project Information		Oil and Gas Required Fields (client use)																
ALS Account # / Quote #:		AFE/Cost Center:			PO#													
Job #:		Major/Minor Code:			Routing Code:													
PO / AFE: 229096 (WUL)		Requisitioner:																
LSD:		Location:																
ALS Lab Work Order # (lab use only)		ALS Contact: Shane Stack			Sampler:													
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mm-yy)	Time (hh:mm)	Sample Type	pH / Conductivity / Alkalinity / Anions	Total Suspended Solids (TSS)	Total Dissolved Solids (TDS)	Total Metals (TM), Hardness	Dissolved Metals (DM) (Filtered and preserved)	Total Mercury, Hardness	Dissolved Mercury [1] (Filtered + preserved)	Total Nutrients (Ammonia)	Dissolved Organic Carbon (DOC)	Number of Containers				
	W46	8-Oct-18	14:40	Water	R	R	R	R	R	R	R	R	R			7		
	W7	8-Oct-18	15:15	Water	R	R	R	R	R	R	R	R	R			7		
	W8A	8-Oct-18	9:30	Water	R	R	R	R	R	R	R	R	R			6		
	W16	8-Oct-18	10:30	Water	R	R	R	R	R	R	R	R	R			7		
	W3	9-Oct-18	9:20	Water	R	R	R	R	R	R	R	R	R			7		
	W17	9-Oct-18	10:15	Water	R	R	R	R	R	R	R	R	R			7		
	W12	9-Oct-18	13:20	Water	R	R	R	R	R	R	R	R	R			6		
	DUP	9-Oct-18		Water	R	R	R	R	R	R	R	R	R			7		
	DUP 1	8-Oct-18		Water	R	R	R	R	R	R	R	R	R			7		
Drinking Water (DW) Samples¹ (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)			SAMPLE CONDITION AS RECEIVED (lab use only)													
Are samples taken from a Regulated DW System? ☐ YES ☒ NO					Frozen ☐ SIF Observations Yes ☐ No ☐													
Are samples for human drinking water use? ☐ YES ☒ NO					Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐													
					Cooling Initiated ☐													
					INITIAL COOLER TEMPERATURES °C: 5.0 FINAL COOLER TEMPERATURES °C: 7													
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)													
Released by: Shaheen Baker		Date: Oct 10, 2018		Time:	Received by: EHF		Date: 11 Oct 2018		Time: 16:40	Received by: H.A.		Date: 10/12		Time: 12:59				

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

OCTOBER 2015 FRONT

BIOASSAY COA's



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 03-OCT-18
Report Date: 22-NOV-18 19:22 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2175227
Project P.O. #: 229101 (MMER)
Job Reference:
C of C Numbers: 2018-10-03 C
Legal Site Desc:

Comments: Please note, this report contains only Nautilus Environmental reports (at the end of the attachment).

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID						
Grouping	Analyte					

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
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** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
----------------------------	---------------------

Chain of Custody Numbers:

2018-10-03 C

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Acute Toxicity Test Results

Sample L2175227-1 W3,
collected October 2, 2018

Final Report

October 23, 2018

Submitted to: **ALS Environmental**
Burnaby, BC

SAMPLE INFORMATION

Sample ID	Dates			<i>Daphnia magna</i> test initiation	Receipt temp.
	Collected	Received	Rainbow trout test initiation		
L2175227-1 W3	02-Oct-18 at 0835h	04-Oct-18 at 1330h	05-Oct-18 at 1545h	04-Oct-18 at 1640h	5.0°C

TESTS

- Rainbow trout 96-h LC50 test
- *Daphnia magna* 48-h LC50 test

RESULTS

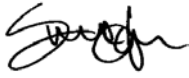
Toxicity test results

Sample ID	LC50 (% v/v)	
	Rainbow trout	<i>Daphnia magna</i>
L2175227-1 W3	> 100	> 100

QA/QC

QA/QC summary	Rainbow trout	<i>Daphnia magna</i>
Reference toxicant LC50 (95% CL)	178.2 (132.2 – 358.8) µg/L Zn ¹	6.8 (5.7 – 8.1) g/L NaCl ²
Reference toxicant historical mean (2 SD range)	85.0 (33.6 – 215.0) µg/L Zn	5.7 (4.0 – 8.1) g/L NaCl
Reference toxicant CV	49%	18%
Organism health history	Acceptable	Acceptable
Protocol deviations	None	None
Water quality range deviations	None	None
Control performance	Acceptable	Acceptable
Test performance	Valid	Valid

¹Test date: October 5, 2018, 2018; ²Test date: October 2, 2018; LC = Lethal Concentration, CL = Confidence Limits, SD = Standard Deviation, CV = Coefficient of Variation



Report By:
Yvonne Lam, B.Sc.
Laboratory Biologist



Reviewed By:
Edmund Canaria, R.P.Bio
Senior Analyst

This report has been prepared by Nautilus Environmental Company Inc. based on data and/or samples provided by our client and the results of this study are for their sole benefit. Any reliance on the data by a third party is at the sole and exclusive risk of that party. The results presented here relate only to the samples tested.

APPENDIX A – Summary of test conditions

Table 1. Summary of test conditions: 96-h rainbow trout (*Oncorhynchus mykiss*) LC50 test.

Test species	<i>Oncorhynchus mykiss</i>
Organism source	Hatchery
Organism age	Juvenile
Test type	Static
Test duration	96 hours
Test vessel	20-L glass aquarium
Test volume	10 to 20 L (depending on size of fish)
Test solution depth	≥15 cm
Test concentrations	Five concentrations, plus laboratory control
Test replicates	1 per treatment
Number of organisms	10 per replicate
Control/dilution water	Dechlorinated Metro Vancouver municipal tapwater
Test solution renewal	None
Test temperature	15 ± 1°C
Feeding	None
Light intensity	100 to 500 lux
Photoperiod	16 hours light / 8 hours dark
Aeration	6.5 ± 1 mL/min/L
Test measurements	Temperature, dissolved oxygen and pH measured daily; salinity measured in the undiluted sample at test initiation; conductivity measured at test initiation and termination; survival checked daily
Test protocol	Environment Canada (2000), EPS 1/RM/13, with 2007 & 2016 amendments
Statistical software	CETIS Version 1.9.4
Test endpoints	Survival (96-hour LC50)
Test acceptability criterion for controls	Survival ≥90%
Reference toxicant	Zinc (added as ZnSO ₄)

Table 2. Summary of test conditions: 48-h *Daphnia magna* LC50 test.

Test species	<i>Daphnia magna</i>
Organism source	In-house culture
Organism age	<24-hour old neonates
Test type	Static
Test duration	48 hours
Test vessel	250-mL glass beaker
Test volume	200 mL
Test solution depth	6 cm
Test concentrations	Five concentrations, plus laboratory control
Test replicates	1 per treatment
Number of organisms	10 per replicate
Control/dilution water	Moderately-hard reconstituted water + 2.5 µg/L Se
Test solution renewal	None
Test temperature	20 ± 2°C
Feeding	None
Light intensity	400 to 800 lux
Photoperiod	16 hours light / 8 hours dark
Aeration	None
Test measurements	Temperature, dissolved oxygen and pH measured daily; salinity, hardness and alkalinity measured in the undiluted sample at test initiation; conductivity measured at test initiation and termination; survival checked daily
Test protocol	Environment Canada (2000), EPS 1/RM/14, with 2016 amendments
Statistical software	CETIS Version 1.9.4
Test endpoints	Survival (48-hour LC50)
Test acceptability criterion for controls	Survival ≥90%
Reference toxicant	Sodium chloride (NaCl)

APPENDIX B – Toxicity test data

Rainbow Trout Summary Sheet

Client: ALS Environmental

Start Date/Time: 05 October 2018; 1545h

Work Order No.: 181670

Test Species: Oncorhynchus mykiss

Sample Information:

Sample ID: L2175227-1 W3
Sample Date: 02 October 2018
Date Received: 04 October 2018
Sample Volume: 7x20L, 3x1L
Other: -

Test Validity Criteria:

≥ 90% control survival

WQ Ranges:

T (°C) = 15 ± 1; DO (mg/L) = 7.0 to 10.3; pH = 5.5 to 8.5

Dilution Water:

Type: Dechlorinated Municipal Tap Water
Hardness (mg/L CaCO₃): 15
Alkalinity (mg/L CaCO₃): 12

Test Organism Information:

Batch No.: 083018b
Source: Lyndon Fish Hatcheries
No. Fish/Volume (L): 10/12L
Loading Density (g/L): 0.42
Mean Length ± SD (mm): 38 ± 3
Mean Weight ± SD (g): 0.50 ± 0.09

Range: 34 - 43
Range: 0.34 - 0.68

Zinc Reference Toxicant Results:

Reference Toxicant ID: RTZn138
Stock Solution ID: 182n06
Date Initiated: 05 October 2018
96-h LC50 (95% CL): 178.2 (132.2 - 358.8) µg/L Zn

Reference Toxicant Mean and Historical Range: 85.0 (33.6 - 215.0) µg/L Zn
Reference Toxicant CV (%): 49

Test Results: The 96 hour LC50 is estimated to be >100% (1/v).

Reviewed by: 

Date reviewed: Oct 23, 2018

96-Hour Rainbow Trout Toxicity Test Data Sheet

Client/Project#: ALS Environmental
 Sample I.D. L2175227-1 W3
 W.O. # 181670
 RBT Batch #: 0830186
 Date Collected/Time: 02Oct18 @ 0835h
 Date Setup/Time: 05Oct18 @ 1545h
 CER #: 10
 Sample Setup By: DK

Number Fish/Volume: 10/12L
 7-d % Mortality: 0.05%
 Total Pre-aeration Time (mins): 30
 Aeration rate adjusted to 6.5 ± 1 mL/min/L? (Y/N): Y

Thermometer: Cer 10
 D.O. meter/probe: 2 / D2
 Cond./Salinity meter/probe: 2 / CP2
 pH meter/probe: 2 / P2

Undiluted Sample WQ			
Parameters	Initial WQ	Adjustment	30 min WQ
Temp °C	15.5	/	15.0
D.O. (mg/L)	9.7		9.8
pH	6.4 7.9		7.9
Cond. (µS/cm)	586		586
Salinity (ppt)	0.3		0.3

Concentration	# Survivors							Temperature (°C)					Dissolved Oxygen (mg/L)					pH					Conductivity (µS/cm)	
(% v/v)	1	2	4	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	96
CH1				10	10	10	10	14.5	14.5	14.5	15.0	14.5	9.8	9.7	9.9	9.5	9.4	7.2	7.0	6.9	7.2	7.0	38	43
6.25				10	10	10	10	14.5	14.5	14.5	15.0	14.5	9.7	9.7	9.8	9.5	9.5	7.5	7.3	7.1	7.3	7.2	39	93
12.5				10	10	10	10	15.0	14.5	14.5	15.0	14.5	9.8	9.6	9.8	9.6	9.5	7.6	7.5	7.3	7.4	7.4	112	117
25				10	10	10	10	15.0	14.5	14.5	15.0	14.5	9.8	9.7	9.9	9.6	9.6	7.8	7.6	7.5	7.6	7.8	230	231
50				10	10	10	10	15.0	14.5	14.5	15.0	14.5	9.8	9.7	9.8	9.6	9.6	7.8	7.9	7.7	8.1	8.0	332	336
100				10	10	10	10	15.0	14.5	14.5	15.0	14.5	9.8	9.8	9.8	9.7	9.6	7.9	8.0	8.0	8.3	8.3	586	580
Initials																								

Sample Description/Comments: DK Pale yellow clear liquid, no odors, black particulates

Fish Description at 96 h All fish appear normal Number of Stressed Fish at 96 h 0

Other Observations: _____

Reviewed by: EW Date Reviewed: Oct 23, 2018

Daphnia magna Summary Sheet

Client: ALS
Work Order No.: 181671

Start Date/Time: Oct 4/2018 @ 1640h
Test Species: Daphnia magna
Set up by: CW

Sample Information:

Sample ID: L217522-1 W3
Sample Date: Oct 2/2018
Date Received: Oct 4/2018
Sample Volume: 3x1L

Test Validity Criteria:

≥ 90% mean control survival and/or mobility and ≤ 2 daphnids exhibit immobility and/or mortality in any single control replicate.

WQ Ranges:

T (°C) = 20 ± 2; DO (mg/L) = 3.6 to 9.4; pH = 6 to 8.5

Test Organism Information:

Broodstock No.: 091118C
Age of young (Day 0): <24 h
Avg No. young per brood in previous 7 d: 15
Mortality (%) in previous 7 d: 10
Days to first brood: 8

NaCl Reference Toxicant Results:

Reference Toxicant ID: DMDC19
Stock Solution ID: 18Na03
Date Initiated: October 2/2018
48-h LC50 (95% CL): 6.8 (5.7 - 8.1) g/L NaCl

Reference Toxicant Mean and Historical Range: 5.7 (4.0 - 8.1) g/L NaCl

Reference Toxicant CV (%): 18

Test Results: The 48h LC50 is estimated to be >100% (V/V).

Reviewed by: CW

Date reviewed: Oct. 18, 2018

Freshwater Acute 48 Hour Toxicity Test Data Sheet

Client: ALS
 Sample ID: L2175227-1 W3
 Work Order No.: 181671

Start Date/Time: Oct-4/2018 @ 1640h
 CER #: 5
 No. Organisms/volume: 10/200mL
 Test Organism: D.magna
 Set up by: CW

Thermometer: 0.45 pH meter/probe: 3 / 3 DO meter/probe: 3 / 3 Cond./Salinity meter/probe: 3 / 3

Concentration (% v/v)	Number of Live Organisms Rep	24		No. Immobilized 48	Temperature (°C)			Dissolved oxygen (mg/L)			pH			Conductivity (µS/cm)	
		48	48		0	24	48	0	24	48	0	24	48	0	48
Control	A	10	10	0	18.5	19.0	19.0	8.8	8.2	8.7	7.5	7.8	7.8	352	354
	B														
	C														
	D														
6.25	A	10	10	0	19.0	19.0	19.0	8.8	8.3	8.7	7.5	7.8	7.8	365	369
	B														
	C														
	D														
12.5	A	10	10	0	19.0	19.0	19.0	8.9	8.3	8.6	7.5	7.8	7.9	380	381
	B														
	C														
	D														
25	A	10	10	0	19.0	19.0	19.0	8.8	8.3	8.6	7.5	7.8	8.0	408	407
	B														
	C														
	D														
50	A	10	10	0	19.0	19.0	19.0	8.7	8.2	8.6	7.5	8.0	8.1	467	469
	B														
	C														
	D														
100	A	10	10	0	18.0	19.0	19.0	8.7	8.2	8.6	7.3	8.1	8.3	571	566
	B														
	C														
	D														
Technician Initials	CW	a	a	a	CW	CW	a	CW	CW	a	CW	CW	a	CW	a

	Hardness*	Alkalinity*
Concentration	*(mg/L as CaCO ₃)	
Control (MHW)	100	78
Highest conc.	296	248
Hardness adjusted	—	—

	Initial WQ	Adjustment	Adjusted WQ
Temp (°C)	18.0		
DO (mg/L)	8.7		
pH	7.3		
Cond (µS/cm)	571		
Salinity (ppt)	0.3		

Comments: _____ Mortality: Heartbeat checked under microscope NO
 Sample Description: Pale yellow^{clear} liquid, no odour, no^{ew} black particulates
 Batch#: 091119 C 7-d previous # young/brood: 15 Previous 7-d Mortality (%): 10 Day of 1st Brood: 8
 Reviewed by: CW Date reviewed: Oct-18, 2018

APPENDIX C – Chain-of-custody form

**L2175227**

VANCOUVER

Subcontract Request Form**Subcontract To:****NAUTILUS ENVIRONMENTAL**8664 COMMERCE COURT
BURNABY, BC V5A 4N7**NOTES:** Please reference on final report and invoice: PO# L2175227
ALS requires QC data to be provided with your final results.Please see enclosed 1 sample(s) in 8 Container(s)

SAMPLE NUMBER	ANALYTICAL REQUIRED	DATE SAMPLED	Priority Flag
		DUE DATE	
L2175227-1 W3		10/2/2018	
	Special Request- Nautilus Environmental (SPECIAL REQUEST-NL 14)	11/5/2018	

Subcontract Info Contact: Walter Lin (604) 253-4188

Analysis and reporting info contact: Shane Stack
8081 LOUGHEED HWY
SUITE 100
BURNABY, BC V5A 1W9

Phone: (604) 253-4188

Email: Shane.Stack@alsglobal.com

Please email confirmation of receipt to:

Shane.Stack@alsglobal.comShipped By: me!Date Shipped: Oct 04 2018Received By: NautilusDate Received: Oct 04/18 @ 13:30Verified By: Tyrene Hamilton

Date Verified: _____

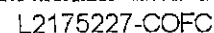
Temperature: 5.0°C

Sample Integrity Issues: _____

7x20L + 3x1L



Canada Toll Free: 1 800 668 9878



Page 1 of 1

[illegible]

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2016 FROM

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backside of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

END OF REPORT



Toxicity Testing for L2175227-1 W3

Sample collected October 2, 2018

Final Report

November 22, 2018

Submitted to: **ALS Environmental**
Burnaby, BC

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SIGNATURE PAGE

Report By:
Emma Marus, B.Sc.
Laboratory Biologist



Reviewed By:
Armando Tang, R.P. Bio
Senior Reviewer

This report has been prepared by Nautilus Environmental Company Inc. based on data and/or samples provided by our client and the results of this study are for their sole benefit. Any reliance on the data by a third party is at the sole and exclusive risk of that party. The results presented here relate only to the samples tested.

SUMMARY

Sample Information and Test Type

Sample ID	L2175227-1 W3
Sample collection date	October 2, 2018
Sample receipt date	October 4, 2018
Sample receipt temperature	5.0°C
Test types	<i>Ceriodaphnia dubia</i> survival and reproduction
	7-d rainbow trout (<i>Oncorhynchus mykiss</i>) embryo viability
	7-d <i>Lemna minor</i> growth inhibition
	72-h <i>Pseudokirchneriella subcapitata</i> growth inhibition

Summary of Results

Endpoint	% v/v
<i>Ceriodaphnia dubia</i>	
Survival LC50	>100
Reproduction IC25	>100
Reproduction IC50	>100
<i>Oncorhynchus mykiss</i>	
Embryo viability EC25	>100
Embryo viability EC50	>100
<i>Lemna minor</i>	
Frond count IC25	>97
Frond count IC50	>97
Dry weight IC25	>97
Dry weight IC50	>97
<i>Pseudokirchneriella subcapitata</i>	
Growth IC25	>95.2
Growth IC50	>95.2

LC = Lethal Concentration, IC = Inhibition Concentration, EC = Effective Concentration

1.0 INTRODUCTION

Nautilus Environmental Company Inc. conducted sub-lethal toxicity tests for ALS Environmental on sample identified as L2175227-1 W3. The sample was collected on October 2, 2018 and delivered to the Nautilus Environmental laboratory in Burnaby, BC on October 4, 2018. The sample was transported in seven 20-L and three 1-L plastic containers and received at a temperature of 5.0°C. The sample was stored in the dark at $4 \pm 2^\circ\text{C}$ prior to testing.

The following toxicity tests were performed on sample L2175227-1 W3:

- *Ceriodaphnia dubia* survival and reproduction
- 7-d rainbow trout (*Oncorhynchus mykiss*) embryo viability
- 7-d *Lemna minor* growth inhibition
- 72-h *Pseudokirchneriella subcapitata* growth inhibition

Testing for L2175227-1 W3 was initiated on October 4, 2018 for *C. dubia*, *O. mykiss* and *L. minor* and on October 5, 2018 for *P. subcapitata*. This report describes the results of these toxicity tests. Copies of raw laboratory data sheets and statistical analyses for each test species are provided in Appendices A to D. The chain-of-custody form is provided in Appendix E.

2.0 METHODS

Methods for the toxicity tests are summarized in Tables 1 to 4. Testing using *C. dubia*, *L. minor* and *P. subcapitata* were conducted according to procedures described by Environment Canada (2007a, 2007b and 2007c). The rainbow trout embryo viability test followed procedures described by Environment Canada (1998) and modified by Canaria *et al.* (1999). Statistical analyses for all the tests were performed using CETIS (Tidepool Scientific Software, 2013).

Table 1. Summary of test conditions: *Ceriodaphnia dubia* survival and reproduction test.

Test species	<i>Ceriodaphnia dubia</i>
Organism source	In-house culture
Organism age	<24 hour old neonates, produced within a 12 hour window
Test type	Static-renewal
Test duration	7 ± 1 day
Test vessel	20-mL glass test tube
Test volume	15 mL
Test solution depth	10 cm
Test concentrations	Seven concentrations, plus laboratory control
Test replicates	10 per treatment
Number of organisms	1 per replicate
Control/dilution water	20% Perrier water and 80% deionized water + 5 µg/L Se and 2 µg/L vitamin B12
Test solution renewal	Daily (100% renewal)
Test temperature	25 ± 1°C
Feeding	Daily with <i>Pseudokirchneriella subcapitata</i> and YCT (3:1 ratio)
Light intensity	100 to 600 lux at water surface
Photoperiod	16 hours light / 8 hours dark
Aeration	None
Test measurements	Temperature, dissolved oxygen, pH and conductivity measured daily; hardness and alkalinity of undiluted sample measured at test initiation; survival and reproduction checked daily
Test protocol	Environment Canada (2007a), EPS 1/RM/21
Statistical software	CETIS Version 1.9.4
Test endpoints	Survival and reproduction ≥80% survival; ≥15 young per surviving control producing three broods; ≥60% of controls producing three or more broods; no ephippia present
Test acceptability criteria for controls	
Reference toxicant	Sodium chloride (NaCl)

Table 2. Summary of test conditions: 7-d rainbow trout (*Oncorhynchus mykiss*) embryo viability test.

Test species	<i>Oncorhynchus mykiss</i>
Organism source	Hatchery
Organism age	<30 minutes post fertilization, <24 hour old gametes
Test type	Static-renewal
Test duration	7 days
Test vessel	2-L plastic container
Test volume	2 L
Test solution depth	17 cm
Test concentrations	Five concentrations, plus laboratory control
Test replicates	4 per treatment
Number of organisms	30 per replicate
Control/dilution water	Dechlorinated Metro Vancouver municipal tapwater
Test solution renewal	Daily (80% renewal)
Test temperature	14 ± 1°C
Feeding	None
Light intensity	Dark
Photoperiod	24 hours dark
Aeration	Continuous gentle aeration
Test measurements	Temperature, dissolved oxygen, pH and conductivity measured daily; hardness and alkalinity of undiluted sample measured at test initiation; survival checked daily
Test protocol	Environment Canada (1998), EPS 1/RM/28; Canaria et al. (1999)
Statistical software	CETIS Version 1.9.4
Test endpoint	Embryo viability
Test acceptability criterion for controls	Embryo viability ≥70%
Reference toxicant	Sodium dodecyl sulphate (SDS)

Table 3. Summary of test conditions: 7-d *Lemna minor* growth inhibition test.

Test species	<i>Lemna minor</i> , strain CPCC# 490
Organism source	In-house axenic culture, obtained from Canadian Phycological Culture Centre, and originally isolated from Wainfleet, Stinking Barn, Niagara Peninsula, Ontario, Canada
Organism age	7- to 10-day old culture
Test type	Static
Test duration	7 days
Test vessel	250-mL glass container
Test volume	100 mL
Test solution depth	4 cm
Test concentrations	Seven concentrations, plus laboratory control
Test replicates	4 per treatment
Number of organisms	Two 3-frond plants per replicate
Control/dilution water	Modified APHA media (deionized water plus 1% of each APHA stock solution A, B and C)
Test solution renewal	None
Test temperature	25 ± 2°C
Feeding	None
Light intensity	4000 to 5600 lux
Photoperiod	24 hours light
Aeration	None
Test measurements	Test area temperature measured daily; temperature, pH and conductivity measured in all concentrations at test initiation; dissolved oxygen of highest concentration measured at test initiation; temperature and pH measured at test termination
Test protocol	Environment Canada (2007b), EPS 1/RM/37
Statistical software	CETIS Version 1.9.4
Test endpoints	Number of fronds and dry weight
Test acceptability criterion for controls	≥ 8-fold increase in number of fronds
Reference toxicant	Potassium chloride (KCl)

Table 4. Summary of test conditions: 72-h *Pseudokirchneriella subcapitata* growth inhibition test.

Test species	<i>Pseudokirchneriella subcapitata</i> , strain CPCC #37
Organism source	In-house axenic culture, obtained from Canadian Phycological Culture Center, and originally isolated from Nivelta River, Norway.
Organism age	3-to 7-day old culture in logarithmic growth phase
Test type	Static
Test duration	72 hours
Test vessel	Microplate
Test volume	220 µL
Test concentrations	Seven concentrations, plus laboratory control
Test replicates	4 per treatment; 8 for laboratory control
Number of organisms	10,000 cells/mL
Control/dilution water	Deionized water supplemented with nutrients
Test solution renewal	None
Test temperature	24 ± 2°C
Feeding	None
Light intensity	3600 to 4400 lux
Photoperiod	24 hours light
Aeration	None
Test measurements	Test area temperature measured daily; temperature and pH measured at test initiation; pH of two control wells measured at test termination
Test protocol	Environment Canada (2007c), EPS 1/RM/25
Statistical software	CETIS Version 1.9.4
Test endpoint	Algal cell growth inhibition
Test acceptability criteria for controls	> 16-fold increase in number of algal cells; CV ≤ 20%; no trend when analyzed using Mann-Kendall test
Reference toxicant	Zinc (added as ZnSO ₄)

3.0 RESULTS

Results of the toxicity tests are summarized in Tables 5 to 8. For sample L2175227-1 W3, there were no adverse effects observed on survival and reproduction of *C. dubia* (Table 5), embryo viability of *O. mykiss* (Table 6), cell yield of *P. subcapitata* (Table 8) or on frond growth and dry weight of *L. minor* (Table 7). The LC and IC values were therefore greater than the highest test concentration for each of these endpoints in the toxicity tests. Stimulatory effects were observed for *P. subcapitata* cell yield, with percent stimulation ranging from 5.6 to 464.5%.

Table 5. Results: *Ceriodaphnia dubia* survival and reproduction test.

Concentration (% v/v)	Survival (%)	Reproduction (Mean ± SD)
Laboratory Control	100	16.8 ± 2.9
1.56	90	15.7 ± 7.2
3.12	100	19.8 ± 3.0
6.25	100	20.6 ± 2.2
12.5	100	21.2 ± 3.7
25	100	17.6 ± 5.4
50	100	18.1 ± 4.0
100	90	19.2 ± 8.2
Test Endpoint (% v/v)		
LC50	>100	--
IC25	--	>100
IC50	--	>100

SD = Standard Deviation, LC = Lethal Concentration, IC = Inhibition Concentration

Table 6. Results: 7-d rainbow trout (*Oncorhynchus mykiss*) embryo viability test.

Concentration (% v/v)	Embryo Viability (%) (Mean $\pm$ SD)
Laboratory Control	90.8 $\pm$ 8.3
6.25	95.0 $\pm$ 4.3
12.5	93.3 $\pm$ 7.2
25	90.8 $\pm$ 7.9
50	90.1 $\pm$ 4.7
100	88.3 $\pm$ 8.8
Test Endpoint (% v/v)	
EC25	> 100
EC50	> 100

SD = Standard Deviation, EC = Effective Concentration

Table 7. Results: 7-d *Lemna minor* growth inhibition test.

Concentration (% v/v)	Frond Growth (No. of Fronds) (Mean $\pm$ SD)	Dry Weight (mg) (Mean $\pm$ SD)
Laboratory Control	69.8 $\pm$ 4.0	5.8 $\pm$ 0.4
1.5	81.0 $\pm$ 16.9	6.4 $\pm$ 1.0
3.0	80.2 $\pm$ 16.9	6.4 $\pm$ 1.2
6.1	77.0 $\pm$ 14.6	6.4 $\pm$ 1.1
12.1	79.2 $\pm$ 5.0	6.4 $\pm$ 0.2
24.2	100.8 $\pm$ 6.1	7.6 $\pm$ 0.5
48.5	106.0 $\pm$ 8.1	8.5 $\pm$ 0.7
97	72.8 $\pm$ 14.6	6.5 $\pm$ 0.8
Test Endpoint (% v/v)		
IC25	>97	>97
IC50	>97	>97

SD = Standard Deviation, IC = Inhibition Concentration

Table 8. Results: 72-h *Pseudokirchneriella subcapitata* growth inhibition test.

Concentration (% v/v)	Cell Yield (x 10⁴ cells/mL) (Mean ± SD)	Stimulation (%)
Laboratory Control	31.0 ± 2.6	--
1.5	32.8 ± 2.4	5.6
3.0	47.5 ± 4.9 *	53.2
6.0	85.8 ± 5.7 *	176.6
11.9	133.5 ± 5.2 *	330.6
23.8	164.5 ± 6.5 *	430.6
47.6	175.0 ± 3.2 *	464.5
95.2	150.0 ± 7.4 *	383.9
Test Endpoint (% v/v)		
IC25	>95.2	--
IC50	>95.2	--

SD = Standard Deviation, IC = Inhibition Concentration

* = Indicates cell yield that were significantly greater than the control

4.0 QA/QC

The health histories of the test organisms used in the exposures were acceptable and met the requirements of the Environment Canada protocols. The tests met all control acceptability criteria and water quality parameters remained within ranges specified in the protocols throughout the tests. Uncertainty associated with the tests is best described by the standard deviation around the means and/or the confidence intervals around the point estimates.

There were no deviations from the test methodologies, except for the 7-d rainbow trout embryo viability test. The eggs were exposed using a blocked design (eggs from each of the four female fish were distributed separately in each replicate A to D) rather than pooled, as specified in the test protocol. The modification was used because the egg quality from each female varied considerably, and blocking would minimize the effects of poor quality eggs from one particular female fish. The deviations did not seem to affect the results of the test since control criterion was met at the end of the exposure.

Results of the reference toxicant tests conducted during the testing program are summarized in Table 9. Results for these tests fell within the range for organism performance of the mean and two standard deviations, based on historical results obtained by the laboratory with these tests. Thus, the sensitivity of the organisms used in the tests was appropriate. The reference toxicant tests were performed under the same conditions as those used for the samples.

Table 9. Reference toxicant test results.

Test Species	Endpoint	Historical Mean (2 SD Range)	CV (%)	Test Date
<i>C. dubia</i>	Survival (LC50): 1.8 g/L NaCl	2.0 (1.8 – 2.2) g/L NaCl	5	October 17, 2018
	Reproduction (IC50): 1.2 g/L NaCl	1.3 (0.8 – 1.9) g/L NaCl	21	
<i>O. mykiss</i>	Viability (EC50): 4.4 mg/L SDS	4.2 (2.0 – 8.8) mg/L SDS	38	October 4, 2018
<i>L. minor</i>	No. Fronds (IC50): 3.5 g/L KCl	3.5 (2.9 – 4.2) g/L KCl	10	September 21, 2018
<i>P. subcapitata</i>	Growth (IC50): 29.1 µg/L Zn	31.2 (25.9 – 37.7) µg/L Zn	9	September 21, 2018

SD = Standard Deviation, CV = Coefficient of Variation, LC = Lethal Concentration, IC = Inhibition Concentration, EC = Effective Concentration

5.0 REFERENCES

- Canaria, E.C., J.R. Elphick and H.C. Bailey. 1999. A simplified procedure for conducting small-scale short-term embryo toxicity tests with salmonids. *Environ Toxicol* 14:301-307.
- Environment Canada. 1998. Biological test method: toxicity tests using early life stages of salmonid fish (rainbow trout). Environmental Protection Series EPS 1/RM/28. Second Edition, July 1998. Environment Canada, Method Development and Application Section, Environmental Technology Centre, Ottawa, ON. 102 pp.
- Environment Canada. 2007a. Biological test method: test of reproduction and survival using the cladoceran *Ceriodaphnia dubia*. Environmental Protection Series. Report EPS 1/RM/21, Second Edition, February 2007. Environment Canada, Method Development and Application Section, Environmental Science and Technology Centre, Science and Technology Branch, Ottawa, ON. 74 pp.
- Environment Canada. 2007b. Biological test method: tests for measuring the inhibition of growth using the freshwater macrophyte, *Lemna minor*. Environmental Protection Series, Report EPS 1/RM/37. Second Edition. January 2007. Environment Canada, Method Development and Application Section, Environmental Technology Centre, Ottawa, ON. 112 pp.
- Environment Canada. 2007c. Biological test method: growth inhibition test using the freshwater alga. Environmental Protection Series, Report EPS 1/RM/25. Second Edition, March 2007. Environment Canada, Method Development and Application Section, Environmental Science and Technology Centre, Science and Technology Branch, Ottawa, ON. 53 pp.
- Tidepool Scientific Software. 2013. CETIS comprehensive environmental toxicity information system, version 1.9.4 Tidepool Scientific Software, McKinleyville, CA. 275 pp.

APPENDIX A – *Ceriodaphnia dubia* Toxicity Test Data

Ceriodaphnia dubia Summary Sheet

Client: ALS (Minto)
Work Order No.: 181673

Start Date/Time: 04/18/18 1400h
Set up by: U/JS

Sample Information:

Sample ID: 217522-1 W-3
Sample Date: 04/2/18
Date Received: 04/4/18
Sample Volume: 7x20L & 3x1L

Test Validity Criteria:

- 1) Mean survival of first generation controls is $\geq 80\%$
- 2) At least 60% of controls have produced three broods within 8 days
- 3) An average of ≥ 15 live young produced per surviving female in the control solutions during the first three broods.
- 4) Invalid if ephippia observed in any control solution at any time.

WQ Ranges:

T ($^{\circ}$ C) = 25 ± 1 ; DO (mg/L) = 3.3 to 8.4; pH = 6.0 to 8.5

Test Organism Information:

Broodstock No.: BB092518A & B
Age of young (Day 0): <24-h (within 12-h)
Avg No. young in first 3 broods of previous 7 d: 18
Mortality (%) in previous 7 d: 2.5
Individual female # used ≥ 8 young on test day: 2, 3, 5, 7-10, 14, 18, 19, 22, 23, 26, 30, 32-40

NaCl Reference Toxicant Results:

Reference Toxicant ID: 18NaCl Cd198
Stock Solution ID: 18NaCl (100g/L NaCl)
Date Initiated: 04/17/18

7-d LC50 (95% CL): 1.8(1.6-2.2) g/L NaCl
7-d IC50 (95% CL): 1.2(1.1-1.3) g/L NaCl

7-d LC50 Reference Toxicant Mean and Historical Range: 2.0(1.8-2.2) g/L NaCl CV (%): 5
7-d IC50 Reference Toxicant Mean and Historical Range: 1.3(0.8-1.9) g/L NaCl CV (%): 21

Test Results:

	Survival	Reproduction
LC50 % (v/v) (95% CL)	<u>>100</u>	
IC25 % (v/v) (95% CL)		<u>>100</u>
IC50 % (v/v) (95% CL)		<u>>100</u>

Reviewed by: JGK

Date reviewed: Nov. 5/18

Chronic Freshwater Toxicity Test Initial and Final Water Quality Measurements

Client: ALS (MINTO)
Sample ID: W-3 2475227-1 W-3
Work Order #: 181673

Start Date & Time: July 10 Oct. 04/18 @ 1400h
Stop Date & Time: Oct 11/18 @ 1500h
CER #: 4
Test Species: Ceriodaphnia dubia

Concentration Control	Days													
	0	1		2		3		4		5		6		7
	init.	old.	new	old.	new	old.	new	old.	new	old.	new	old.	new	final
Temperature (°C)	25.0	25.0	25.0	25.0	24.0	25.0	24.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
DO (mg/L)	8.0	7.8	8.2	7.5	8.0	7.4	8.0	7.1	7.8	7.3	8.0	7.9	8.0	6.4
pH	7.6	7.7	8.0	7.0	7.9	7.8	8.1	8.1	8.4	7.8	8.1	7.7	8.2	7.8
Cond. (µS/cm)	224	225		224		223		223		224		221		227
Initials	JB	JB		A		A		K		JB		JB		JB

Concentration 1.56	Days													
	0	1		2		3		4		5		6		7
	init.	old.	new	old.	new	old.	new	old.	new	old.	new	old.	new	final
Temperature (°C)	24.0	25.0	24.0	25.0	24.0	25.0	24.0	25.0	24.5	25.0	25.0	25.0	25.0	25.0
DO (mg/L)	7.8	7.7	7.8	7.5	8.2	7.4	8.0	7.1	7.9	7.3	7.9	7.9	7.7	6.7
pH	7.8	7.9	7.9	8.1	8.1	7.9	8.1	8.1	8.2	7.9	7.9	7.7	8.0	7.8
Cond. (µS/cm)	231	231		230		232		226		222		214		211
Initials	JB	JB		A		A		K		JB		JB		JB

Concentration 12.5	Days													
	0	1		2		3		4		5		6		7
	init.	old.	new	old.	new	old.	new	old.	new	old.	new	old.	new	final
Temperature (°C)	24.0	25.0	24.0	25.0	24.0	25.0	24.0	25.0	24.5	25.0	25.0	25.0	25.0	25.0
DO (mg/L)	7.9	7.8	7.8	7.8	8.1	7.4	8.0	6.6	7.9	7.4	7.9	7.4	7.7	6.7
pH	7.8	8.0	7.9	8.2	8.1	8.0	8.1	8.0	8.1	7.9	7.9	7.7	8.0	7.8
Cond. (µS/cm)	270	271		268		266		266		264		261		255
Initials	JB	JB		A		A		K		JB		JB		JB

Concentration 100	Days													
	0	1		2		3		4		5		6		7
	init.	old.	new	old.	new	old.	new	old.	new	old.	new	old.	new	final
Temperature (°C)	25.0	25.0	25.0	25.0	24.0	25.0	24.0	25.0	24.5	25.0	25.0	25.0	25.0	25.0
DO (mg/L)	8.1	7.7	7.8	7.5	8.1	7.4	8.0	7.0	7.9	7.4	7.9	8.1	8.1	6.5
pH	7.5	8.3	7.6	8.4	7.8	8.3	7.9	8.4	8.0	8.2	7.7	7.6	7.8	8.2
Cond. (µS/cm)	569	569		566		570		559		567		565		524
Initials	JB	JB		A		A		K		JB		JB		JB

Thermometer: 4 DO meter/probe: 1/1/1 pH meter/probe: 1/1/1 Conductivity meter/probe: 1/1/1

	Control	100%		
Hardness*	100	296		
Alkalinity*	98	248		

* mg/L as CaCO₃

Analysts: JB, AD, KL

Reviewed by: JB

Date reviewed: Oct-29/18

Sample Description: Brown pale yellow, clear, odourless, no black particulates

Comments: Broodboard Used: 000925A & B (1, 2, 3, 5, 7-10, 14, 18, 19, 22, 23, 26, 30, 32-40)

Chronic Freshwater Toxicity Test *C. dubia* Reproduction Data

Client: ALB (MINTD)
Sample ID: ~~W-3~~ W-4755 EL175227-1 W-3.
Work Order: 181673

Start Date & Time: Oct 01/18 @ ~~1400h~~ ^{1400h}
Stop Date & Time: Oct 11/18 @ 1500h
Set up by: VL/JS

Days	Concentration: 10^{-5} M										Concentration: 10^{-6} M										Concentration: 10^{-7} M												
	A	B	C	D	E	F	G	H	I	J	Init	A	B	C	D	E	F	G	H	I	J	Init	A	B	C	D	E	F	G	H	I	J	Init
1	—	—	—	—	—	—	—	—	—	—	JB	—	—	—	—	—	—	—	—	—	—	JB	—	—	—	—	—	—	—	—	—	—	JB
2	—	—	—	—	—	—	—	—	—	—	A	—	—	—	—	—	—	—	—	—	—	A	—	—	—	—	—	—	—	—	—	—	A
3	—	—	—	—	—	—	—	—	—	—	A	—	—	—	—	—	—	—	—	—	—	A	—	—	—	—	—	—	—	—	—	—	A
4	—	2	—	—	—	2	3	—	3	2	4	—	2	—	2	—	—	—	3	—	—	4	—	—	—	—	2	—	2	—	2	—	4
5	3	7	3	1	—	3	5	3	5	JB	JB	—	3	5	5	2	—	2	5	3	4	JB	—	—	4	3	6	2	4	5	4	JB	JB
6	8	—	6	8	—	9	8	7	—	—	JB	—	8	—	X	6	—	9	—	7	8	JB	—	8	9	10	—	10	9	10	8	—	JB
7	10	10	8	9	—	9	9	—	—	—	9	—	10	—	—	—	2	—	4	—	—	JB	—	—	—	10	7	8	10	9	9	10	JB
8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	21	14	17	21	12	14	16	16	17	15	4	20	17	24	17	2	2	21	15	19	17	4	22	20	23	22	15	20	16	22	16	22	4

Days	Concentration: 1.25											Concentration: 12.5											Concentration: 25											
	A	B	C	D	E	F	G	H	I	J	Init	A	B	C	D	E	F	G	H	I	J	Init	A	B	C	D	E	F	G	H	I	J	Init	
1	/	/	/	/	/	/	/	/	/	/	15	/	/	/	/	/	/	/	/	/	/	15	/	/	/	/	/	/	/	/	/	/	15	
2	/	/	/	/	/	/	/	/	/	/	1	/	/	/	/	/	/	/	/	/	/	1	/	/	/	/	/	/	/	/	/	/	1	
3	/	/	/	/	/	/	/	/	/	/	1	/	/	/	/	/	/	/	/	/	/	1	/	/	/	/	/	/	/	/	/	/	1	
4	/	/	/	/	/	2	1	1	2	1	1	/	2	2	1	1	1	1	1	1	2	1	1	2	1	1	1	1	1	1	2	1	1	
5	3	2	3	2	2	5	4	3	6	4	15	3	6	6	4	4	2	4	4	4	5	7	15	4	5	1	5	4	3	3	5	3	15	
6	8	8	9	8	9	12	9	9	1	15	10	1	1	11	12	9	9	6	13	1	1	15	10	1	3	9	9	4	9	6	1	9	15	
7	11	11	10	8	10	11	10	12	10	8	1	9	10	11	9	10	12	8	11	9	13	1	11	11	11	11	8	10	9	7	9	10	1	
8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Total	22	24	20	18	21	19	24	24	18	18	1	22	18	19	25	23	23	18	28	16	20	1	25	18	8	16	21	22	18	10	16	22	1	1

[illegible]

Notes: X = mortality.

Sample Description: see info sheet

Comments: Total # Young only based on the first 3

Comments: Total # Young only based on the first 3 Broods. Fourth and subsequent broods not included in total count.

Reviewed by:

Date reviewed:

CETIS Analytical Report

Report Date: 02 Nov-18 18:41 (p 1 of 2)

Test Code/ID: 181673 / 02-3281-0147

Ceriodaphnia 7-d Survival and Reproduction Test

Nautilus Environmental

Analysis ID: 15-3289-3941	Endpoint: 7d Survival Rate	CETIS Version: CETISv1.9.4
Analyzed: 23 Oct-18 17:09	Analysis: Linear Interpolation (ICPIN)	Status Level: 1
Batch ID: 11-3243-4269	Test Type: Reproduction-Survival (7d)	Analyst: Kania Lywe
Start Date: 04 Oct-18 14:00	Protocol: EC/EPS 1/RM/21	Diluent: 20% Perrier Water
Ending Date: 11 Oct-18 15:00	Species: Ceriodaphnia dubia	Brine:
Test Length: 7d 1h	Taxon: Branchiopoda	Source: In-House Culture Age: <24
Sample ID: 00-9926-6391	Code: 5EAAF57	Project:
Sample Date: 02 Oct-18 08:35	Material: Water Sample	Source: ALS
Receipt Date: 04 Oct-18 13:30	CAS (PC):	Station: L2175227-1 W3
Sample Age: 53h (5 °C)	Client: ALS	

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	1180215	200	Yes	Two-Point Interpolation

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
EC5	66.03	50	n/a	1.514	n/a	2
EC10	100	61.35	n/a	1	n/a	1.63
EC15	>100	n/a	n/a	<1	n/a	n/a
EC20	>100	n/a	n/a	<1	n/a	n/a
EC25	>100	n/a	n/a	<1	n/a	n/a
EC40	>100	n/a	n/a	<1	n/a	n/a
EC50	>100	n/a	n/a	<1	n/a	n/a

7d Survival Rate Summary

Conc-%	Code	Count	Calculated Variate(A/B)							Isotonic Variate	
			Mean	Min	Max	Std Dev	CV%	%Effect	A/B	Mean	%Effect
0	N	10	1.0000	1.0000	1.0000	0.0000	0.00%	0.0%	10/10	1	0.0%
1.56		10	0.9000	0.0000	1.0000	0.3162	35.14%	10.0%	9/10	0.9833	1.67%
3.12		10	1.0000	1.0000	1.0000	0.0000	0.00%	0.0%	10/10	0.9833	1.67%
6.25		10	1.0000	1.0000	1.0000	0.0000	0.00%	0.0%	10/10	0.9833	1.67%
12.5		10	1.0000	1.0000	1.0000	0.0000	0.00%	0.0%	10/10	0.9833	1.67%
25		10	1.0000	1.0000	1.0000	0.0000	0.00%	0.0%	10/10	0.9833	1.67%
50		10	1.0000	1.0000	1.0000	0.0000	0.00%	0.0%	10/10	0.9833	1.67%
100		10	0.9000	0.0000	1.0000	0.3162	35.14%	10.0%	9/10	0.9	10.0%

7d Survival Rate Detail

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	N	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1.56		1.0000	1.0000	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
3.12		1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
6.25		1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
12.5		1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
25		1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
50		1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
100		1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

7d Survival Rate Binomials

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	N	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
1.56		1/1	1/1	1/1	0/1	1/1	1/1	1/1	1/1	1/1	1/1
3.12		1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
6.25		1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
12.5		1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
25		1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
50		1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
100		1/1	0/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1

CETIS Analytical Report

Report Date: 02 Nov-18 18:41 (p 2 of 2)
Test Code/ID: 181673 / 02-3281-0147

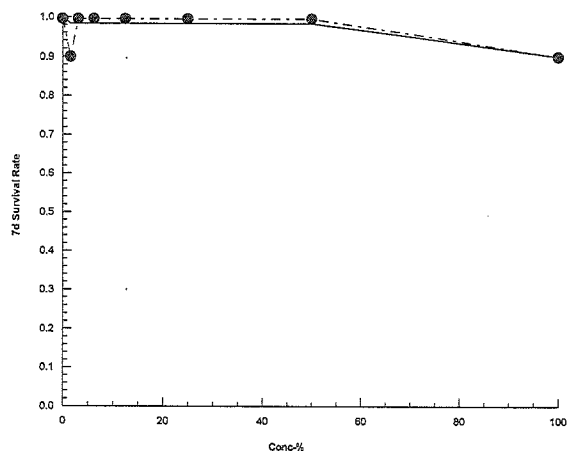
Ceriodaphnia 7-d Survival and Reproduction Test

Nautilus Environmental

Analysis ID: 15-3289-3941 Endpoint: 7d Survival Rate
Analyzed: 23 Oct-18 17:09 Analysis: Linear Interpolation (ICPIN)

CETIS Version: CETISv1.9.4
Status Level: 1

Graphics



CETIS Analytical Report

Report Date: 02 Nov-18 18:42 (p 1 of 2)
Test Code/ID: 181673 / 02-3281-0147

Ceriodaphnia 7-d Survival and Reproduction Test				Nautilus Environmental	
Analysis ID:	16-4050-3872	Endpoint:	Reproduction	CETIS Version:	CETISv1.9.4
Analyzed:	23 Oct-18 17:10	Analysis:	Linear Interpolation (ICPIN)	Status Level:	1
Batch ID:	11-3243-4269	Test Type:	Reproduction-Survival (7d)	Analyst:	Kania Lywe
Start Date:	04 Oct-18 14:00	Protocol:	EC/EPS 1/RM/21	Diluent:	20% Perrier Water
Ending Date:	11 Oct-18 15:00	Species:	Ceriodaphnia dubia	Brine:	
Test Length:	7d 1h	Taxon:	Branchiopoda	Source:	In-House Culture
					Age: <24
Sample ID:	00-9926-6391	Code:	5EAAF57	Project:	
Sample Date:	02 Oct-18 08:35	Material:	Water Sample	Source:	ALS
Receipt Date:	04 Oct-18 13:30	CAS (PC):		Station:	L2175227-1 W3
Sample Age:	53h (5 °C)	Client:	ALS		

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	1803119	200	Yes	Two-Point Interpolation

Residual Analysis

Attribute	Method	Test Stat	Critical	P-Value	Decision(α:5%)
Control Trend	Mann-Kendall Trend Test		1.96	0.1032	Non-Significant Trend in Controls

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
IC5	>100	n/a	n/a	<1	n/a	n/a
IC10	>100	n/a	n/a	<1	n/a	n/a
IC15	>100	n/a	n/a	<1	n/a	n/a
IC20	>100	n/a	n/a	<1	n/a	n/a
IC25	>100	n/a	n/a	<1	n/a	n/a
IC40	>100	n/a	n/a	<1	n/a	n/a
IC50	>100	n/a	n/a	<1	n/a	n/a

Reproduction Summary

			Calculated Variate						Isotonic Variate	
Conc-%	Code	Count	Mean	Min	Max	Std Dev	CV%	%Effect	Mean	%Effect
0	N	10	16.8	12	21	2.898	17.25%	0.0%	18.82	0.0%
1.56		10	15.7	2	24	7.15	45.54%	6.55%	18.82	0.0%
3.12		10	19.8	15	23	3.011	15.21%	-17.86%	18.82	0.0%
6.25		10	20.6	18	24	2.221	10.78%	-22.62%	18.82	0.0%
12.5		10	21.2	16	28	3.676	17.34%	-26.19%	18.82	0.0%
25		10	17.6	8	25	5.379	30.56%	-4.76%	18.3	2.76%
50		10	18.1	14	27	3.985	22.01%	-7.74%	18.3	2.76%
100		10	19.2	0	28	8.176	42.58%	-14.29%	18.3	2.76%

Reproduction Detail

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	N	21	19	17	21	12	14	16	16	17	15
1.56		20	17	24	4	18	2	21	15	19	17
3.12		22	20	23	22	15	20	16	22	16	22
6.25		22	21	22	18	21	19	23	24	18	18
12.5		22	18	19	25	23	23	18	28	16	20
25		25	18	8	16	21	22	18	10	16	22
50		27	15	19	14	22	17	19	18	15	15
100		13	0	24	20	27	24	18	28	17	21

CETIS Analytical Report

Report Date: 02 Nov-18 18:42 (p 2 of 2)

Test Code/ID: 181673 / 02-3281-0147

Ceriodaphnia 7-d Survival and Reproduction Test

Nautilus Environmental

Analysis ID: 16-4050-3872

Endpoint: Reproduction

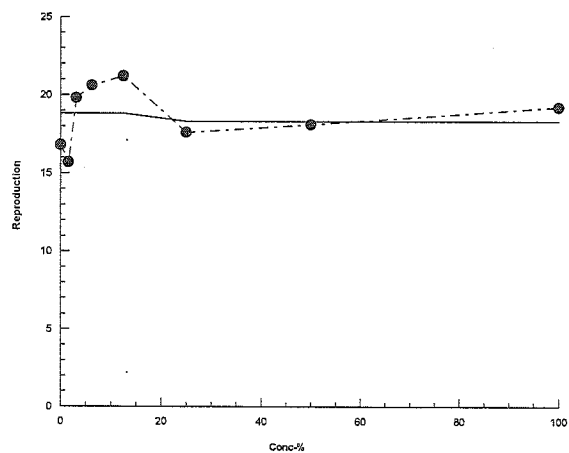
CETIS Version: CETISv1.9.4

Analyzed: 23 Oct-18 17:10

Analysis: Linear Interpolation (ICPIN)

Status Level: 1

Graphics



APPENDIX B – *Oncorhynchus mykiss* Toxicity Test Data

Rainbow Trout Early Life Stage Summary Sheet

Client: ALS

Start Date/Time: October 4, 2018 @ 1450h

Work Order No.: 181672

Test Species: Oncorhynchus mykiss

Sample Information:

Sample ID: L2175227-1 W3

Sample Date: October 2, 2018

Date Received: October 4, 2018

Sample Volume: 7 x 20L

Dilution Water:

Type: Dechlorinated Tap Water

Hardness (mg/L CaCO₃): 12

Alkalinity (mg/L CaCO₃): 14

Test Organism Information:

Batch No.: 100418

Source: Lynden Fish Hatcheries, New Dundee, ON

Loading Density: 1.06 g/L

Number of male broodstock used: 4

Number of female broodstock used: 4

Sperm motility check: Verification of sperm motility using a compound microscope

SDS Reference Toxicant Results:

Reference Toxicant ID: RTE108

Stock Solution ID: 18502

Date Initiated: October 4, 2018

7-d EC50 (95% CL): 4.4 (4.2-4.6) mg/L SDS

Reference Toxicant Mean and Range: 4.2 (2.0-8.8) mg/L SDS

Reference Toxicant CV (%): 38

Test Results:

		Sample ID	
		L2175227-1 W3	
EC25 % (v/v) (95% CL)	>100		
EC50 % (v/v) (95% CL)	>100		

Reviewed by: JCH

Date reviewed: Oct-23/18

7-d Chronic Freshwater Toxicity Test **Initial and Final Water Quality Measurements**

Client: ALS
 Sample ID: L2175227-1 W3
 Work Order #: 181672

Start Date & Time: October 4, 2018 @ 1450h
 Stop Date & Time: October 11, 2018 @ 1115h
 CER #: 3
 Test Species: Oncorhynchus mykiss

Control Concentration (% v/v)	Days													
	0	1		2		3		4		5		6		7
	init.	new	old	new	old	new	old	new	old	new	old	new	old	final
Temperature (°C)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	13.5	14.0	14.0	14.0	14.0	14.0
DO (mg/L)	9.9	10.0	9.9	10.2	9.9	10.1	9.8	9.9	10.0	10.0	9.9	9.9	10.1	9.9
pH	7.1	6.9	7.0	7.1	7.0	7.0	6.9	7.1	7.0	7.1	7.1	7.2	7.2	7.3
Cond. (µS/cm)	38	39		38		39		39		39		39		39
Initials	UML	UML		A		A		UML		UML		UML		UML

6.25 Concentration	Days													
	0	1		2		3		4		5		6		7
	init.	new	old	new	old	new	old	new	old	new	old	new	old	final
Temperature (°C)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	13.5	14.0	14.0	14.0	14.0	14.0
DO (mg/L)	10.0	10.0	9.9	10.2	9.9	10.1	9.7	9.9	10.1	10.1	10.0	10.0	10.1	9.9
pH	7.1	7.1	7.1	7.2	7.1	7.1	7.1	7.1	7.2	7.2	7.3	7.3	7.4	7.45
Cond. (µS/cm)	77	79		76		78		73		76		79		78
Initials	UML	UML		A		A		UML		UML		UML		UML

25 Concentration	Days													
	0	1		2		3		4		5		6		7
	init.	new	old	new	old	new	old	new	old	new	old	new	old	final
Temperature (°C)	14.5	14.0	14.0	14.0	14.0	14.0	14.0	14.0	13.5	14.0	14.0	14.0	14.0	14.0
DO (mg/L)	10.0	10.0	10.0	10.2	9.8	10.2	9.8	10.0	10.1	10.1	10.0	10.0	10.1	10.0
pH	7.1	7.3	7.4	7.3	7.3	7.3	7.4	7.3	7.6	7.6	7.7	7.6	7.9	7.9
Cond. (µS/cm)	188	189		192		190		186		196		185		190
Initials	UML	UML		A		A		UML		UML		UML		UML

100 Concentration	Days													
	0	1		2		3		4		5		6		7
	init.	new	old	new	old	new	old	new	old	new	old	new	old	final
Temperature (°C)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	13.5	14.0	14.0	14.0	14.0	14.0
DO (mg/L)	10.3	10.1	10.0	10.3	9.9	10.2	9.8	10.0	10.1	10.2	10.0	9.9	10.1	10.0
pH	7.3	7.5	7.6	7.5	7.9	7.5	7.9	7.6	8.2	7.5	8.3	7.7	8.2	8.4
Cond. (µS/cm)	570	575		575		575		575		575		572		574
Initials	UML	UML		A		A		UML		UML		UML		UML

Thermometer: CER-3 DO meter/probe: 213 / 213 pH meter/probe: 213 / 213 Conductivity meter/probe: 213 / 213

	Control	100%		
Hardness*	12	296		
Alkalinity*	14	248		

Analysts: AWD, UML

Reviewed by: Joh

Date reviewed: Oct. 23/18

* mg/L as CaCO₃

Sample Description: clear, light yellow, no odour, some particulates

Comments:

Embryo Toxicity Test Daily Mortality

Client: ALS
 Sample ID: L2175227-1 W3
 Work Order #: 181672

Start Date & Time: October 4, 2018 @ 1450h
 Stop Date & Time: October 11, 2018 @ 1115h
 Test Species: Oncorhynchus mykiss

Concentration (% v/v)	Rep	Day of Test - No. of Mortalities							Total Dead Eggs	Total Undeveloped	Total No. Embryo	Total Exposed
		1	2	3	4	5	6	7				
Control	1	0	0	0	0	0	0	0	0	3	27	30
	2	1	1	1	1	1	1	0	0	0	30	30
	3	1	1	1	1	1	1	1	1	5	24	30
	4	1	1	1	1	1	1	1	1	1	28	30
6.25	1	1	1	1	1	1	1	0	0	1	29	30
	2	1	1	1	1	1	1	1	0	0	30	30
	3	1	1	1	1	1	1	1	0	3	27	30
	4	1	1	1	1	1	1	1	0	2	28	30
12.5	1	1	1	1	1	1	1	1	0	0	30	30
	2	1	1	1	1	1	1	1	1	0	28	29
	3	1	1	1	1	1	1	0	0	5	25	30
	4	1	1	1	1	1	1	1	2	0	28	30
25	1	1	1	1	1	1	1	0	0	1	29	30
	2	1	1	1	1	1	1	0	0	1	29	30
	3	1	1	1	1	1	1	3	3	3	24	30
	4	1	1	1	1	1	1	0	1	2	27	30
50	1	1	1	1	0	1	1	0	0	2	28	30
	2	1	1	1	1	1	1	1	2	0	28	30
	3	1	1	1	0	1	1	2	2	3	25	30
	4	1	1	1	0	1	1	0	1	2	28	31
100	1	1	1	1	0	1	1	0	0	1	29	30
	2	1	1	1	0	1	1	2	2	0	28	30
	3	1	1	1	1	1	1	4	6	1	23	30
	4	1	1	1	0	1	1	1	2	2	26	30
	1											
	2											
	3											
	4											
	1											
	2											
	3											
	4											
Tech Initials		mm	a	~	mm	mm	mm	mm	mm	mm	mm	mm

Comments:

Reviewed by: Joe

Date reviewed: Oct-23/18

CETIS Analytical Report

Report Date: 23 Oct-18 09:01 (p 1 of 2)

Test Code/ID: 181672 / 01-0182-5393

Salmonid Embryo Survival and Development Test

Nautilus Environmental

Analysis ID: 08-3146-9398	Endpoint: Proportion Normal	CETIS Version: CETISv1.9.4
Analyzed: 23 Oct-18 9:01	Analysis: Linear Interpolation (ICPIN)	Status Level: 1
Batch ID: 21-3271-3291	Test Type: Development	Analyst: Yvonne Lam
Start Date: 04 Oct-18 14:50	Protocol: EC/EPS 1/RM/28	Diluent: Dechlorinated Tap Water
Ending Date: 11 Oct-18 11:15	Species: Oncorhynchus mykiss	Brine:
Test Length: 6d 20h	Taxon: Actinopterygii	Source: Lyndon Fish Hatcheries Age:
Sample ID: 00-9926-6391	Code: 5EAAF57	Project:
Sample Date: 02 Oct-18 08:35	Material: Water Sample	Source: ALS
Receipt Date: 04 Oct-18 13:30	CAS (PC):	Station: L2175227-1 W3
Sample Age: 54h (5 °C)	Client: ALS	

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	2095694	200	Yes	Two-Point Interpolation

Residual Analysis

Attribute	Method	Test Stat	Critical	P-Value	Decision(α:5%)
Control Trend	Mann-Kendall Trend Test			1.0000	Non-Significant Trend in Controls

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
EC5	97.98	n/a	n/a	1.021	n/a	n/a
EC10	>100	n/a	n/a	<1	n/a	n/a
EC15	>100	n/a	n/a	<1	n/a	n/a
EC20	>100	n/a	n/a	<1	n/a	n/a
EC25	>100	n/a	n/a	<1	n/a	n/a
EC40	>100	n/a	n/a	<1	n/a	n/a
EC50	>100	n/a	n/a	<1	n/a	n/a

Proportion Normal Summary

Proportion Normal Summary			Calculated Variate(A/B)							Isotonic Variate	
Conc-%	Code	Count	Mean	Min	Max	Std Dev	CV%	%Effect	A/B	Mean	%Effect
0	N	4	0.9083	0.8000	1.0000	0.0833	9.17%	0.0%	109/120	0.9305	0.0%
6.25		4	0.9500	0.9000	1.0000	0.0430	4.53%	-4.59%	114/120	0.9305	0.0%
12.5		4	0.9330	0.8333	1.0000	0.0718	7.70%	-2.72%	111/119	0.9305	0.0%
25		4	0.9083	0.8000	0.9667	0.0788	8.67%	0.0%	109/120	0.9083	2.38%
50		4	0.9008	0.8333	0.9333	0.0472	5.24%	0.83%	109/121	0.9008	3.19%
100		4	0.8833	0.7667	0.9667	0.0882	9.98%	2.75%	106/120	0.8833	5.07%

Proportion Normal Detail

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4
0	N	0.9000	1.0000	0.8000	0.9333
6.25		0.9667	1.0000	0.9000	0.9333
12.5		1.0000	0.9655	0.8333	0.9333
25		0.9667	0.9667	0.8000	0.9000
50		0.9333	0.9333	0.8333	0.9032
100		0.9667	0.9333	0.7667	0.8667

Proportion Normal Binomials

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4
0	N	27/30	30/30	24/30	28/30
6.25		29/30	30/30	27/30	28/30
12.5		30/30	28/29	25/30	28/30
25		29/30	29/30	24/30	27/30
50		28/30	28/30	25/30	28/31
100		29/30	28/30	23/30	26/30

CETIS Analytical Report

Report Date: 23 Oct-18 09:01 (p 2 of 2)
Test Code/ID: 181672 / 01-0182-5393

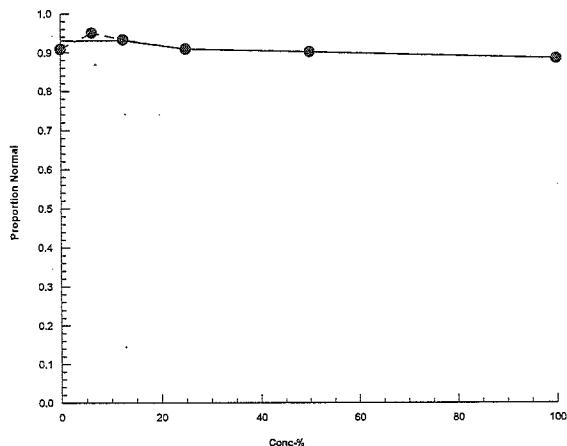
Salmonid Embryo Survival and Development Test

Nautilus Environmental

Analysis ID: 08-3146-9398 Endpoint: Proportion Normal
Analyzed: 23 Oct-18 9:01 Analysis: Linear Interpolation (ICPIN)

CETIS Version: CETISv1.9.4
Status Level: 1

Graphics



APPENDIX C – *Lemna minor* Toxicity Test Data

Lemna minor Summary Sheet

Client: ALS (minto)
Work Order No.: 181

Start Date: Oct 4/18
Set up by: MLJ

Sample Information:

Sample ID: L2175227-1 W3
Sample Date: Oct 2/18
Date Received: Oct 4/18
Sample Volume: 7X20L, 3X1L

Test Organism Information:

Culture Date: 092718
Age of culture (Day 0): 7 days
>8X growth in APHA?: Y (35 Fronds)

KCI Reference Toxicant Results:

Reference Toxicant ID: Lm164
Date Initiated: Sept 21/18

7-d No. of Fronds IC50 (95% CL): ^{MLJ}
3.6 (3.0 - 4.2) g/L KCl
3.5 (2.9 - 4.3)

7-d No. Fronds IC50 Reference Toxicant Mean (2 SD Range): 3.5 (2.9 - 4.2) CV (%): 10
g/L KCl

Test Results:	Number of Fronds		Dry Weight	
	IC25 %(v/v) (95% CL)	797	797	797
	IC50 %(v/v) (95% CL)	797	797	797

Reviewed by: 

Date reviewed: Nov. 15, 2018

Plant Growth Inhibition Toxicity Test Water Quality Measurements

Client : ALS (mint) Setup by: MLJ
 Sample ID: L2175227-1 W3 Test Date: Oct 4/18
 Work Order No.: 181674 CER #: 1
 Culture Source: CPC #490 Test Species: Lemna minor
 Test Culture Age: 7 days > 8X Growth? (Y/N): y (25 Fronds)
 Light Intensity Range: 4600-5100 lux Date Measured: Oct 4/18

Day	0	1	2	3	4	5	6	7
Shelf Temp (°C)	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Initials	MLJ	MLJ	MLJ	MLJ	MLJ	MLJ	MLJ	MLJ

Sample Characteristics: Initial Water Quality Adjusted Water Quality
 Temperature (°C) 25.0 Aeration?: 20 min 25.0
 DO (mg/L) 8.3 Nutrients added?: y 8.0
 pH 7.5 8.0
 Conductivity (µS) 585 1352

¹ 10 mL of each APHA stock (A,B and C) added to 970 mL sample.

Concentration % (v/v)	Temperature (°C)		pH		Conductivity (µS)
	Day 0	Day 7	Day 0	Day 7	0 h
Control	25.0	25.0	8.3	8.8	885
1.5	25.0	25.0	8.3	8.8	899
3	25.0	25.0	8.3	8.8	902
MLJ 36.1	25.0	25.0	8.2	8.7	918
12.1	25.0	25.0	8.2	8.9	950
24.2	25.0	25.0	8.1	9.1	1010
48.5	25.0	25.0	8.0	8.9	1125 1124
97	25.0	25.0	8.0	8.9	1352
Initials	JB	MLJ	JB	MLJ	JB

Thermometer: 4 Light meter: 1 pH meter/probe: 1,1 DO meter/probe: 1,1 Conductivity meter/probe: 1,1

Sample Description: pale yellow, clear, colourless, black particulates

Comments: _____

Reviewed: MLJ

Date Reviewed: NN-14, 2018

Lemma minor Toxicity Test Data Sheet - 7-d Frond Counts

Client: ALs (mnpb)
 Sample ID: L2175227-1 W3
 Work Order #: 181674

Start Date: Oct 4/18
 Termination Date: Oct 11/18
 Test set up by: WJ

Concentration	Rep	No. of fronds		Chlorosis	Necrosis	Yellow	Abnormal size	Gibbosity	Single fronds	Root destruction	Loss of buoyancy	Comments	Initials
		Day 0	Day 7										
control	A	6	74										WJ
	B	6	78										
	C	6	71										
	D	6	80										
1.5	A	6	81										
	B	6	110										
	C	6	70										
	D	6	87										
3	A	6	82										
	B	6	73										
	C	6	79										
	D	6	111										
6.1	A	6	66										
	B	6	92										
	C	6	76										
	D	6	98										
12.1	A	6	78										
	B	6	86										
	C	6	89										
	D	6	88										
24.2	A	6	99										
	B	6	105										
	C	6	110										
	D	6	113										

Comments:

Reviewed by: WJ

Date Reviewed:

Nov. 14, 2018

Lemma minor Toxicity Test Data Sheet - 7-d Frond Counts

Client: ALC(minh)
 Sample ID: 12175227-1 113
 Work Order #: 181674

Start Date: Oct 4/18
 Termination Date: Oct 11/18
 Test set up by: MLG

Concentration (% v/v)	Rep	No. of fronds		Chlorosis	Necrosis	Yellow	Abnormal size	Gibbosity	Single fronds	Root destruction	Loss of buoyancy	Comments	Initials
		Day 0	Day 7										
48.5	A	6	106										MLG
	B	6	109										
	C	6	109										
	D	6	124										
97	A	6	79										MLG
	B	6	89										
	C	6	58										
	D	6	89										
	A												
	B												
	C												
	D												
	A												
	B												
	C												
	D												
	A												
	B												
	C												
	D												
	A												
	B												
	C												
	D												

Comments:

Reviewed by: MLG

Date Reviewed:

Nov 14, 2018

7-d Lemna minor Weight Data Sheet

Client:

Sample ID:

WO #:

0.6 (v/v)

ALS (Minto)

L2175227-1 W3

181674

purple - E

Start Date:

Oct 4/18

Termination Date:

Oct 11/18

Balance ID:

Bal - 1

Concentration	Rep	Pan No.	Pan weight (mg)	Pan + plant (mg)	Initials
control	A	1	1154.38	1160.03	JW
	B	2	1137.95	1144.30	
	C	3	1125.27	1130.77	
	D	4	1140.30	1146.12	
1.5	A	5	1146.42	1151.99	
	B	6	1136.65	1144.51	
	C	7	1129.77	1135.70	
	D	8	1138.80	1145.15	
3	A	9	1139.17	1144.93	
	B	10	1124.83	1130.39	
	C	11	1137.01	1143.19	
	D	12	1132.65	1140.74	
6.1	A	13	1138.49	1144.40	
	B	14	1125.53	1131.51	
	C	15	1123.09	1128.85	
	D	16	1123.16	1131.18	
12.1	A	17	1143.26	1149.48	
	B	18	1127.71	1134.01	
	C	19	1143.91	1150.39	
	D	20	1147.65	1154.21	
24.2	A	21	1142.11 1141.81	1149.23	
	B	22	1129.11	1136.45	
	C	23	1137.22	1144.58	
	D	24	1142.40	1150.75	
48.5	A	25	1145.32 1130.61	1138.87	
	B	26	1149.36 1145.32	1153.34	
	C	27	1119.35	1127.66	
	D	28	1125.46	1135.01	

Comments:

10% reweigh (mg): #7 - 1135.20

#24 - 1150.14

#16 - 1130.23

#30 - 1156.16

Reviewed by:

[Signature]

Date Reviewed:

11-14-2018

7-d Lemna minor Weight Data Sheet

Client:

Sample ID:

WO #:

o/v/v

ALS (mint)

L2175227-1 W3

181674

purple-E

Start Date:

Oct 4/18

Termination Date:

Oct 11/18

Balance ID:

Bal - 1

Concentration	Rep	Pan No.	Pan weight (mg)	Pan + plant (mg)	Initials
97	A	29	1150.39	1157.15	gan
	B	30	1149.61	1156.63	↓
	C	31	1139.50	1144.79	↓
	D	32	1123.97	1131.05	↓
	A				
	B				
	C				
	D				
	A				
	B				
	C				
	D				
	A				
	B				
	C				
	D				
	A				
	B				
	C				
	D				
	A				
	B				
	C				
	D				

Comments:

Reviewed by:

EW

Date Reviewed:

NN-14, 2018

CETIS Analytical Report

Report Date: 09 Nov-18 17:47 (p 1 of 2)

Test Code/ID: 181674 / 16-3568-5362

Lemna Growth Inhibition Test

Nautilus Environmental

Analysis ID: 03-9036-5693	Endpoint: Frond Count	CETIS Version: CETISv1.9.4
Analyzed: 09 Nov-18 17:46	Analysis: Linear Interpolation (ICPIN)	Status Level: 1
Batch ID: 05-8270-6827	Test Type: Lemna Growth	Analyst: Mimi Tran
Start Date: 04 Oct-18	Protocol: EC/EPS 1/RM/37	Diluent: Modified APHA
Ending Date: 11 Oct-18	Species: Lemna minor	Brine:
Test Length: 7d 0h	Taxon: Tracheophyta	Source: CPCC#490
		Age: 7d
Sample ID: 00-9926-6391	Code: 5EAAF57	Project:
Sample Date: 02 Oct-18 08:35	Material: Water Sample	Source: ALS
Receipt Date: 04 Oct-18 13:30	CAS (PC):	Station: L2175227-1 W3
Sample Age: 39h (5 °C)	Client: ALS	

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	1211040	200	Yes	Two-Point Interpolation

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
IC5	61.89	50.8	n/a	1.616	n/a	1.969
IC10	78.89	52.27	n/a	1.268	n/a	1.913
IC15	>97	n/a	n/a	<1.031	n/a	n/a
IC20	>97	n/a	n/a	<1.031	n/a	n/a
IC25	>97	n/a	n/a	<1.031	n/a	n/a
IC40	>97	n/a	n/a	<1.031	n/a	n/a
IC50	>97	n/a	n/a	<1.031	n/a	n/a

Frond Count Summary

Conc-%	Code	Count	Calculated Variate						Isotonic Variate	
			Mean	Min	Max	Std Dev	CV%	%Effect	Mean	%Effect
0	N	4	69.75	65	74	4.031	5.78%	0.0%	84.86	0.0%
1.5		4	81	64	104	16.87	20.83%	-16.13%	84.86	0.0%
3		4	80.25	67	105	16.92	21.08%	-15.05%	84.86	0.0%
6.1		4	77	60	92	14.65	19.03%	-10.39%	84.86	0.0%
12.1		4	79.25	72	83	4.992	6.30%	-13.62%	84.86	0.0%
24.2		4	100.8	93	107	6.131	6.09%	-44.44%	84.86	0.0%
48.5		4	106	100	118	8.124	7.66%	-51.97%	84.86	0.0%
97		4	72.75	52	83	14.61	20.09%	-4.3%	72.75	14.27%

Frond Count Detail

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4
0	N	68	72	65	74
1.5		75	104	64	81
3		76	67	73	105
6.1		60	86	70	92
12.1		72	80	83	82
24.2		93	99	104	107
48.5		100	103	103	118
97		73	83	52	83

CETIS Analytical Report

Report Date: 09 Nov-18 17:47 (p 2 of 2)
Test Code/ID: 181674 / 16-3568-5362

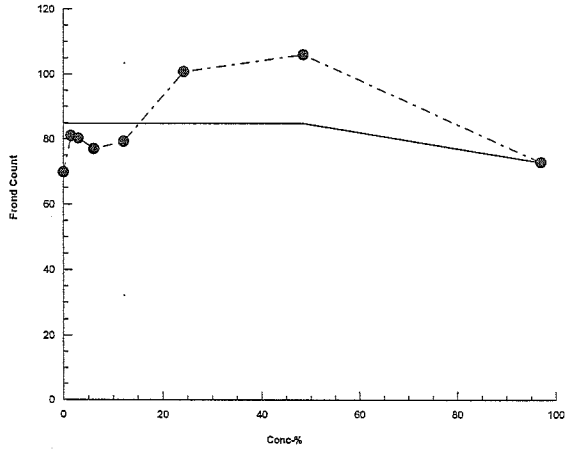
Lemna Growth Inhibition Test

Nautilus Environmental

Analysis ID: 03-9036-5693 Endpoint: Frond Count
Analyzed: 09 Nov-18 17:46 Analysis: Linear Interpolation (ICPIN)

CETIS Version: CETISv1.9.4
Status Level: 1

Graphics



CETIS Analytical Report

Report Date: 09 Nov-18 17:47 (p 1 of 2)

Test Code/ID: 181674 / 16-3568-5362

Lemna Growth Inhibition Test

Nautilus Environmental

Analysis ID: 03-2457-1961	Endpoint: Total Dry Weight-mg	CETIS Version: CETISv1.9.4
Analyzed: 09 Nov-18 17:47	Analysis: Linear Interpolation (ICPIN)	Status Level: 1
Batch ID: 05-8270-6827	Test Type: Lemna Growth	Analyst: Mimi Tran
Start Date: 04 Oct-18	Protocol: EC/EPS 1/RM/37	Diluent: Modified APHA
Ending Date: 11 Oct-18	Species: Lemna minor	Brine:
Test Length: 7d 0h	Taxon: Tracheophyta	Source: CPCC#490 Age: 7d
Sample ID: 00-9926-6391	Code: 5EAAF57	Project:
Sample Date: 02 Oct-18 08:35	Material: Water Sample	Source: ALS
Receipt Date: 04 Oct-18 13:30	CAS (PC):	Station: L2175227-1 W3
Sample Age: 39h (5 °C)	Client: ALS	

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	1154959	200	Yes	Two-Point Interpolation

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
IC5	>97	n/a	n/a	<1.031	n/a	n/a
IC10	>97	n/a	n/a	<1.031	n/a	n/a
IC15	>97	n/a	n/a	<1.031	n/a	n/a
IC20	>97	n/a	n/a	<1.031	n/a	n/a
IC25	>97	n/a	n/a	<1.031	n/a	n/a
IC40	>97	n/a	n/a	<1.031	n/a	n/a
IC50	>97	n/a	n/a	<1.031	n/a	n/a

Total Dry Weight-mg Summary

			Calculated Variate						Isotonic Variate	
Conc-%	Code	Count	Mean	Min	Max	Std Dev	CV%	%Effect	Mean	%Effect
0	N	4	5.83	5.5	6.35	0.3705	6.36%	0.0%	6.802	0.0%
1.5		4	6.427	5.57	7.86	1.007	15.66%	-10.25%	6.802	0.0%
3		4	6.397	5.56	8.09	1.158	18.09%	-9.73%	6.802	0.0%
6.1		4	6.418	5.76	8.02	1.072	16.71%	-10.08%	6.802	0.0%
12.1		4	6.39	6.22	6.56	0.157	2.46%	-9.61%	6.802	0.0%
24.2		4	7.617	7.34	8.35	0.4895	6.43%	-30.66%	6.802	0.0%
48.5		4	8.535	8.02	9.55	0.6884	8.07%	-46.4%	6.802	0.0%
97		4	6.538	5.29	7.08	0.8432	12.90%	-12.14%	6.538	3.89%

Total Dry Weight-mg Detail

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4
0	N	5.65	6.35	5.5	5.82
1.5		5.57	7.86	5.93	6.35
3		5.76	5.56	6.18	8.09
6.1		5.91	5.98	5.76	8.02
12.1		6.22	6.3	6.48	6.56
24.2		7.42	7.34	7.36	8.35
48.5		8.26	8.02	8.31	9.55
97		6.76	7.02	5.29	7.08

CETIS Analytical Report

Report Date: 09 Nov-18 17:47 (p 2 of 2)
Test Code/ID: 181674 / 16-3568-5362

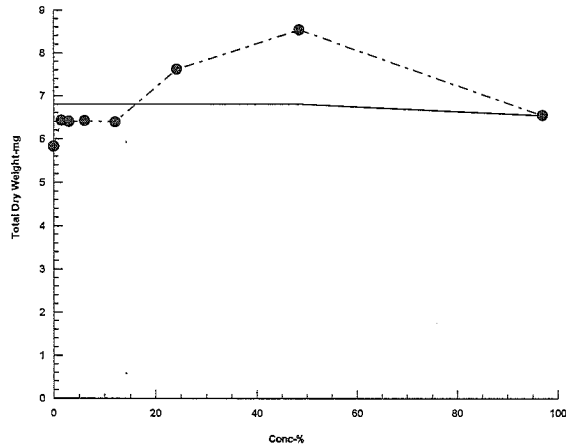
Lemna Growth Inhibition Test

Nautilus Environmental

Analysis ID: 03-2457-1961 Endpoint: Total Dry Weight-mg
Analyzed: 09 Nov-18 17:47 Analysis: Linear Interpolation (ICPIN)

CETIS Version: CETISv1.9.4
Status Level: 1

Graphics



CETIS Analytical Report

Report Date: 09 Nov-18 17:50 (p 1 of 2)
 Test Code/ID: 181674 / 16-3568-5362

Lemna Growth Inhibition Test

Nautilus Environmental

Analysis ID: 09-4497-2304	Endpoint: Frond Count	CETIS Version: CETISv1.9.4
Analyzed: 09 Nov-18 17:50	Analysis: Parametric-Control vs Treatments	Status Level: 1
Batch ID: 05-8270-6827	Test Type: Lemna Growth	Analyst: Mimi Tran
Start Date: 04 Oct-18	Protocol: EC/EPS 1/RM/37	Diluent: Modified APHA
Ending Date: 11 Oct-18	Species: Lemna minor	Brine:
Test Length: 7d 0h	Taxon: Tracheophyta	Source: CPCC#490 Age: 7d
Sample ID: 00-9926-6391	Code: 5EAAF57	Project:
Sample Date: 02 Oct-18 08:35	Material: Water Sample	Source: ALS
Receipt Date: 04 Oct-18 13:30	CAS (PC):	Station: L2175227-1 W3
Sample Age: 39h (5 °C)	Client: ALS	

Data Transform	Alt Hyp	NOEL	LOEL	TOEL	TU	PMSD
Untransformed	C < T	97	>97	n/a	1.031	30.09%

Dunnnett Multiple Comparison Test

Control	vs	Conc-%	Test Stat	Critical	MSD	DF	P-Type	P-Value	Decision(α:5%)
Negative Control		1.5	1.331	2.482	20.99	6	CDF	0.3341	Non-Significant Effect
		3	1.242	2.482	20.99	6	CDF	0.3716	Non-Significant Effect
		6.1	0.8574	2.482	20.99	6	CDF	0.5476	Non-Significant Effect
		12.1	1.124	2.482	20.99	6	CDF	0.4240	Non-Significant Effect
		24.2*	3.666	2.482	20.99	6	CDF	0.0035	Significant Effect
		48.5*	4.287	2.482	20.99	6	CDF	7.7E-04	Significant Effect
		97	0.3548	2.482	20.99	6	CDF	0.7645	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	4741.47	677.353	7	4.737	0.0019	Significant Effect
Error	3431.75	142.99	24			
Total	8173.22		31			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance Test	10.24	18.48	0.1752	Equal Variances
Distribution	Shapiro-Wilk W Normality Test	0.974	0.9081	0.6164	Normal Distribution

Frond Count Summary

Conc-%	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	N	4	69.75	63.34	76.16	70	65	74	2.016	5.78%	0.00%
1.5		4	81	54.15	107.8	78	64	104	8.436	20.83%	-16.13%
3		4	80.25	53.33	107.2	74.5	67	105	8.459	21.08%	-15.05%
6.1		4	77	53.69	100.3	78	60	92	7.326	19.03%	-10.39%
12.1		4	79.25	71.31	87.19	81	72	83	2.496	6.30%	-13.62%
24.2		4	100.8	90.99	110.5	101.5	93	107	3.065	6.08%	-44.44%
48.5		4	106	93.07	118.9	103	100	118	4.062	7.66%	-51.97%
97		4	72.75	49.5	96	78	52	83	7.307	20.09%	-4.30%

Frond Count Detail

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4
0	N	68	72	65	74
1.5		75	104	64	81
3		76	67	73	105
6.1		60	86	70	92
12.1		72	80	83	82
24.2		93	99	104	107
48.5		100	103	103	118
97		73	83	52	83

CETIS Analytical Report

Report Date: 09 Nov-18 17:50 (p 2 of 2)
Test Code/ID: 181674 / 16-3568-5362

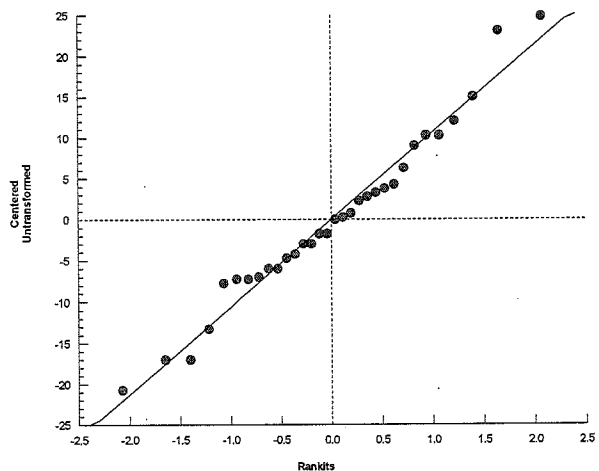
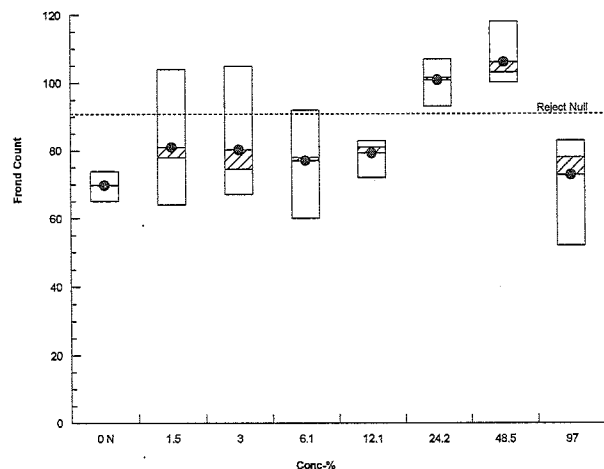
Lemna Growth Inhibition Test

Nautilus Environmental

Analysis ID: 09-4497-2304 Endpoint: Frond Count
Analyzed: 09 Nov-18 17:50 Analysis: Parametric-Control vs Treatments

CETIS Version: CETISv1.9.4
Status Level: 1

Graphics



CETIS Analytical Report

Report Date: 09 Nov-18 17:50 (p 1 of 2)
 Test Code/ID: 181674 / 16-3568-5362

Lemna Growth Inhibition Test

Nautilus Environmental

Analysis ID: 00-9425-8105	Endpoint: Total Dry Weight-mg	CETIS Version: CETISv1.9.4
Analyzed: 09 Nov-18 17:50	Analysis: Parametric-Control vs Treatments	Status Level: 1
Batch ID: 05-8270-6827	Test Type: Lemna Growth	Analyst: Mimi Tran
Start Date: 04 Oct-18	Protocol: EC/EPS 1/RM/37	Diluent: Modified APHA
Ending Date: 11 Oct-18	Species: Lemna minor	Brine:
Test Length: 7d 0h	Taxon: Tracheophyta	Source: CPCC#490 Age: 7d
Sample ID: 00-9926-6391	Code: 5EAAF57	Project:
Sample Date: 02 Oct-18 08:35	Material: Water Sample	Source: ALS
Receipt Date: 04 Oct-18 13:30	CAS (PC):	Station: L2175227-1 W3
Sample Age: 39h (5 °C)	Client: ALS	

Data Transform	Alt Hyp	NOEL	LOEL	TOEL	TU	PMSD
Untransformed	C < T	97	>97	n/a	1.031	24.01%

Dunnnett Multiple Comparison Test

Control	vs	Conc-%	Test Stat	Critical	MSD	DF	P-Type	P-Value	Decision(α:5%)
Negative Control		1.5	1.059	2.482	1.4	6	CDF	0.4534	Non-Significant Effect
		3	1.006	2.482	1.4	6	CDF	0.4780	Non-Significant Effect
		6.1	1.042	2.482	1.4	6	CDF	0.4616	Non-Significant Effect
		12.1	0.9928	2.482	1.4	6	CDF	0.4842	Non-Significant Effect
		24.2*	3.169	2.482	1.4	6	CDF	0.0114	Significant Effect
		48.5*	4.796	2.482	1.4	6	CDF	2.2E-04	Significant Effect
		97	1.254	2.482	1.4	6	CDF	0.3662	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	21.1836	3.02623	7	4.757	0.0018	Significant Effect
Error	15.2692	0.636216	24			
Total	36.4528		31			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance Test	11.04	18.48	0.1367	Equal Variances
Distribution	Shapiro-Wilk W Normality Test	0.9197	0.9081	0.0204	Normal Distribution

Total Dry Weight-mg Summary

Conc-%	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	N	4	5.83	5.24	6.42	5.735	5.5	6.35	0.1853	6.36%	0.00%
1.5		4	6.427	4.825	8.03	6.14	5.57	7.86	0.5034	15.66%	-10.25%
3		4	6.397	4.556	8.239	5.97	5.56	8.09	0.5788	18.09%	-9.73%
6.1		4	6.418	4.711	8.124	5.945	5.76	8.02	0.5361	16.71%	-10.08%
12.1		4	6.39	6.14	6.64	6.39	6.22	6.56	0.07852	2.46%	-9.60%
24.2		4	7.617	6.839	8.396	7.39	7.34	8.35	0.2448	6.43%	-30.66%
48.5		4	8.535	7.44	9.63	8.285	8.02	9.55	0.3442	8.07%	-46.40%
97		4	6.538	5.196	7.879	6.89	5.29	7.08	0.4216	12.90%	-12.14%

Total Dry Weight-mg Detail

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4
0	N	5.65	6.35	5.5	5.82
1.5		5.57	7.86	5.93	6.35
3		5.76	5.56	6.18	8.09
6.1		5.91	5.98	5.76	8.02
12.1		6.22	6.3	6.48	6.56
24.2		7.42	7.34	7.36	8.35
48.5		8.26	8.02	8.31	9.55
97		6.76	7.02	5.29	7.08

11/14/18

CETIS Analytical Report

Report Date: 09 Nov-18 17:50 (p 2 of 2)
Test Code/ID: 181674 / 16-3568-5362

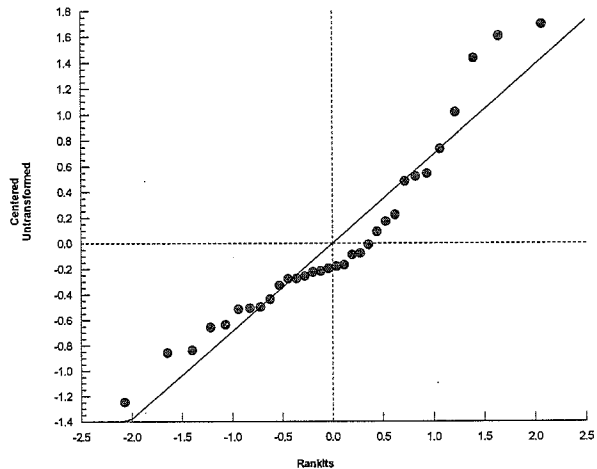
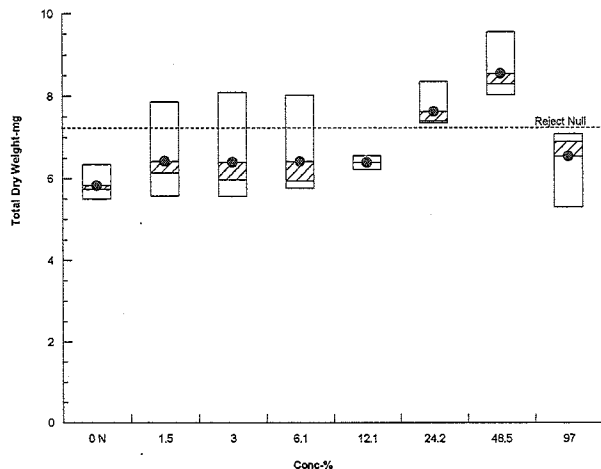
Lemna Growth Inhibition Test

Nautilus Environmental

Analysis ID: 00-9425-8105 Endpoint: Total Dry Weight-mg
Analyzed: 09 Nov-18 17:50 Analysis: Parametric-Control vs Treatments

CETIS Version: CETISv1.9.4
Status Level: 1

Graphics



APPENDIX D – *Pseudokirchneriella subcapitata* Toxicity Test Data

***Pseudokirchneriella subcapitata* Summary Sheet**

Client: ALS (mint)
Work Order No.: 181675

Start Date: Oct 5/18
Set up by: ML

Sample Information:

Sample ID: L2175227-1 W3
Sample Date: Oct 2/18
Date Received: Oct 4/18
Sample Volume: 7x20L, 3x1L

Test Organism Information:

Culture Date: Sept 28/18
Age of culture (Day 0): 7d

Zinc Reference Toxicant Results:

Reference Toxicant ID: SC174
Stock Solution ID: 18Zn05
Date Initiated: Sept 21/18

72-h IC50 (95% CL): 29.1(21.9-33.8) µg/L Zn

72-h IC50 Reference Toxicant Mean and Range: 31.2(25.9-37.7) µg/L Zn CV (%): 9

Test Results:

	Algal Growth
IC25 %(v/v) (95% CL)	<u>795.0</u>
IC50 %(v/v) (95% CL)	<u>795.0</u>

Reviewed by: 

Date reviewed: Nov 14, 2018

72-h Algal Growth Inhibition Toxicity Test Water Quality Measurements

Client : ALB (Minto) Setup by: MLT
 Sample ID: L2195227-1 W3 Test Date/Time: Oct 5/18 @ 0700h
 Work Order No.: 181675 CER #: 4
 Test Species: Pseudokirchneriella subcapitata
 Culture Date: Sept 28/18 Age of Culture: 7d Culture Health: Good
 Culture Count: 1 400 2 420 Average: 410 Culture Cell Density (c1): 410 x 10⁴ cells/mL

$$v1 = \frac{220,000 \text{ cells/mL} \times 10^5 \text{ mL}}{(c1) \quad 410 \times 10^4 \quad \text{cells/mL}} = 5.37 \text{ mL}$$

Time Zero Counts: 1 23 2 21 Average: 22

No. of Cells/mL: 22 x 10⁴ Initial Density: # cells/mL + 220 µL x 10 µL = 10000 cells/mL

Concentration %(v/v)	Water Quality		Incubator Temperature				Microplates rotated 2X per day?			
	pH	Temp (°C)	(°C)							
	0 h	0 h	0 h	24 h	48 h	72 h	0 h	24 h	48 h	72 h
Control	6.9	23.0	25.0	26.0	26.0	25.0	✓	✓	✓	✓
1.5	6.9	23.0	✓	✓	✓	✓	✓	✓	✓	✓
3	6.9	23.0	✓	✓	✓	✓	✓	✓	✓	✓
6	6.9	23.0	✓	✓	✓	✓	✓	✓	✓	✓
11.9	7.2	23.0	✓	✓	✓	✓	✓	✓	✓	✓
23.8	7.5	23.0	✓	✓	✓	✓	✓	✓	✓	✓
47.6	7.9	23.0	✓	✓	✓	✓	✓	✓	✓	✓
95.2	8.0	23.0	✓	✓	✓	✓	✓	✓	✓	✓
Initials	MLT	MLT	MLT	MLT	MLT	MLT	MLT	MLT	MLT	MLT

Initial control pH: Well 1: 6.9 Well 2: 6.9

Final control pH: Well 1: 7.0 Well 2: 7.0

Light intensity (lux): 4030 Date measured: Oct 5/18

Thermometer: 4 Light meter: 1 pH meter/probe: 1.1

Sample Description: pale yellow, clear, no clots, black particulates

Comments: _____

Reviewed: MLT Date reviewed: Nov 14, 2018

***Pseudokirchneriella subcapitata* Toxicity Test Data Sheet**
72-h Algal Cell Counts

Client: ALS (minto) Start Date/Time: Oct 5/18 @ 0700h
 Work Order #: 181675 Termination Date: Oct 8/18 @ 0700h
 Sample ID: L2175227-1 W3 Test set up by: MLG
 % (v/v)

Concentration	Rep	Count 1	Count 2	Count 3	Count 4	Comments	Initials
Control	A	30					MLG
	B	35					
	C	35					
	D	34					
	E	29					
	F	33					
	G	29					
	H	31					
1.5	A	32					
	B	34					
	C	32					
	D	33					
3.0	A	40					
	B	54					
	C	51					
	D	43					
6.0	A	84					
	B	91					
	C	80					
	D	92					
11.9	A	132					
	B	129					
	C	141					
	D	136					
23.8	A	161					
	B	167					
	C	174					
	D	160					
47.6	A	173					
	B	174					
	C	180					
	D	177					
95.2	A	150					
	B	142					
	C	152					
	D	160					✓

Comments: _____
 Reviewed by:  Date Reviewed: Nov. 14, 2018

***Pseudokirchneriella subcapitata* Algal Counts**

Client: ALS (Minto)
 WO#: 181675
 Sample ID: L2175227-1 W3

Start Date/Time: 5-Oct-18 @ 0700h
 Termination Date/Time: 8-Oct-18 @ 0700h

Initial Cell Density: 10000 cell/mL
 220000
 0.22
 0.01
 10000

Concentration %(v/v)	Rep	Count 1 (x 10 ⁴)	Count 2 (x 10 ⁴)	Count 3 (x 10 ⁴)	Count 4 (x 10 ⁴)	Mean (x 10 ⁴)	Cell Yield (x 10 ⁴) cell/mL		
Control	A	30				30	29.0	mean	31.0
	B	35				35	34.0	SD	2.56348
	C	35				35	34.0	CV	8.26929
	D	34				34	33.0		
	E	29				29	28.0		
	F	33				33	32.0		
	G	29				29	28.0		
	H	31				31	30.0		
1.5	A	32				32	31.0		
	B	34				34	33.0		
	C	32				32	31.0		
	D	37				37	36.0		
3	A	46				46	45.0		
	B	54				54	53.0		
	C	51				51	50.0		
	D	43				43	42.0		
6	A	84				84	83.0		
	B	91				91	90.0		
	C	80				80	79.0		
	D	92				92	91.0		
11.9	A	132				132	131.0		
	B	129				129	128.0		
	C	141				141	140.0		
	D	136				136	135.0		
23.8	A	161				161	160.0		
	B	167				167	166.0		
	C	174				174	173.0		
	D	160				160	159.0		
47.6	A	173				173	172.0		
	B	174				174	173.0		
	C	180				180	179.0		
	D	177				177	176.0		
95.2	A	150				150	149.0		
	B	142				142	141.0		
	C	152				152	151.0		
	D	160				160	159.0		

Reviewed by: 

Date reviewed: Nov. 15, 2018

CETIS Analytical Report

Report Date: 09 Nov-18 16:50 (p 1 of 2)

Test Code/ID: 181675 / 12-8863-8116

EC Alga Growth Inhibition Test

Nautilus Environmental

Analysis ID: 04-6998-3052	Endpoint: Cell Yield	CETIS Version: CETISv1.9.4
Analyzed: 09 Nov-18 16:50	Analysis: Linear Interpolation (ICPIN)	Status Level: 1
Batch ID: 06-2739-3271	Test Type: Cell Growth	Analyst: Mimi Tran
Start Date: 05 Oct-18 07:00	Protocol: EC/EPS 1/RM/25	Diluent: Deionized Water + nutrients
Ending Date: 08 Oct-18 07:00	Species: Pseudokirchneriella subcapitata	Brine:
Test Length: 72h	Taxon: Chlorophyta	Source: In-House Culture Age: 7d
Sample ID: 00-9926-6391	Code: 5EAAF57	Project:
Sample Date: 02 Oct-18 08:35	Material: Water Sample	Source: ALS
Receipt Date: 04 Oct-18 13:30	CAS (PC):	Station: L2175227-1 W3
Sample Age: 70h (5 °C)	Client: ALS	

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	1172048	200	Yes	Two-Point Interpolation

Residual Analysis

Attribute	Method	Test Stat	Critical	P-Value	Decision(α:5%)
Control Trend	Mann-Kendall Trend Test			0.1855	Non-Significant Trend in Controls

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
IC5	>95.2	n/a	n/a	<1.05	n/a	n/a
IC10	>95.2	n/a	n/a	<1.05	n/a	n/a
IC15	>95.2	n/a	n/a	<1.05	n/a	n/a
IC20	>95.2	n/a	n/a	<1.05	n/a	n/a
IC25	>95.2	n/a	n/a	<1.05	n/a	n/a
IC40	>95.2	n/a	n/a	<1.05	n/a	n/a
IC50	>95.2	n/a	n/a	<1.05	n/a	n/a

Cell Yield Summary

			Calculated Variate							Isotonic Variate	
Conc-%	Code	Count	Mean	Min	Max	Std Dev	CV%	%Effect		Mean	%Effect
0	N	8	31	28	34	2.563	8.27%	0.0%		102.5	0.0%
1.5		4	32.75	31	36	2.363	7.22%	-5.65%		102.5	0.0%
3		4	47.5	42	53	4.933	10.39%	-53.23%		102.5	0.0%
6		4	85.75	79	91	5.737	6.69%	-176.6%		102.5	0.0%
11.9		4	133.5	128	140	5.196	3.89%	-330.6%		102.5	0.0%
23.8		4	164.5	159	173	6.455	3.92%	-430.6%		102.5	0.0%
47.6		4	175	172	179	3.162	1.81%	-464.5%		102.5	0.0%
95.2		4	150	141	159	7.394	4.93%	-383.9%		102.5	0.0%

Cell Yield Detail

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	N	29	34	34	33	28	32	28	30
1.5		31	33	31	36				
3		45	53	50	42				
6		83	90	79	91				
11.9		131	128	140	135				
23.8		160	166	173	159				
47.6		172	173	179	176				
95.2		149	141	151	159				

CETIS Analytical Report

Report Date: 09 Nov-18 16:50 (p 2 of 2)
Test Code/ID: 181675 / 12-8863-8116

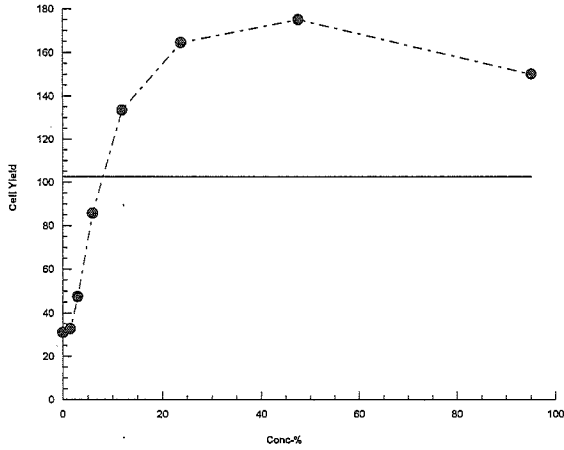
EC Alga Growth Inhibition Test

Nautilus Environmental

Analysis ID: 04-6998-3052 Endpoint: Cell Yield
Analyzed: 09 Nov-18 16:50 Analysis: Linear Interpolation (ICPIN)

CETIS Version: CETISv1.9.4
Status Level: 1

Graphics



CETIS Analytical Report

Report Date: 09 Nov-18 16:50 (p 1 of 2)
Test Code/ID: 181675 / 12-8863-8116

EC Alga Growth Inhibition Test

Nautilus Environmental

Analysis ID: 04-3656-0472	Endpoint: Cell Yield	CETIS Version: CETISv1.9.4
Analyzed: 09 Nov-18 16:50	Analysis: Parametric-Control vs Treatments	Status Level: 1
Batch ID: 06-2739-3271	Test Type: Cell Growth	Analyst: Mimi Tran
Start Date: 05 Oct-18 07:00	Protocol: EC/EPS 1/RM/25	Diluent: Deionized Water + nutrients
Ending Date: 08 Oct-18 07:00	Species: Pseudokirchneriella subcapitata	Brine:
Test Length: 72h	Taxon: Chlorophyta	Source: In-House Culture Age: 7d
Sample ID: 00-9926-6391	Code: 5EAAF57	Project:
Sample Date: 02 Oct-18 08:35	Material: Water Sample	Source: ALS
Receipt Date: 04 Oct-18 13:30	CAS (PC):	Station: L2175227-1 W3
Sample Age: 70h (5 °C)	Client: ALS	

Data Transform	Alt Hyp	NOEL	LOEL	TOEL	TU	PMSD
Untransformed	C < T	1.5	3	2.121	66.67	23.76%

Dunnett Multiple Comparison Test

Control	vs	Conc-%	Test Stat	Critical	MSD	DF	P-Type	P-Value	Decision(α:5%)
Negative Control		1.5	0.6003	2.526	7.364	10	CDF	0.7421	Non-Significant Effect
		3*	5.66	2.526	7.364	10	CDF	1.5E-05	Significant Effect
		6*	18.78	2.526	7.364	10	CDF	<1.0E-37	Significant Effect
		11.9*	35.16	2.526	7.364	10	CDF	<1.0E-37	Significant Effect
		23.8*	45.8	2.526	7.364	10	CDF	<1.0E-37	Significant Effect
		47.6*	49.4	2.526	7.364	10	CDF	<1.0E-37	Significant Effect
		95.2*	40.82	2.526	7.364	10	CDF	<1.0E-37	Significant Effect

Auxiliary Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:5%)
Control Trend	Mann-Kendall Trend Test			0.1855	Non-Significant Trend in Controls

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	120578	17225.5	7	760.1	<1.0E-37	Significant Effect
Error	634.5	22.6607	28			
Total	121213		35			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance Test	8.057	18.48	0.3276	Equal Variances
Distribution	Shapiro-Wilk W Normality Test	0.9849	0.9166	0.8942	Normal Distribution

Cell Yield Summary

Conc-%	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	N	8	31	28.86	33.14	31	28	34	0.9063	8.27%	0.00%
1.5		4	32.75	28.99	36.51	32	31	36	1.181	7.21%	-5.65%
3		4	47.5	39.65	55.35	47.5	42	53	2.466	10.39%	-53.23%
6		4	85.75	76.62	94.88	86.5	79	91	2.869	6.69%	-176.61%
11.9		4	133.5	125.2	141.8	133	128	140	2.598	3.89%	-330.65%
23.8		4	164.5	154.2	174.8	163	159	173	3.227	3.92%	-430.65%
47.6		4	175	170	180	174.5	172	179	1.581	1.81%	-464.52%
95.2		4	150	138.2	161.8	150	141	159	3.697	4.93%	-383.87%

CETIS Analytical Report

Report Date: 09 Nov-18 16:50 (p 2 of 2)
Test Code/ID: 181675 / 12-8863-8116

EC Alga Growth Inhibition Test

Nautilus Environmental

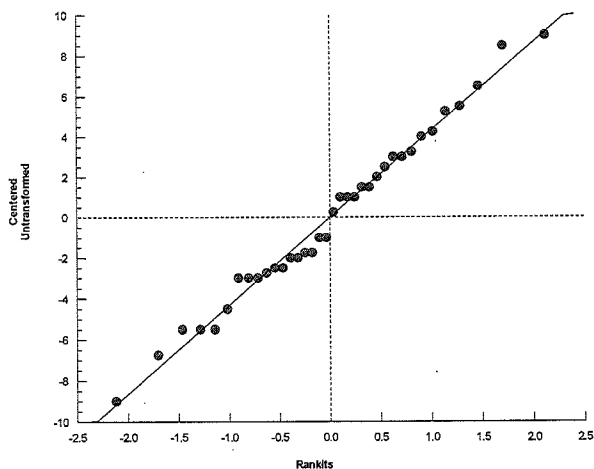
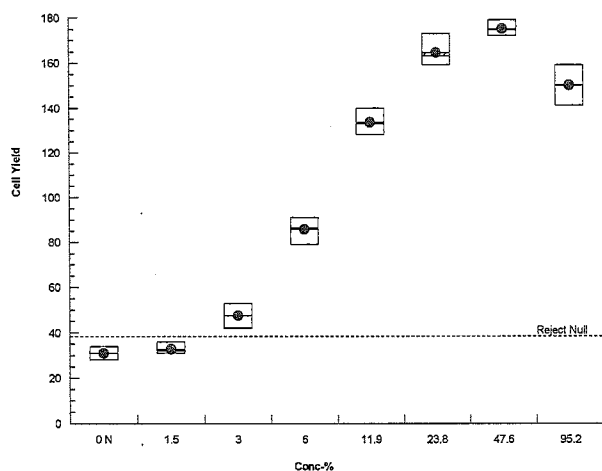
Analysis ID: 04-3656-0472 Endpoint: Cell Yield
Analyzed: 09 Nov-18 16:50 Analysis: Parametric-Control vs Treatments

CETIS Version: CETISv1.9.4
Status Level: 1

Cell Yield Detail

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	N	29	34	34	33	28	32	28	30
1.5		31	33	31	36				
3		45	53	50	42				
6		83	90	79	91				
11.9		131	128	140	135				
23.8		160	166	173	159				
47.6		172	173	179	176				
95.2		149	141	151	159				

Graphics



APPENDIX E – Chain-of-Custody Form

**L2175227**

VANCOUVER

Subcontract Request Form**Subcontract To:****NAUTILUS ENVIRONMENTAL**8664 COMMERCE COURT
BURNABY, BC V5A 4N7**NOTES:** Please reference on final report and invoice: PO# L2175227
ALS requires QC data to be provided with your final results.Please see enclosed 1 sample(s) in 8 Container(s)

SAMPLE NUMBER	ANALYTICAL REQUIRED	DATE SAMPLED	Priority Flag
		DUE DATE	
L2175227-1 W3		10/2/2018	
	Special Request- Nautilus Environmental (SPECIAL REQUEST-NL 14)	11/5/2018	

Subcontract Info Contact: Walter Lin (604) 253-4188

Analysis and reporting info contact: Shane Stack
8081 LOUGHEED HWY
SUITE 100
BURNABY, BC V5A 1W9
Phone: (604) 253-4188

Email: Shane.Stack@alsglobal.com

Please email confirmation of receipt to: **Shane.Stack@alsglobal.com**

Shipped By: me Date Shipped: Oct 04 2018

Received By: Nautilus Date Received: Oct 04/18 @ 13:30

Verified By: Tyrene Hamilton Date Verified: _____

Temperature: 5.0°C

Sample Integrity Issues: 7x20L + 3x1L



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



COC Number: 2018-10-03 C
Page 1 of 1

www.alsglobal.com

Contact and company name below will appear on the final report

Report Format / Distribution

Select Service Level Below - Please confirm all EAP TATs with your AM - surcharges will apply

Company: Minto Explorations Ltd.

Select Report Format: ☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)

Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply

Contact: Minto Environment - Coordinator

Quality Control (QC) Report with Report ☒ YES ☐ NO

1 Business day [E-1] ☐

Phone: 1-804-759-4656

☒ Compare Results to Criteria on Report - provide details below if box checked

3 day [P3] ☐

Company address below will appear on the final report

Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX

2 day [P2] ☐

Street: 2100-510 West Georgia St.

Email 1 or Fax: mintoenviroment@mintoexpl.com

Emergency ☐

City/Province: Vancouver, British Columbia

Email 2

Same Day, Weekend or Statutory holiday [E0] ☐

Postal Code: V6B 0M3

Email 3

Date and Time Required for all EAP TATs:

Invoice To: Same as Report To

Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX

Analysis Request

Company: Minto Explorations Ltd.

Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX

Contact: Ruth Cayetano

Email 1 or Fax: ap@mintoexpl.com

Project Information

Oil and Gas Required Fields (client use)

ALS Account # / Quote #:

AFCost Center:

Job #: 228101 (MMER)

Major/Minor Code:

PO / AFE: 228101 (MMER)

Routing Code:

LSD:

Location:

ALS Lab Work Order # (lab use only)

ALS Contact:

Sampler:

CR/EB

Number of Containers

ALS Sample # (lab use only) Sample Identification and/or Coordinates (This description will appear on the report)

Date (dd-mm-yy) Time (hh:mm) Sample Type

W3

2-Oct-18

8:35

Water

10

7x20L

3x1L

Drinking Water (DW) Samples¹ (client use)

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

Sample description: Pale yellow clear liquid. No odour, black particulates.

Are samples taken from a Regulated DW System?

☐ YES ☒ NO

Are samples for human drinking water use?

☐ YES ☒ NO

Released by: Corey Roberts

Date: 2018-10-03

Time: 11:30

Received by: EHF

Date: 03 Oct 2018

Time: 11:30

Time: 12:00

SHIPMENT RELEASE (client use)

INITIAL SHIPMENT RECEPTION (lab use only)

FINAL SHIPMENT RECEPTION (lab use only)

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION
Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy
1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an authorized DW COC form.

END OF REPORT



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[illegible]

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WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2016 FRONT

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1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

Appendix K – Minto Creek Sediment, Periphyton and Benthic Invertebrate Community Assessment 2018 Update



**Minto Creek Sediment, Periphyton, and
Benthic Invertebrate Community
Assessment - 2018**

Prepared for:
Minto Mine
Whitehorse, Yukon

Prepared by:
Minnow Environmental Inc.
Victoria, British Columbia

March 2019

**Minto Creek Sediment, Periphyton, and
Benthic Invertebrate Community
Assessment - 2018**

Lisa Bowron, M.Sc., R.P. Bio.
Project Manager



Pierre Stecko, M.Sc., EP, R.P. Bio.
Senior Project Advisor

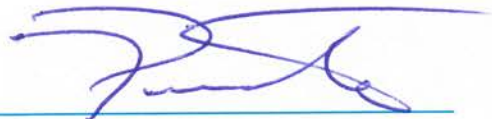


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1 INTRODUCTION

1.1 Site Description

The Minto Mine is a high-grade copper mine located within Selkirk First Nation (SFN) Category A Settlement Land Parcel R-6A approximately 240 km northwest of Whitehorse, Yukon Territory (62°37'N latitude and 137°15'W longitude; Figure 1.1). It is owned and operated by Minto Explorations Ltd. (MintoEx), a wholly owned subsidiary of Capstone Mining Corporation (Capstone). Mine development was initiated in 1997, commercial operations started in October 2007, and the mine entered temporary care and maintenance on October 19, 2018. The facility was permitted to conduct open pit and underground mining with milling at a rate of 4,200 tonnes of copper/gold/silver ore. Minto Mine produced 35.9 million pounds of copper in 2017. Mill tailings are stored in the Main Pit, Area 2 Pit, and the Dry Stack Tailing Storage Facility (DSTSF; Figure 1.2). Mine-impacted seepage from the DSTSF and under the Mill Valley Fill Extension (MVFE) is collected at the toe of the MVFE and pumped to the Main Pit (Figure 1.2). Non-impacted water and treated mine-impacted water are collected in a Water Storage Pond (WSP; Figure 1.2). Effluent from the WSP is periodically discharged to Minto Creek under conditions specified in Water Use Licence (WUL) QZ14-031 (August 2015). Minto Creek, in turn, discharges to the Yukon River approximately 7.7 km south-east of the WSP (Figure 1.2).

1.2 Background

Under the WUL, Minto Mine implements an Environmental Monitoring, Surveillance, and Reporting Plan (EMSRP) that includes routine water quality monitoring during the ice-free period (typically from April to October or November) in Minto Creek and reference tributaries at sampling frequencies varying from weekly to monthly. In accordance with the WUL, the Minto Mine submits water quality data to the Yukon Water Board as original laboratory reports and monthly summary reports within 30 days of month-end. Water quality monitoring data indicates that total suspended solids concentrations can increase dramatically during high flow events and concurrent concentrations of many metals (including aluminum, chromium, copper, and iron) are higher than Canadian Water Quality Guidelines (CWQGs) for the protection of aquatic life even under background and reference conditions (e.g., HKP 1994, Minnow 2009, 2010a,b).

Minto Mine also implements biological monitoring under the EMSRP, including Environmental Effects Monitoring (EEM) in accordance with federal requirements under the *Fisheries Act* and an Aquatic Environmental Monitoring Plan (AEMP). Biological monitoring under EEM is implemented every three years and Phase 4 of the EEM was recently completed (Minnow 2018b). Some mine influence was observed in routine water quality monitoring and water samples collected in conjunction with benthic invertebrate sampling. Analytes with concentrations higher

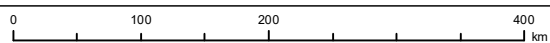




Map of Canada



Location of the Minto Mine



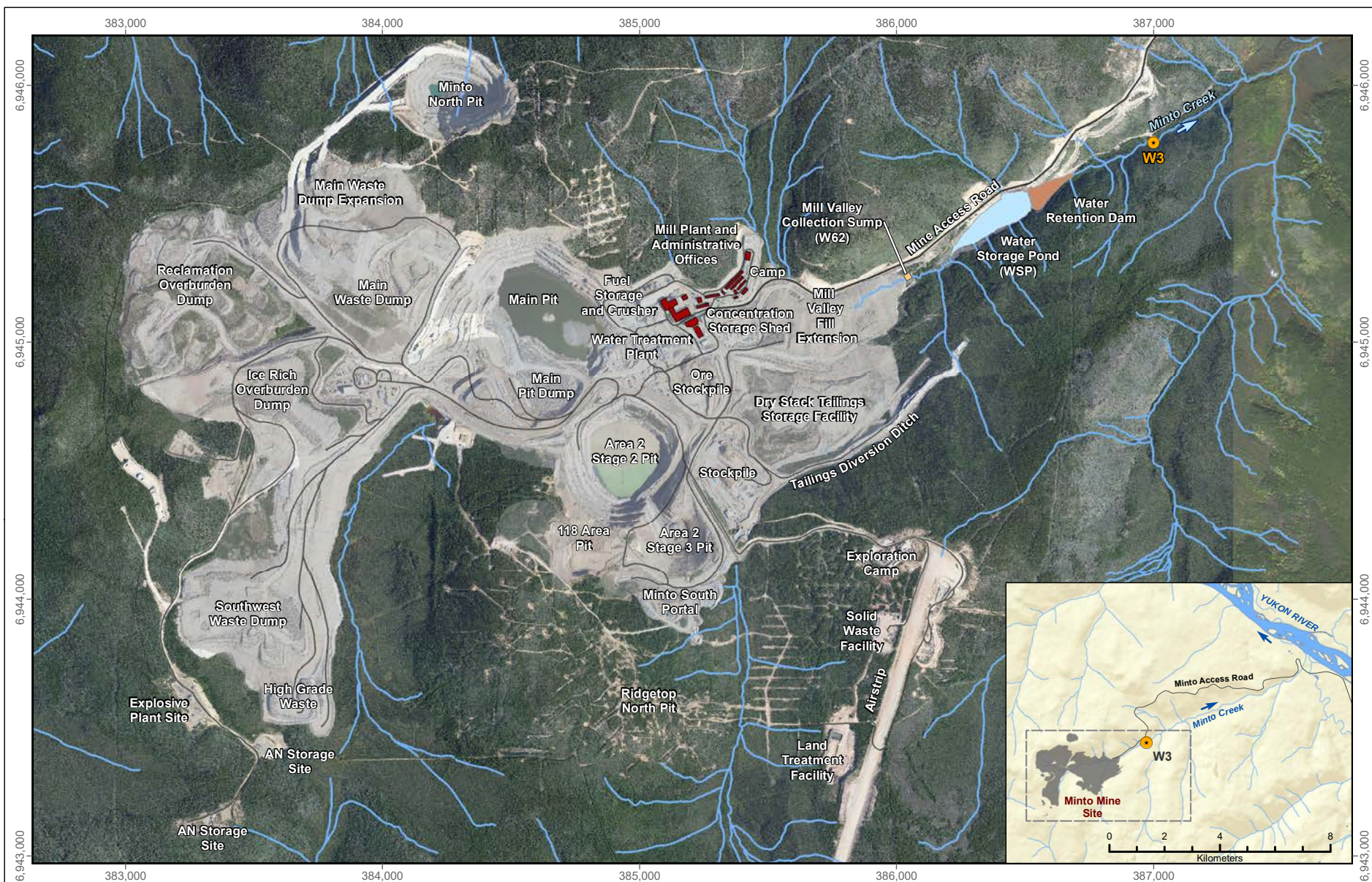
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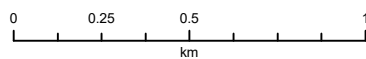


Figure 1.1

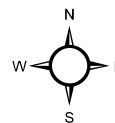


LEGEND

- Final Effluent Discharge Point
- Mine Footprint
- Water Retention Dam
- Building



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Minto Mine Site Layout and Receiving Environment

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Figure 1.2

than reference (or the reference range), include conductivity, hardness, nitrate, total Kjeldahl nitrogen, total phosphorus, and total aluminum, arsenic, copper, iron, molybdenum, and selenium. Concentrations of nitrate were most strongly associated with the release of water from the WSP, but remained below the CWQG. Mean concentrations of aluminum and arsenic were above CWQG but at both reference and exposed areas. Copper exceeded CWQG but was lower than the site-specific water quality objective (SSWQO). Primary EEM metrics (density, taxon richness, Simpson's Evenness, and Bray-Curtis index) were within reference condition at upper Minto Creek but density was significantly lower at upper Minto Creek than reference in a control-impact comparison (Minnow 2018b). The difference was not considered ecologically meaningful since the magnitude of difference was below the critical effect size (CES) of ± 2 standard deviations (Minnow 2018b). Fish exposed to the highest concentrations of Minto Mine effluent (25 percent [%]) for 47 days were slightly larger and of better condition than reference fish, but differences were less than the CES of 10%, and considered not to be ecologically meaningful (Minnow 2018b). The study design for the Phase 5 EEM has been submitted and work should begin in the summer of 2019.

The annual AEMP includes monitoring of water, sediment, periphyton, benthic invertebrates, fish, and fish habitat. Data from 1994 (baseline) and 2006 to 2017 have been reported previously (e.g., Minnow 2018a), with some program modification over time. AEMP water quality monitoring has indicated that analytes were all below WUL SSWQOs. Fluoride was above CWQG at both the exposed and references areas. Total copper was above CWQG at upper Minto Creek but dissolved copper was below the SSWQO. Concentrations of copper in upper and lower Minto Creek were greater than the Interim Sediment Quality Guidelines (ISQGs) for the protection of aquatic life and the reference areas. Similar concentrations were observed in previous years. In 2017, the periphyton community at lower Minto Creek had a different composition than lower Wolverine Creek. Temporal variability was observed in periphyton community metrics and composition between lower Minto and lower Wolverine creeks. Benthic invertebrate community of lower Minto Creek did not differ from either reference, or was intermediate between references for all community metrics. High temporal variability in benthic invertebrate community condition was presumably due to inter-annual variability in environmental conditions.

1.3 Objectives

The objectives of this study and report are to characterize and interpret current (2018) sediment quality, periphyton and benthic invertebrate community condition, and tissue quality (periphyton and benthic invertebrate) of Minto Creek relative to reference and previous years' conditions. Supporting environmental data are also reported.



2 METHODS

2.1 Overview

Minnow Environmental Inc. implemented the Minto Creek sediment, periphyton, and benthic invertebrate assessment from September 5 to 12, 2018 with the assistance of Minto Mine staff. The Minto Mine was not actively discharging during the study and had not been discharging since August 31, 2018. The study was completed in accordance with specifications of the Minto Mine WUL (QZ14-031). Sediment sampling was undertaken in upper Minto Creek, lower Minto Creek, and corresponding reference areas (Table 2.1; Figure 2.1). Toxicity tests were run on sediment from lower Minto and lower Wolverine creeks (Table 2.1; Figure 2.1). Periphyton and benthic invertebrate community and tissue sampling were undertaken in erosional habitat of lower Minto Creek and their corresponding reference areas (Table 2.1; Figure 2.1). Supporting measures (e.g., field meter measures, water quality samples, depth, flow, habitat observations) were collected at all sampling areas.

2.2 Supporting Measures

2.2.1 Field Collection

Many environmental variables were measured to support the sediment quality, periphyton community, benthic invertebrate community, and tissue chemistry data collected for the Minto Creek assessment. The location of each station was recorded using a handheld Geographic Positioning System (GPS) with coordinates recorded in Universal Transverse Mercator (UTM) units (using the North American Datum of 1983).

Supporting measures collected concurrent with sediment sampling (i.e., at depositional areas) included core penetration depth (lower creek areas only), sample texture, and the presence or absence of organic detritus. *In situ* measurements, including temperature, dissolved oxygen, specific conductance, and pH were taken at each station using either a YSI ProPlus field meter (Yellow Springs Instruments, Yellow Springs, OH) or a Hanna 4M multiparameter field meter (Woonsocket, RI).

At periphyton and benthic invertebrate stations (community and tissue), *in situ* water quality measurements (by field meter as described above), water depth (by meter stick), and water velocity (by HACH FH950 handheld flow meter [HACH Company, Loveland, CO]) were measured. Habitat was characterized at each periphyton and benthic invertebrate sampling area and included elevation, gradient, creek wetted and bankfull widths (by tape measure or range finder), water appearance, creek morphology, bank condition, substrate texture, instream cover and features, overhead canopy, aquatic vegetation, riparian vegetation, surrounding land use and



Table 2.1: Minto Mine Water Use Licence Sediment, Periphyton, and Benthic Invertebrate Monitoring Program Overview, September 2018

Area Type	Area	Station	Minto Mine Water Use Licence (QZ14-031, Amendment 10)								
			Water	Sediment by Spoon ^a	Sediment by Hand Corer/Petite Ponar ^b	Sediment Toxicity Testing	Periphyton Chlorophyll-a	Periphyton Community	Periphyton Tissue ^c	Benthic Community by Hess Sampler ^d	Benthic Invertebrate Tissue ^c
Lower Creek Areas	Lower Wolverine Creek (Reference)	LWC-1	✓		✓	✓	✓	✓	✓	✓	✓
		LWC-2			✓	✓	✓	✓	✓	✓	✓
		LWC-3			✓	✓	✓	✓	✓	✓	✓
		LWC-4			✓	✓	✓	✓	✓	✓	✓
		LWC-5			✓	✓	✓	✓	✓	✓	✓
	Lower Big Creek (Reference)	LBC-1	✓						✓	✓	✓
		LBC-2							✓	✓	✓
		LBC-3							✓	✓	✓
		LBC-4							✓	✓	✓
		LBC-5							✓	✓	✓
	Lower Minto Creek (Exposed)	LMC-1	✓		✓	✓	✓	✓	✓	✓	✓
		LMC-2			✓	✓	✓	✓	✓	✓	✓
		LMC-3			✓	✓	✓	✓	✓	✓	✓
		LMC-4			✓	✓	✓	✓	✓	✓	✓
		LMC-5			✓	✓	✓	✓	✓	✓	✓
Upper Creek Areas	Upper McGinty Creek (Reference)	URC-1	✓	✓							
		URC-2		✓							
		URC-3		✓							
		URC-4		✓							
		URC-5		✓							
	Upper Minto Creek (Exposed)	UMC-1	✓	✓							
		UMC-2		✓							
		UMC-3		✓							
		UMC-4		✓							
		UMC-5		✓							

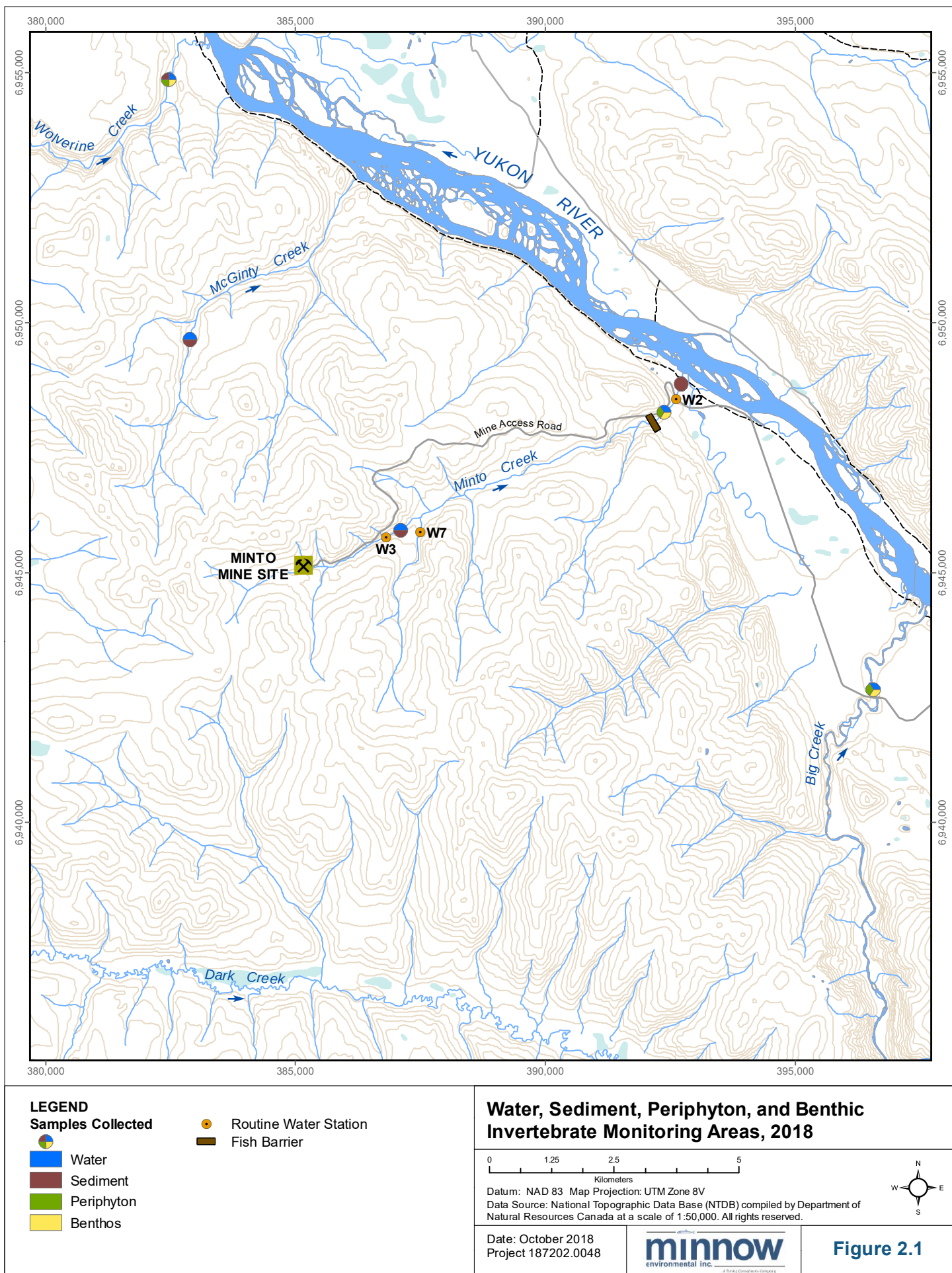
Note: ✓ = Included in the Monitoring Program.

^a Top 2 centimeters collected; minimum 3-grab composite.

^b Top 2 centimeters collected; 3-grab composite.

^c Productivity permitting; in some cases, replication (of 5) may not be achieved with reasonable effort.

^d 500 µm mesh; 3-grab composite.



anthropogenic disturbance. At each benthic invertebrate station, the intermediate axis lengths of 100 rocks that were washed during collection of the community sample were measured and the percent embeddedness of ten randomly selected rocks were evaluated and recorded. This type of substrate characterization is similar to those recommended under the Canadian Aquatic Biomonitoring Network (CABIN) protocol (CABIN 2012) for characterizing benthic invertebrate habitat. This provides additional information to assess and standardize habitat conditions among sampling stations and areas. Summary statistics of intermediate axis lengths (including the median and geometric mean) and median embeddedness were calculated for each station as per the CABIN protocol.

Water samples for chemical analysis were collected at all sampling areas (Table 2.1, Figure 2.1). Samples were collected using a master bottle from which the collected water was poured into pre-labeled sample bottles and preservatives were added, as required. A field duplicate was collected from one area using a split sample method; water from the master bottle was poured into one bottle and then into a duplicate bottle. Water samples for dissolved organic carbon (DOC) and for dissolved metals were filtered in the field using 0.45 micrometre (μm) polypropylene filters. Immediately after collection, water samples were placed in a cooler and later into a refrigerator at approximately 4 degrees Celsius ($^{\circ}\text{C}$). They were later submitted to ALS Environmental in Whitehorse, YT, for analysis of alkalinity by auto titration, anions by ion chromatography, total and dissolved organic carbon by combustion, total inorganic carbon by CO_2 purge, total cyanide by Continuous Flow Analyzer (CFA), conductivity by electrode, hardness by calculation, total and dissolved mercury by Cold Vapour Atomic Fluorescence Spectrophotometry (CVAFS [low]), total and dissolved metals by Collision Cell Mass Spectrometry (CCMS) and Inductively Coupled Plasma-Optical Emission Spectrophotometry (ICP-OES), total and dissolved phosphorus by colour, total dissolved and suspended solids by gravimetrics, pH and turbidity by meter, and ammonia by fluorescence.

The productivity of lower Minto and lower Wolverine creeks was evaluated using measurements of chlorophyll-a in periphyton. Chlorophyll-a is the primary photosynthetic pigment of all oxygen-evolving photosynthetic organisms (Wetzel 2001) and therefore provides an indicator of the standing stock of photosynthetic organisms representing the lowest trophic level. Minto Creek is a lotic system and measuring chlorophyll-a in periphyton was considered more representative of productivity than measuring it in water. A stainless steel razor blade was used to scrape periphyton from five rocks and then periphyton was transferred to filter paper which was placed in a pre-labeled opaque sampling jar. The surface area sampled was measured and recorded. All samples were maintained in coolers with ice packs during transport and then kept frozen on site until submission to ALS Environmental (Whitehorse, YT).



2.2.2 Data Analysis

A formal data quality review (DQR) was completed to assess water data quality (Appendix A). The quality of the data was evaluated by comparing laboratory method detection limits (MDL) to target detection limits, which are ideally $\leq 1/10^{\text{th}}$ of guideline values. On a subset of samples, the laboratory conducted Quality Assurance/Quality Control (QA/QC) analysis, including method blanks, laboratory duplicates, matrix spikes, spiked blanks, and certified reference materials. Field duplicates were collected and analyzed as a part of the DQR.

Water quality of Minto Creek was evaluated relative to WUL objectives, concentrations measured at reference areas, applicable CWQG (CCME 1999), and historical water quality. Supporting field measures (temperature, dissolved oxygen, pH, and specific conductance) and chlorophyll-a results were tested for differences between lower Minto Creek and reference areas (lower Wolverine and lower Big creeks) using two-sample t-tests. The assumption of normality was assessed using the Shapiro Wilks' test ($\alpha = 0.05$) and homogeneity of variance was assessed using Levene's Test ($\alpha = 0.05$). If variances were unequal, then the two-sample t-test for unequal variances was conducted (Ruxton 2006). Data were $\log_{10}$ transformed when required to meet the assumption of normality. A value of 1 was added before taking the logarithm if values of zero were in the data set. If normality could not be achieved after data transformation, a non-parametric Mann-Whitney test was used. A significance level (α) of 0.05 was used for all statistical tests of supporting field measures. Statistical comparisons were conducted in excel using the Real Statistics (Zaiontz 2018) add-in for Microsoft Excel. A magnitude of difference (MOD) was reported for statistical comparisons that were significant as:

$$MOD = \frac{(MCT_{Exp} - MCT_{Ref})}{MCT_{Ref}} \times 100\%$$

where *MCT* is the measure of central tendency (i.e., mean for the ANOVA after back-transforming to original data units when a transformation was used, and median for the Mann-Whitney test).

Chlorophyll-a was compared to the British Columbia Water Quality Guideline (BCWQG). Creek productivity was characterized by comparing chlorophyll-a concentrations to the Dodds et al. (1998) productivity classification system for temperate streams.

2.3 Sediment Quality

2.3.1 Sample Collection and Laboratory Analysis

Sediment samples were collected for particle size and chemical analysis at depositional areas within Minto Creek and reference creeks (Table 2.1, Figure 2.1). At lower Minto and lower Wolverine creeks, sediment samples for particle size analysis were collected using a



15.24 centimetre (cm) x 15.24 cm (6 inches ["] x 6") stainless steel petite ponar grab sampler (0.023 square metres [m²] sampling area). A composite sample was created by collecting the surficial 2 cm of sediment from each of three acceptable grabs (i.e., full to each edge of the sampler) using a stainless steel spoon. Each sample that formed the composite was added to a plastic bin and mixed together. The mixed composite samples were placed into pre-labeled glass sampling jars. Sediment samples for chemical analyses were collected by carefully inserting a 4.7 cm (2"; inside diameter) Lexan™ core tube into sediment deposits, capping the end with a fitted plastic cap, and retrieving by hand. From each acceptable core (i.e., each core containing an intact, representative sediment-water interface), the surficial 2 cm of sediment was manually extruded upwards into a graded core collar, cut with a stainless steel core knife, and placed into a pre-labeled glass sampling jar. Samples from three cores were composited to form a single sample from each station. At upper Minto and upper McGinty creeks, sediment deposits were rare and typically very shallow (i.e., deposits were less than one centimeter in depth). Collection of sediment by ponar or coring was ineffective in the upper creek areas and therefore sediments were collected using a stainless steel spoon. At locations of sediment deposition, surficial sediment was carefully collected by slowly spooning the sediment into a pre-labeled glass jar, with care taken to avoid the loss of fine material. In order to be as consistent as possible with the sediment collected in the lower creek areas, samples included no more than the top 1 cm of deposited sediment. Immediately after collection, sediment samples were placed in a cooler and later into a refrigerator at approximately 4°C. They were later submitted to ALS Environmental in Whitehorse, YT or Burnaby, BC, for analysis of particle size by dry and wet sieving and pipette sedimentation method, total organic carbon and loss on ignition by combustion, inorganic carbon derived from a calculation, metals by collision/reaction cell-inductively coupled plasma mass spectrometry (CRC ICP-MS), mercury by CVAFS, total Kjeldahl nitrogen by colorimetric analysis, and pH by probe.

Survival and growth were measured in sediment toxicity tests (10-day *Chironomus dilutus* and 14-day *Hyalella azteca*) at lower Minto and lower Wolverine creeks (Environment Canada 1997, 2013). Sediment for toxicity testing was collected using a 15.24 cm x 15.24 cm (6" x 6") stainless steel petite ponar grab sampler (0.023 m² sampling area) and the top 2 cm from three grabs were collected to form a composite sample from each station (five stations formed the replicates in the toxicity tests). Samples from each station were placed into a pre-labeled 1 L jar and mixed with a stainless steel spoon. Immediately after collection, samples were placed in a cooler, then later transferred to a refrigerator and stored at approximately 4°C until they were submitted to Nautilus Environmental Inc. in Burnaby, BC for sediment toxicity testing.



2.3.2 Data Analysis

A formal DQR was completed to assess the sediment data quality (Appendix A). The MDLs achieved by the laboratory were compared to target limits, generally $\leq 1/10^{\text{th}}$ guideline values. Laboratory QA/QC analysis included method blanks, laboratory duplicates, spiked blanks and certified reference materials (Appendix A). Sediment chemistry endpoints were summarized by reporting mean, standard deviation, minimum, and maximum for each area. Sediment quality data were evaluated relative to sediment quality guidelines (SQGs) for the protection of aquatic life (e.g., CCME 1999) and reference concentrations to identify metals with the potential to adversely affect aquatic life and/or that could be elevated due to mine activity. Sediment quality data were also compared to results obtained in previous years of sampling (1994 and 2006 to 2017). Interpretation was conducted with careful consideration of a methodological change made in 2010 and carried through to 2018 (sediments collected as described in Section 2.3.1) relative to previous years. Sediments collected in years before 2010 were collected within the active channel of the creek using an aluminum or Teflon scoop. Samples were submitted whole for analysis of particle size distribution, which generally included significant quantities of gravel and sand. Only material passing through a 230 mesh sieve ($< 63 \mu\text{m}$; silt and clay) was digested and analyzed for metals. While this approach does analyze the geochemically-relevant fine sediment (e.g., Horowitz 1991), it impedes interpreting the biological significance of sediment chemistry. Organisms are exposed to whole sediment (not just fines) and SQGs for the protection of aquatic life (e.g., CCME 1999) apply to whole sediment.

The laboratory performed QA/QC on sediment toxicity tests by comparing results to reference toxicant tests. Total ammonia was monitored in lower Minto and lower Wolverine sediment toxicity test vessels. If un-ionized ammonia (as N) rose above 0.20 milligram per litre (mg/L) in reference treatments (lower Wolverine Creek) renewal of overlying water would be required. Sediment toxicity from lower Minto Creek were compared to lower Wolverine Creek and laboratory control sediment. Results were also compared to previous sediment toxicity testing conducted in 2011 and 2015 to 2017 (Minnow 2012, 2016, 2017, 2018a). Statistical analysis were conducted and summarized in a report by Nautilus Environmental (Appendix C).

2.4 Periphyton Community

2.4.1 Sample Collection and Laboratory Analysis

Periphyton is the assemblage of algae, bacteria, fungi, and meiofauna attached to submerged substrate in freshwaters. However, periphyton communities are generally characterized based on the attached alga community, which represent the lowest trophic level and are indicators of primary productivity. Periphyton community samples were collected in erosional habitat of lower



Minto, lower Wolverine, and lower Big creeks (Table 2.1, Figure 2.1). A stainless steel razor blade was used to scrape periphyton from five randomly selected rocks in each of the five replicate stations per area. The area sampled was measured and recorded. Samples preserved with Lugol's iodine solution were placed in pre-labeled sampling jars. The samples were placed in a cooler, then later transferred to a refrigerator and stored at approximately 4°C until they were shipped to Plankton Resources Inc. (Winnipeg, MB) for analysis to species level.

2.4.2 Data Analysis

A formal DQR was completed to assess the quality of the periphyton community data (Appendix A). Laboratory duplicate samples were collected on 10% of the periphyton community samples. Periphyton communities were compared between lower Minto Creek and reference areas, lower Wolverine and lower Big creeks. Temporal comparisons were made to data collected in 1994 and 2011 to 2018.

Total organism density (cells per centimetre squared [cells/cm²]) and biomass (microgram per centimetre squared [µg/cm²]) were calculated for periphyton community samples. The diversity metric "number of taxa" (also known as taxon richness) included all separate taxa identified to the species level. Simpson's Diversity and Evenness indices were computed according to formulae presented by Smith and Wilson (1996) and recommended by Environment Canada (2012). These indices take into account the relative abundance of taxa and number of taxa, with values ranging from 0 (low diversity or evenness) to 1 (high diversity or evenness). The Bray-Curtis index was also calculated according to Environment Canada (2012). This metric takes into account the abundance of each taxon at each station compared to the median reference abundance (lower Wolverine Creek), to compute an index of the relative "dissimilarity" of each station from the hypothetical reference median station. Larger Bray-Curtis index values indicate greater dissimilarity from reference.

Periphyton community endpoints were summarized by reporting mean, median, minimum, maximum, and standard deviation for each study area. Differences among Minto Creek and the reference areas were tested using a two-sample t-test, with a p-value < 0.10. A p-value of 0.10 was used as per suggested EEM guidelines (Environment Canada 2012). The assumption of normality was assessed using the Shapiro Wilks' test ($\alpha = 0.05$) and homogeneity of variance was assessed using Levene's Test ($\alpha = 0.05$). If variances were unequal, then the two-sample t-test for unequal variances was conducted (Ruxton 2006). Data that could not be normalized were log, square root, or fourth root transformed. A value of 1 was added before taking the logarithm if values of zero were in the data set. If data could not be normalized after transformation, a non-parametric Mann-Whitney test was applied. Statistical comparisons were conducted using



Real Statistics in excel (Zaiontz 2018). A magnitude of difference (MOD) was calculated for each community metric as:

$$MOD = \frac{(\bar{X}_{Exp} - \bar{X}_{Ref})}{SD}$$

where the SD is an estimate of the reference standard deviation. The estimate of the reference standard deviation was the pooled standard deviation in the two-sample t-test for equal variances or the reference standard deviation when the two-sample t-test for unequal variances was applied.

The MOD for the Mann-Whitney test was calculated using medians instead of means and the pooled median absolute deviation (MAD) instead of the SD. The MAD is calculated as the median of the absolute values of the differences between each observation and the median observation for that area (and corrected by a factor of 1.4826 to scale the MAD to a comparable magnitude to the SD). A study design with two areas and $n = 5$ samples per area has an approximate power of 0.9 to detect a two standard deviation difference between areas using $\alpha = 0.1$ (Environment Canada 2012).

Periphyton data collected in 2018 were compared to data collected in baseline studies (HKP 1994) and from 2011 to 2017. Due to differences in reporting of periphyton community data in the 1994 baseline report (e.g., taxa were only identified as present, common or dominant), a non-statistical comparison was performed against 1994 data using proportional abundances at the taxonomic level of Phylum.

2.5 Benthic Invertebrate Community

2.5.1 Sample Collection and Laboratory Analysis

Benthic invertebrate community samples were collected in erosional habitat of lower Minto, lower Wolverine, and lower Big creeks as required under the WUL (Table 2.1, Figure 2.1). Benthic invertebrate community samples were collected from riffle/run habitat with cobble and gravel substrate using a Surber sampler (0.093 m²) outfitted with 500 µm mesh. Three grab composites (0.279 m² area in total) were collected at five replicate stations within each sampling area. For each grab, the substrate within the sampler was disturbed and scrubbed (by hand and nail brush) with care taken to ensure that all dislodged organic material was swept into the sampler collection net. The substrate was disturbed to a depth of approximately 3 cm over a period of approximately five minutes. This procedure was repeated at new subsampling locations for the second and third grab, following which all of the material contained in the collection net was carefully transferred to a pre-labeled 1 litre (L) wide-mouth plastic jar using a stainless steel spoon and a wash bottle while working over a plastic bin to avoid any potential loss of organisms. Any organisms that adhered to the sieve bag were removed by hand and added to the sample. All samples were



labeled internally (using wooden sticks) and externally with the station number, area identifier, Minnow project number, date and field personnel in order to ensure correct identification at the laboratory. Samples were preserved within six hours of collection using buffered formalin solution to a nominal concentration of 10% in ambient water.

All benthic invertebrate samples were shipped to Cordillera Consulting in Summerland, BC. Each sample was elutriated to remove sand, gravel, clay, and the remaining organic material was preserved in 70% ethanol. Elutriate was examined for any mollusc or Trichoptera cases, then each sample was examined to estimate the total number of invertebrates. If the estimated number of organisms were greater than 600 and the sample was fine and non-clumping, a subsample was taken using a Folsom Plankton Splitter (Motodo 1959, Van Guelpen et al. 1982). Empty snail or bivalve shells, empty caddisfly cases, and invertebrate fragments such as legs, gills, antennae etc. were kept but excluded from the count. When organism fragments were encountered, only the heads were counted towards the total. Larval and pupal exuviae were excluded while terrestrial stages and terrestrial drop-ins were indicated as such but excluded from the total count. Benthic invertebrates were identified to the “lowest practicable taxonomic level” (which in most cases were genus) and counted. Following identification and counting, representative specimens of each new taxon were preserved in a museum quality vial with a polyseal lid and added to the Minto Mine voucher collection. Internal labels were used to identify the taxa, the client, date collected, site code, and the project.

2.5.2 Data Analysis

A formal DQR was completed to assess the benthic invertebrate community data quality (Appendix A). Laboratory QA/QC included an assessment of sub-sampling error and sorting efficiency on at least 10% of the samples (Appendix A). Benthic invertebrate communities were evaluated using summary metrics, including invertebrate density (number of organisms per m², calculated based on a sample area of 0.279 m²), number of taxa, Simpson's Diversity and Evenness, and Bray-Curtis index. Before these endpoints could be calculated, abundances of organisms identified to a less-specific level were first added to abundances of organisms within that grouping identified to a more-specific level (e.g. abundances of organisms only identified to Order were added to abundances of organisms identified to Family, Genus, or Species within that Order). This process (data compression) assess benthic invertebrate taxonomic richness without redundancy. Abundance of a less-specific taxon was redistributed within that taxon proportionally according to abundances of organisms identified to more-specific levels. Data compression was conducted proportionally because the distribution of organisms identified beyond the family-level likely reflect the proportional distribution of organisms identified to associated less-specific levels, because those organisms are frequently at early developmental stages and lack some



differentiating features. Total organism density (individuals/m²), taxon richness, Simpson's Diversity and Evenness, and Bray-Curtis index were calculated in the same manner as periphyton community data (Section 2.4.2). It was noted that in previous years total organism density did not always account for area sampled (2013 to 2017). All density samples were re-calculated to include area and total organism density now represents individuals/m². Bray-Curtis index was calculated based on the median of each reference area as well as the combined reference median. The combined reference median was presented within the text, as this is the optimal method for determining potential effluent effects, since using a reference median value calculated from only one area biases the outcome toward detecting a difference between two areas regardless of potential anthropogenic stressors. This occurs because the area used to calculate the median was inherently more similar to itself than any other area (Huebert et al. 2011), even if the two areas in question are 'natural-pristine' areas.

The relative proportions of the most abundant taxa were calculated relative to the total number of organisms in the sample. Dominant taxon groups were defined as groups representing greater than 10% of total organism abundance in one or more areas or any groups considered important indicators of environmental stress. In this study, relative proportions of the major groups, such as chironomids and EPT taxa (Ephemeroptera [mayfly], Plecoptera [stonefly], Trichoptera [caddisfly] taxa) were examined. It is often possible to relate low relative abundance of sensitive taxonomic groups (e.g., EPT taxa) to environmental stress (e.g., Taylor and Bailey 1997). Similarly, high relative abundance of tolerant taxonomic groups (e.g., oligochaetes) may also indicate higher environmental stress (Chapman et al. 1982a,b).

Differences among Minto Creek and the reference areas were tested using ANOVA with $\alpha = 0.1$ as per EEM guidelines (Environment Canada 2012). Prior to ANOVA, all data were transformed ($\log_{10}$, square root, or fourth root transformation) as necessary to meet assumptions of normality (Shapiro Wilks' test; $\alpha = 0.05$) and homogeneity of variance (Levene's test; $\alpha = 0.05$). A value of 1 was added before taking the logarithm if values of zero were in the data set. If data failed the assumptions of normality and homogeneity of variance, then a non-parametric Kruskal-Wallis test was conducted. Post-hoc contrasts following the ANOVA were conducted between the exposed area and each reference area using the contrast methods described in Oehlert (2010). Contrasts following the Kruskal-Wallis test were conducted using Dunn's test using the *dunn.test* package in R (Dinno 2017; R Core Team 2017). A magnitude of difference (MOD) for each comparison and community metric was calculated using the same approach as described for the periphyton (Section 2.4.2).

Benthic invertebrate community data were also evaluated in comparison to results obtained in previous years of sampling (1994, 2006, 2008, and 2010 to 2016). Summary metrics from earlier



years were previously re-calculated (Minnow 2011) to ensure consistency and appropriate comparisons over time.

2.6 Tissue Chemistry

2.6.1 Sample Collection and Laboratory Analysis

Periphyton and benthic invertebrate tissue samples were collected from lower Minto (exposed), lower Wolverine (reference), and lower Big creeks (reference; Table 2.1, Figure 2.1). Periphyton samples were collected by scraping submerged cobble-size rocks with a stainless steel razor blade. Scraped material (periphyton) was placed in pre-labeled sample jars. Benthic invertebrate tissue samples were collected in areas with cobble substrate using a kick-net, and by overturning rocks and collecting organisms by hand. Periphyton and benthic invertebrate tissue samples (2 to 5 grams [g]) were placed into pre-labeled sample jars and Whirl-Pak™ bags, respectively. A total of five periphyton and five benthic invertebrate samples were collected at each area. Immediately after collection, all tissue samples were placed in a cooler, and later in a freezer until they were submitted to ALS Environmental in Burnaby, BC. Samples were analyzed for percent moisture and for metals by High-Resolution ICP-MS, and later converted to dry weight using percent moisture.

2.6.2 Data Analysis

Summary statistics were calculated for each metal by area and tissue type (periphyton and benthic invertebrates). The follow summary statistics were reported: sample size, percent of values below the laboratory reporting limit (LRL), mean, standard deviation, minimum value, median, and maximum value. Commonly used substitution methods (e.g., substituting values < LRL with half the LRL) for censored data introduces bias in summary statistics (Helsel 2012). Means and standard deviations were therefore estimated using the Kaplan-Meier (K-M) method. This method involves transforming the left censored (i.e., < value) dataset to a right censored (i.e., > value) dataset, and then using the K-M estimator (used to estimate the mean survival time in survival analysis) to estimate the mean. The calculation was conducted using the *survfit* function in the *survival* package (Therneau 2017) in R and involves calculating the area under the K-M survival curve. The K-M method is non-parametric and can accommodate multiple laboratory reporting limits (LRLs). This method of estimating the mean is equivalent to using the distribution of detectable values below the LRL to represent values that are < LRL. For example, the mean of the data set {1, 2, < 4, 5} is estimated as the mean of 1, 2, [$\frac{1}{2} \times 1 + \frac{1}{2} \times 2$], and 5 which is 2.375. The value < 4 is replaced by the distribution of values below 4 (i.e. 1 and 2 with equal weight of $\frac{1}{2}$). Similarly, the mean of the data set {1, 1.6, 2, 2.1, < 4, 5} is estimated as the mean of 1, 1.6, 2, 2.1, [$\frac{1}{4} \times 1 + \frac{1}{4} \times 1.6 + \frac{1}{4} \times 2 + \frac{1}{4} \times 2.1$], and 5 which is 2.229. Again, the value < 4 is replaced by



the distribution of values below 4 (i.e., 1, 1.6, 2, and 2.1 with equal weight of $\frac{1}{4}$). If the minimum value in the data set is below the LRL then it is replaced with the LRL. Therefore, if there is only one LRL and no detected values below the LRL, then the K-M estimate of the mean is equivalent to replacing the value below the LRL with the LRL (i.e., the best guess for the values $< \text{LRL}$ is the LRL). When a standard deviation could not be estimated (e.g., when all data were below the LRL), then it was not reported. When a value was reported below a poor LRL (defined as a LRL that exceeded the maximum detected value) then the value was removed from the dataset.

The primary objective of tissue collection was to support a selenium assessment reported under a separate cover. Accordingly, data are reported herein for future reference with limited interpretation. Tissue metal concentrations for periphyton and benthic invertebrates from LMC (exposed) were compared relative to LWC and LBC (reference) using analysis of variance (ANOVA). The comparisons were conducted using ANOVA on untransformed or $\log_{10}$ -transformed data (whichever transformation best fit the data identified using Shapiro-Wilk's test). When assumptions of normality and homogeneity of variances were not met (Shapiro-Wilk's test and Levene's test on the median, respectively), the Kruskal-Wallis test was used. When data were reported below multiple laboratory reporting limits (LRLs), the Wilcoxon Score test (WST) as used (Helsel 2012). Post-hoc contrasts following the ANOVA were conducted between the exposed area and each reference area using the contrast methods described in Oehlert (2010). Contrasts following the Kruskal-Wallis test were conducted using Dunn's test using the *dunn.test* package in R (Dinno 2017; R Core Team 2017). Contrasts for the WST were conducted as separate two-sample WST. The WST was conducted using the *cenfit* function of the *NADA* package in R (Lee 2017). Statistical comparisons were conducted using a significance level (α) of 0.05. P-values for the contrasts were Bonferroni adjusted for the $n = 2$ comparisons.

A magnitude of difference (MOD) was reported for statistical comparisons that were significant as:

$$MOD = \frac{(MCT_{Exp} - MCT_{Ref})}{MCT_{Ref}} \times 100\%$$

where *MCT* is the measure of central tendency (i.e., mean for the ANOVA after back-transforming to original data units when a transformation was used, and median for the Mann-Whitney test and WST). The median for the WST was estimated using the Kaplan-Meier method as described above.



3 SUPPORTING MEASURES

3.1 Field Measures

Mean temperature at the sediment sampling area of upper Minto Creek (2.6°C) was significantly higher than in upper McGinty Creek (1.9°C; Figure 3.1, Appendix Table B.3). Specific conductance was significantly higher in upper Minto Creek (481 micro Siemens per centimetres [$\mu\text{S}/\text{cm}$]) than in upper McGinty Creek (119 $\mu\text{S}/\text{cm}$; Figure 3.1, Appendix Table B.3). Dissolved oxygen (percentage and mg/L) was significantly lower at upper Minto Creek (70.0% saturation and 9.52 mg/L) than at upper McGinty Creek (84.9% saturation and 11.76 mg/L; Figure 3.1, Appendix Table B.3). The pH at upper Minto Creek (7.97) was significantly higher than reference area, upper McGinty Creek (7.49; Figure 3.1, Appendix Table B.3). Temperature at lower Minto Creek (4.5°C) was not significantly different from at the reference area, lower Wolverine Creek (5.5°C; Figure 3.1, Appendix Table B.3). Lower Minto Creek (329 $\mu\text{S}/\text{cm}$) had significantly higher specific conductance than compared to the lower Wolverine Creek reference (170 $\mu\text{S}/\text{cm}$; Figure 3.1; Appendix Table B.3). Lower Minto Creek had significantly higher dissolved oxygen (85.5% saturation and 11.25 mg/L) compared to lower Wolverine Creek (38.1% saturation and 4.93 mg/L; Figure 3.1, Appendix Table B.3). Lower dissolved oxygen at lower Wolverine Creek could be attributed to sampling in back eddies, which were the only areas that support sediment deposition. Lower Minto Creek had significantly higher pH (8.05) than lower Wolverine Creek (7.40; Figure 3.1, Appendix Table B.3).

Physico-chemical measurements were also taken in erosional areas of lower Minto, lower Wolverine, and lower Big creeks in support of benthic invertebrate community sampling. Temperature was the only parameter measured that was significantly lower at lower Minto Creek (2.6°C) compared to both reference areas, lower Wolverine (4.4°C) and lower Big Creek (6.6°C; Figure 3.2, Appendix Table B.4). No significant differences were observed between lower Minto Creek and both reference creeks for dissolved oxygen (percentage and mg/L), specific conductance, or pH (Figure 3.2). All areas were within the range of the WUL objective for pH.

3.2 Water Chemistry and Chlorophyll-a

The quality of water chemistry data was assessed prior to data analysis and interpretation, and was judged as good (Appendix A). Fluoride exceeded the interim CWQG in upper and lower Minto Creek and reference area, upper McGinty Creek (Table 3.1). Total copper concentrations (a metal of particular interest at the Minto Mine) were above CWQG at upper Minto Creek and reference areas lower Wolverine and lower Big creeks but dissolved copper was well below SSWQO set out in the WUL (Table 3.1, Appendix Table B.7).



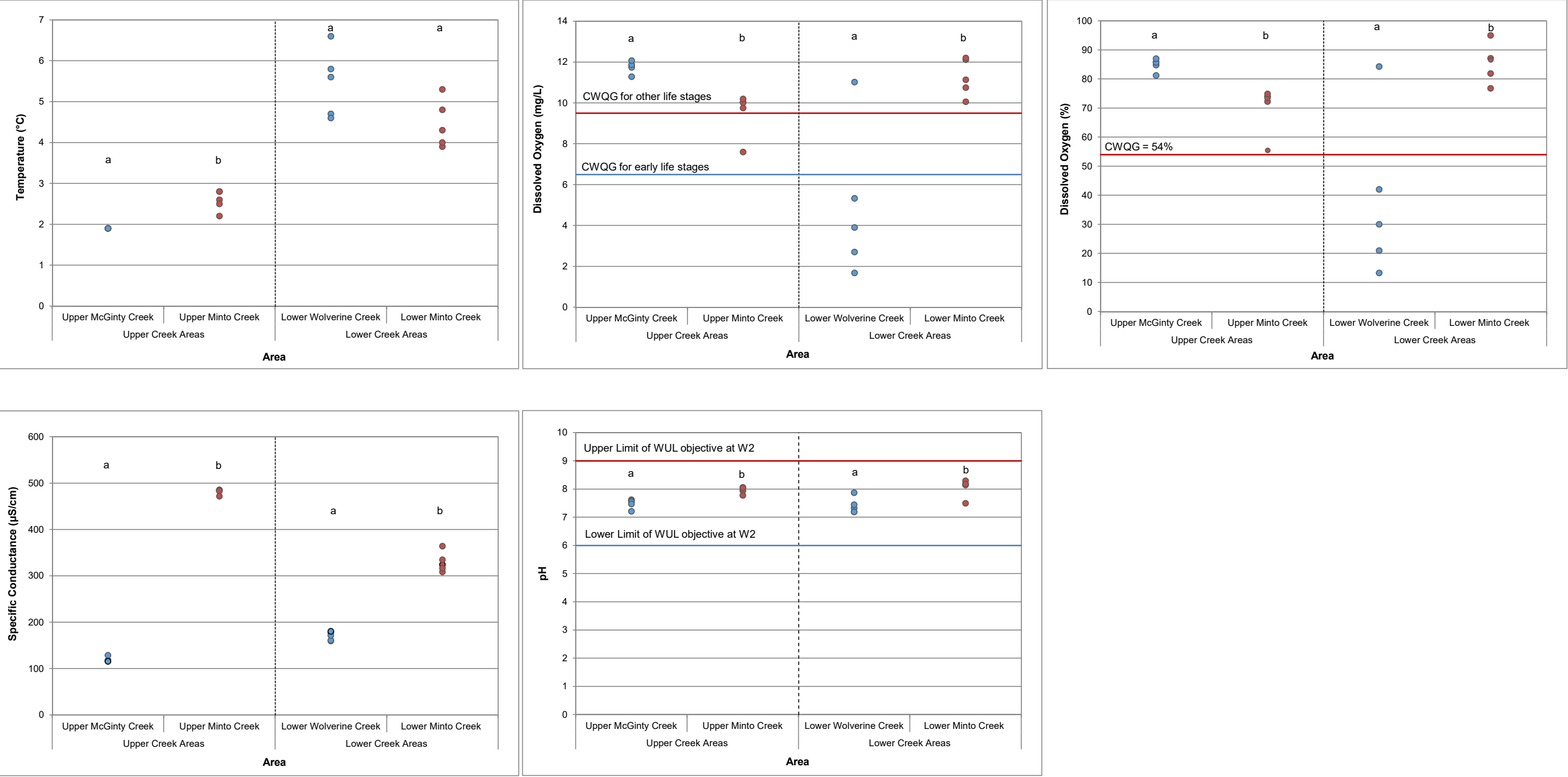


Figure 3.1: Physico-chemical Measurements in Depositional Areas of Upper and Lower Minto Creek Relative to Reference Areas, Minto Mine, 2018

Notes: Samples sizes were n = 5 in all areas (except for pH at upper Minto Creek, n = 4). Different letters represent a significant difference between areas within each creek area.

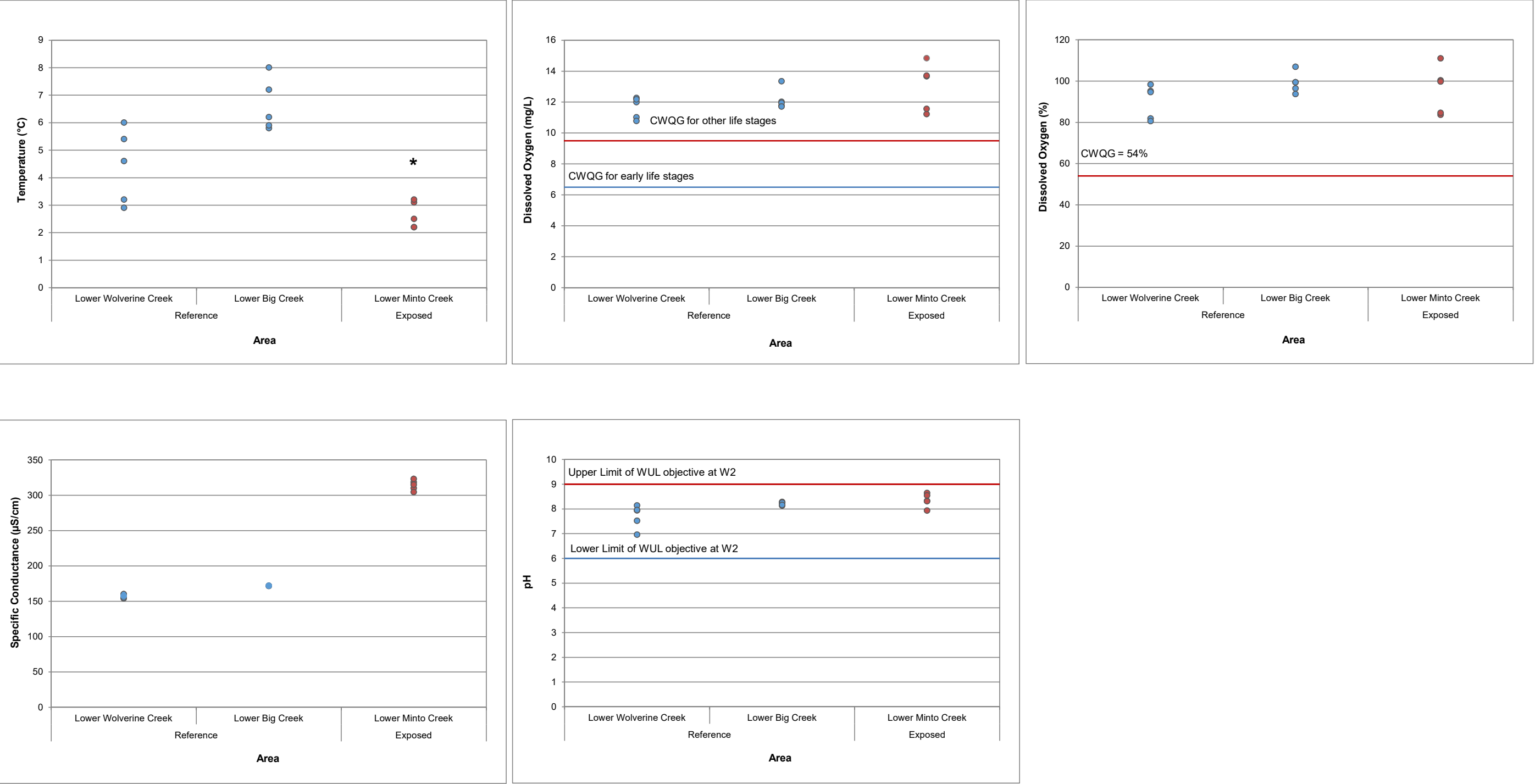


Figure 3.2: Physico-chemical Measurements in Erosional Areas in Lower Minto Creek and Reference Areas, Minto Mine, 2018

Notes: Samples sizes were n = 5 in all areas. Asterisk (*) indicates when lower Minto Creek was significantly different from lower Wolverine and lower Big creeks.

Table 3.1: Water Quality Results at Exposed and Reference Areas, Minto Mine WUL, September 2018

Analyte		Units	CCME Water Quality Guidelines ^a		WUL Objectives at W2	Upper McGinty Creek (Reference)	Upper Minto Creek (Exposed)	Lower Wolverine Creek (Reference)	Lower Big Creek (Reference)	Lower Minto Creek (Exposed)
			Long-term	Short-term						
Physical Tests	Conductivity	µS/cm	-	-	-	146	556	179	209	367
	Hardness (as CaCO ₃)	mg/L	-	-	-	68	256	82	95	179
	pH	pH Units	6.5 - 9.0	-	6.0 - 9.0	7.85	8.28	8.04	8.16	8.41
	Total Suspended Solids	mg/L	-	-	-	8.8	3.3	<3.0	<3.0	3.7
	Total Dissolved Solids	mg/L	-	-	-	121	344	144	147	237
	Turbidity	NTU	-	-	-	1.2	0.13	0.73	1.7	0.59
Anions and Nutrients	Total Alkalinity	mg/L	-	-	-	61	249	81	96	178
	Total Ammonia (as N)	mg/L	0.41 ^b	-	0.25	<0.0050	<0.0050	0.0053	<0.0050	<0.0050
	Bromide (Br)	mg/L	-	-	-	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl)	mg/L	120	640	-	<0.50	4.5	<0.50	<0.50	1.6
	Fluoride (F)	mg/L	0.12	-	-	0.26	0.53	0.12	0.11	0.42
	Nitrate (as N)	mg/L	3.0	124	9.1	0.054	0.11	0.020	0.063	0.053
	Nitrite (as N)	mg/L	0.060	-	0.060	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Phosphorus (P)-Total dissolved	mg/L	-	-	-	0.011	0.0052	0.0072	0.0037	0.0061
	Phosphorus (P)-Total	mg/L	-	-	-	0.012	0.024	0.010	0.0042	0.0069
	Sulfate (SO ₄)	mg/L	-	-	-	10	58	13	15	22
Other	Total Cyanide	mg/L	-	-	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Dissolved Organic Carbon	mg/L	-	-	-	17	6.4	17	7.8	8.7
	Total Inorganic Carbon	mg/L	-	-	-	14	60	17	22	41
	Total Organic Carbon	mg/L	-	-	-	16	6.2	18	7.6	8.7
Total Metals	Total Aluminum (Al)	mg/L	0.10 ^c	-	-	0.028	0.010	0.076	0.062	0.0088
	Total Antimony (Sb)	mg/L	-	-	-	<0.00010	<0.00010	0.00010	0.00015	<0.00010
	Total Arsenic (As)	mg/L	0.0050	-	-	0.00041	0.00026	0.00047	0.00086	0.00049
	Total Barium (Ba)	mg/L	-	-	-	0.029	0.064	0.034	0.062	0.059
	Total Beryllium (Be)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Total Bismuth (Bi)	mg/L	-	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Total Boron (B)	mg/L	1.5	29	-	<0.010	0.023	<0.010	<0.010	<0.010
	Total Cadmium (Cd)	mg/L	0.00012 ^d	0.0014 ^d	-	<0.0000050	<0.0000050	<0.0000050	0.0000062	<0.0000050
	Total Calcium (Ca)	mg/L	-	-	-	18	58	18	22	43
	Total Cesium (Cs)	mg/L	-	-	-	<0.000010	<0.000010	<0.000010	0.000015	<0.000010
	Total Chromium (Cr)	mg/L	0.0010 Cr(VI)	-	-	0.00039	0.00019	0.00058	0.00044	0.00031
	Total Cobalt (Co)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Total Copper (Cu)	mg/L	0.0020 ^d	-	-	0.0014	0.0041	0.0023	0.0022	0.0018
	Total Iron (Fe)	mg/L	0.30	-	-	0.23	0.019	0.21	0.086	0.059
	Total Lead (Pb)	mg/L	0.0020 ^d	-	-	<0.000050	<0.000050	<0.000050	0.000056	<0.000050
	Total Lithium (Li)	mg/L	-	-	-	<0.0010	0.0030	0.0015	0.0014	0.0016
	Total Magnesium (Mg)	mg/L	-	-	-	5.9	31	10	9.0	17
	Total Manganese (Mn)	mg/L	-	-	-	0.013	0.040	0.0071	0.0093	0.0022
	Total Mercury (Hg)	mg/L	0.000026	-	-	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Total Molybdenum (Mo)	mg/L	0.073	-	-	0.00091	0.0046	0.00042	0.0012	0.0016
	Total Nickel (Ni)	mg/L	0.071 ^d	-	-	0.00096	0.00099	0.0018	0.0011	0.00090
	Total Phosphorus (P)	mg/L	-	-	-	<0.050	<0.050	<0.050	<0.050	<0.050
	Total Potassium (K)	mg/L	-	-	-	0.41	2.4	0.58	0.78	1.5
	Total Rubidium (Rb)	mg/L	-	-	-	<0.00020	0.00032	0.00044	0.00075	0.00052
	Total Selenium (Se)	mg/L	0.0010	-	-	0.00026	0.00017	0.00013	0.000067	0.00015
	Total Silicon (Si)	mg/L	-	-	-	5.8	3.8	5.3	5.8	5.6
	Total Silver (Ag)	mg/L	0.00025	-	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Total Sodium (Na)	mg/L	-	-	-	3.9	19	6.5	6.6	10
	Total Strontium (Sr)	mg/L	-	-	-	0.13	0.71	0.16	0.23	0.43
	Total Sulfur (S)	mg/L	-	-	-	3.0	11	4.4	4.2	6.8
	Total Tellurium (Te)	mg/L	-	-	-	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Total Thallium (Tl)	mg/L	0.00080	-	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Total Thorium (Th)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Total Tin (Sn)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Total Titanium (Ti)	mg/L	-	-	-	<0.00090	0.00034	<0.0027	0.0017	<0.00060
	Total Tungsten (W)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Total Uranium (U)	mg/L	0.015	0.033	-	0.00035	0.0028	0.00052	0.0023	0.0020
	Total Vanadium (V)	mg/L	-	-	-	0.00055	<0.00050	0.0011	0.00084	0.00075
	Total Zinc (Zn)	mg/L	0.024 ^e	0.11 ^e	-	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Total Zirconium (Zr)	mg/L	-	-	-	0.00041	0.00011	0.00055	0.00024	0.00015

- Water quality guideline not met.
- Water use licence objectives not met.
- Water quality guideline and water use licence objectives not met.

^a CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Environmental Quality Guidelines. 1999 (plus updates), Canadian Council of Ministers of the Environment, Winnipeg. See Appendix Table B.6 for explanatory notes on selected water quality guidelines.

^b Based on lowest guideline using highest temperature and pH.

^c Based on lowest guideline using highest pH.

^d Based on lowest guideline using lowest hardness.

^e Based on guideline using 25th percentile of hardness, DOC, and field pH.

^f Dissolved Cadmium (µg/L) guidelines based on the following formula using the lowest hardness: e(0.736(ln(Hardness)))-4.943).

^g Dissolved Copper water quality objective depends on concentration of dissolved organic carbon (DOC). If DOC is > 10 mg/L/ DOC is ≤ 10 mg/L..

Table 3.1: Water Quality Results at Exposed and Reference Areas, Minto Mine WUL, September 2018

Analyte		Units	CCME Water Quality Guidelines ^a		WUL Objectives at W2	Upper McGinty Creek (Reference)	Upper Minto Creek (Exposed)	Lower Wolverine Creek (Reference)	Lower Big Creek (Reference)	Lower Minto Creek (Exposed)
			Long-term	Short-term						
Dissolved Metals	Dissolved Aluminum (Al)	mg/L	-	-	0.10	0.025	<0.0020	0.029	0.016	<0.0040
	Dissolved Antimony (Sb)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	0.00014	<0.00010
	Dissolved Arsenic (As)	mg/L	-	-	0.0050	0.00039	0.00025	0.00043	0.00074	0.00045
	Dissolved Barium (Ba)	mg/L	-	-	-	0.028	0.068	0.030	0.060	0.059
	Dissolved Beryllium (Be)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Dissolved Bismuth (Bi)	mg/L	-	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Dissolved Boron (B)	mg/L	-	-	-	<0.010	0.022	<0.010	<0.010	<0.010
	Dissolved Cadmium (Cd)	mg/L	-	-	0.00016 ^f	<0.0000050	0.0000062	0.0000052	0.0000064	<0.0000050
	Dissolved Calcium (Ca)	mg/L	-	-	-	18	55	17	22	44
	Dissolved Cesium (Cs)	mg/L	-	-	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Dissolved Chromium (Cr)	mg/L	-	-	0.0010	0.00038	<0.00010	0.00048	0.00019	0.00019
	Dissolved Cobalt (Co)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Dissolved Copper (Cu)	mg/L	-	-	0.020/0.013 ^g	0.0014	0.0028	0.0020	0.0019	0.0016
	Dissolved Iron (Fe)	mg/L	-	-	1.1	0.19	0.014	0.14	0.032	0.040
	Dissolved Lead (Pb)	mg/L	-	-	0.0040	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Dissolved Lithium (Li)	mg/L	-	-	-	<0.0010	0.0029	0.0014	0.0013	0.0015
	Dissolved Magnesium (Mg)	mg/L	-	-	-	5.5	29	9.5	9.7	17
	Dissolved Manganese (Mn)	mg/L	-	-	-	0.012	0.037	0.0045	0.0067	0.00087
	Dissolved Mercury (Hg)	mg/L	-	-	-	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Dissolved Molybdenum (Mo)	mg/L	-	-	0.073	0.00088	0.0050	0.00045	0.0012	0.0017
	Dissolved Nickel (Ni)	mg/L	-	-	0.11	0.00094	0.00092	0.0016	0.00088	0.00084
	Dissolved Phosphorus (P)	mg/L	-	-	-	<0.050	<0.050	<0.050	<0.050	<0.050
	Dissolved Potassium (K)	mg/L	-	-	-	0.41	2.3	0.55	0.78	1.5
	Dissolved Rubidium (Rb)	mg/L	-	-	-	<0.00020	0.00028	0.00033	0.00063	0.00050
	Dissolved Selenium (Se)	mg/L	-	-	0.0020	0.00028	0.00033	0.000077	0.000071	0.00016
	Dissolved Silicon (Si)	mg/L	-	-	-	5.7	5.8	5.0	5.9	5.9
	Dissolved Silver (Ag)	mg/L	-	-	0.00010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Dissolved Sodium (Na)	mg/L	-	-	-	3.7	18	6.1	6.7	9.8
	Dissolved Strontium (Sr)	mg/L	-	-	-	0.12	0.77	0.16	0.25	0.46
	Dissolved Sulfur (S)	mg/L	-	-	-	3.0	19	4.2	4.8	7.9
	Dissolved Tellurium (Te)	mg/L	-	-	-	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Dissolved Thallium (Tl)	mg/L	-	-	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Dissolved Thorium (Th)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Dissolved Tin (Sn)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Dissolved Titanium (Ti)	mg/L	-	-	-	0.00061	<0.00030	<0.00090	<0.00030	<0.00030
	Dissolved Tungsten (W)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Dissolved Uranium (U)	mg/L	-	-	-	0.00035	0.0027	0.00048	0.0022	0.0019
	Dissolved Vanadium (V)	mg/L	-	-	-	<0.00050	<0.00050	0.00088	0.00070	0.00059
	Dissolved Zinc (Zn)	mg/L	-	-	0.030	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Dissolved Zirconium (Zr)	mg/L	-	-	-	0.00040	0.000090	0.00049	0.00024	0.00015

- Water quality guideline not met.
- Water use licence objectives not met.
- Water quality guideline and water use licence objectives not met.

^a CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Environmental Quality Guidelines. 1999 (plus updates), Canadian Council of Ministers of the Environment, Winnipeg. See Appendix Table B.6 for explanatory notes on selected water quality guidelines.

^b Based on lowest guideline using highest temperature and pH.

^c Based on lowest guideline using highest pH.

^d Based on lowest guideline using lowest hardness.

^e Based on guideline using 25th percentile of hardness, DOC, and field pH.

^f Dissolved Cadmium (µg/L) guidelines based on the following formula using the lowest hardness: $e(0.736(\ln(\text{Hardness})-4.943))$.

^g Dissolved Copper water quality objective depends on concentration of dissolved organic carbon (DOC). If DOC is > 10 mg/L/ DOC is ≤ 10 mg/L.

Chlorophyll-a data quality was assessed prior to data analysis and interpretation, and was judged as good (Appendix A). Concentrations of periphyton chlorophyll-a were not significantly different between lower Minto Creek (55 milligram per metre squared [mg/m^2]) and lower Wolverine Creek ($43 \text{ mg}/\text{m}^2$; Figure 3.3, Appendix Table B.8) but was below the BCWQG of $100 \text{ mg}/\text{m}^2$ for the protection of aquatic life (BCMOE 1985). Station LWC-5 (reference) had higher concentrations of chlorophyll-a compared to guidelines, but overall both areas were below guidelines and did not differ significantly (Figure 3.3, Appendix Table B.8). Chlorophyll-a concentrations have been variable over time and between areas but concentrations are often higher (but not always significantly different and below BCWQG) at lower Minto Creek (Appendix Figure B.1). Dodd's et al (1998) classification system sets the trophic status of lower Minto ($55 \text{ mg}/\text{m}^2$) and lower Wolverine creeks ($43 \text{ mg}/\text{m}^2$) as mesotrophic. Based on only total phosphorus, both creeks would be defined as oligotrophic as was observed in previous years (Dodds et al. 1998).

3.3 Summary

Supporting measures collected in September 2018 indicated good Minto Creek water quality. Influence of the Minto Mine was evident in higher specific conductance and pH than in reference creeks, but water quality concentrations were lower than SSWQO. Concentration of total copper at upper Minto Creek was higher than CWQG and the reference area but dissolved copper was much lower than the SSWQO. Total copper concentrations were lower than CWQG at lower Minto Creek but were higher than CWQG at lower Wolverine and lower Big creeks (reference areas) indicating concentrations might be natural. Mean concentrations of chlorophyll-a were not significantly different between areas and were below BCWQG. Production classification at the exposure and reference areas were different from 2017 (lower Minto Creek was mesotrophic and lower Wolverine Creek was oligotrophic) as lower Minto and lower Wolverine creeks were defined as mesotrophic.



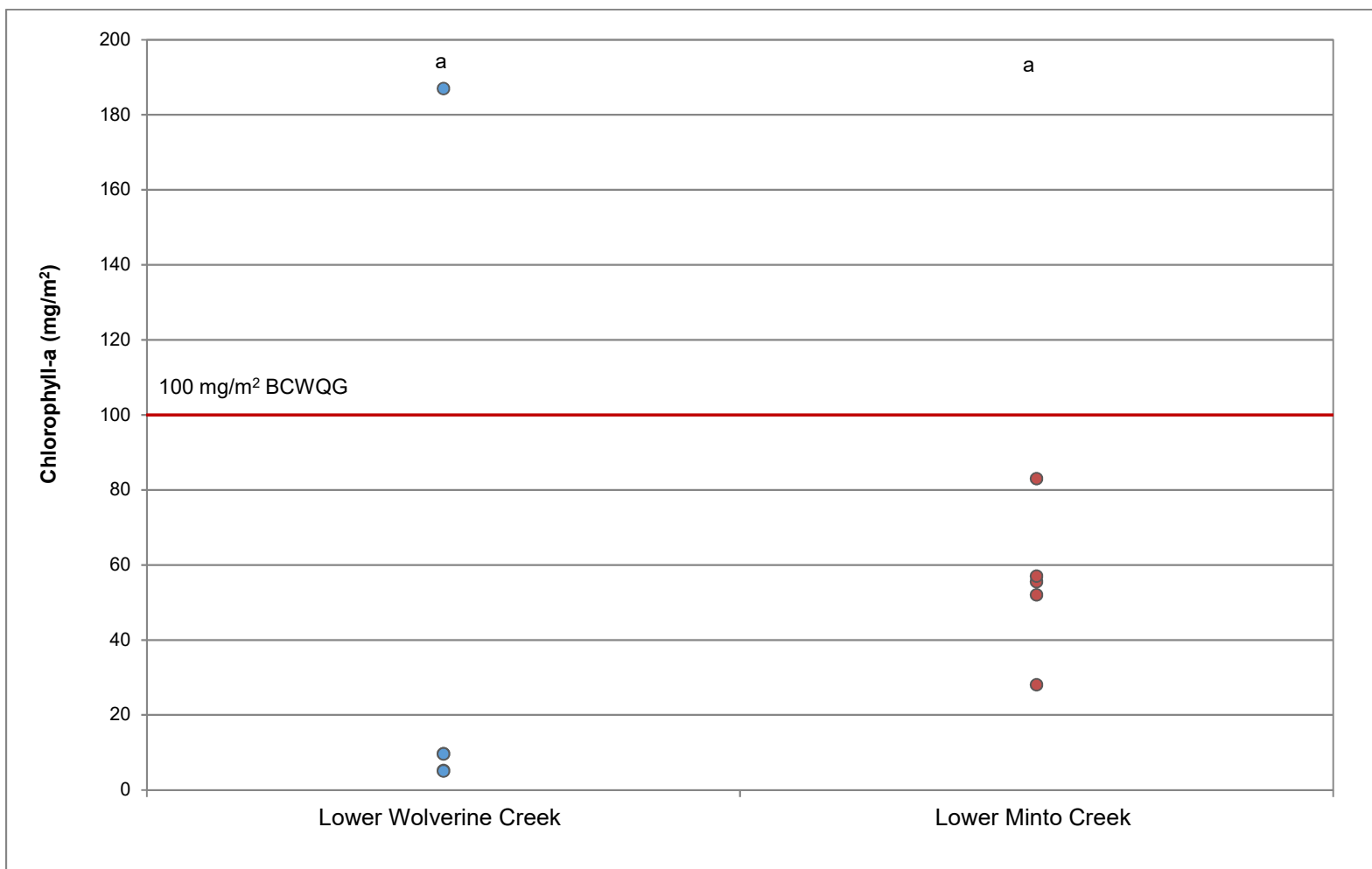


Figure 3.3: Concentrations of Chlorophyll-a in Periphyton at Lower Wolverine and Lower Minto Creeks, Minto Mine WUL, 2018

Notes: Different letters represent significant differences between areas. Sample size = 5.

4 SEDIMENT QUALITY

4.1 Sediment Particle Size and Chemistry

Sediment data quality were assessed prior to data analysis and interpretation, and were judged as good, except for a lack of agreement between field duplicates for particle size and other physical tests (Appendix A). Sediments collected in 2018 were largely composed of fine particles in the silt and sand size categories (Figure 4.1, Table 4.1, Appendix Table C.1). Mean total organic carbon (TOC) content of sediment collected from upper Minto Creek (2.9%) was slightly lower (but not significantly) than at the upper McGinty Creek reference area (3.8%; Table 4.1). Lower Minto Creek had lower (but not significantly) TOC (4.1%) than the lower Wolverine Creek reference area (6.4%; Table 4.1). Arsenic and copper were the only analytes with mean concentrations greater than Interim Sediment Quality Guidelines (ISQG) for the protection of aquatic life (CCME 1999) in an effluent-exposed area (Table 4.1, Appendix Table C.1). However, mean arsenic concentration in upper Minto Creek was below ISQG and lower than the reference area, upper McGinty Creek (which was greater than ISQG). This suggests that arsenic concentrations were unrelated to the Minto Mine. Mean copper concentration in upper Minto Creek was above the Probable Effect Level (PEL) and lower Minto Creek was greater than the ISQG. Concentrations of copper at lower Wolverine Creek were also above the ISQG (Figure 4.2, Table 4.1). With progression from upper to lower Minto Creek, sediment copper concentrations decreased from a mean of 210 to 45 milligram per kilogram (mg/kg), respectively, indicating improvement with distance downstream.

Due to the predominantly erosional habitat in upper Minto Creek, relatively few areas had deposited sediment and even this only occurred in small quantities that likely wash away each year during freshet. Therefore, elevated copper in fine sediment in the upper reaches of Minto Creek may be of limited importance in terms of exposure and potential effects to biota. In lower Minto Creek, fine sediment deposits were somewhat more common and therefore more relevant to aquatic life.

4.2 Temporal Comparisons

Particle size distribution in 2018 was similar to the distribution observed from 2010 to 2017 but was notably different from data collected prior to 2010, which employed different sampling methodology (Figure 4.1). Mean copper concentration at upper Minto Creek in 2018 was greater than the PEL and most previous years (except 2016), including the 1994 baseline that was greater than the ISQG (Figure 4.2). At lower Minto Creek, mean copper concentration in 2018 was greater than ISQG as was the case during most years, and was greater than 1994 baseline (Figure 4.2, Table 4.1, Appendix Table C.1). This does not necessarily indicate an influence of



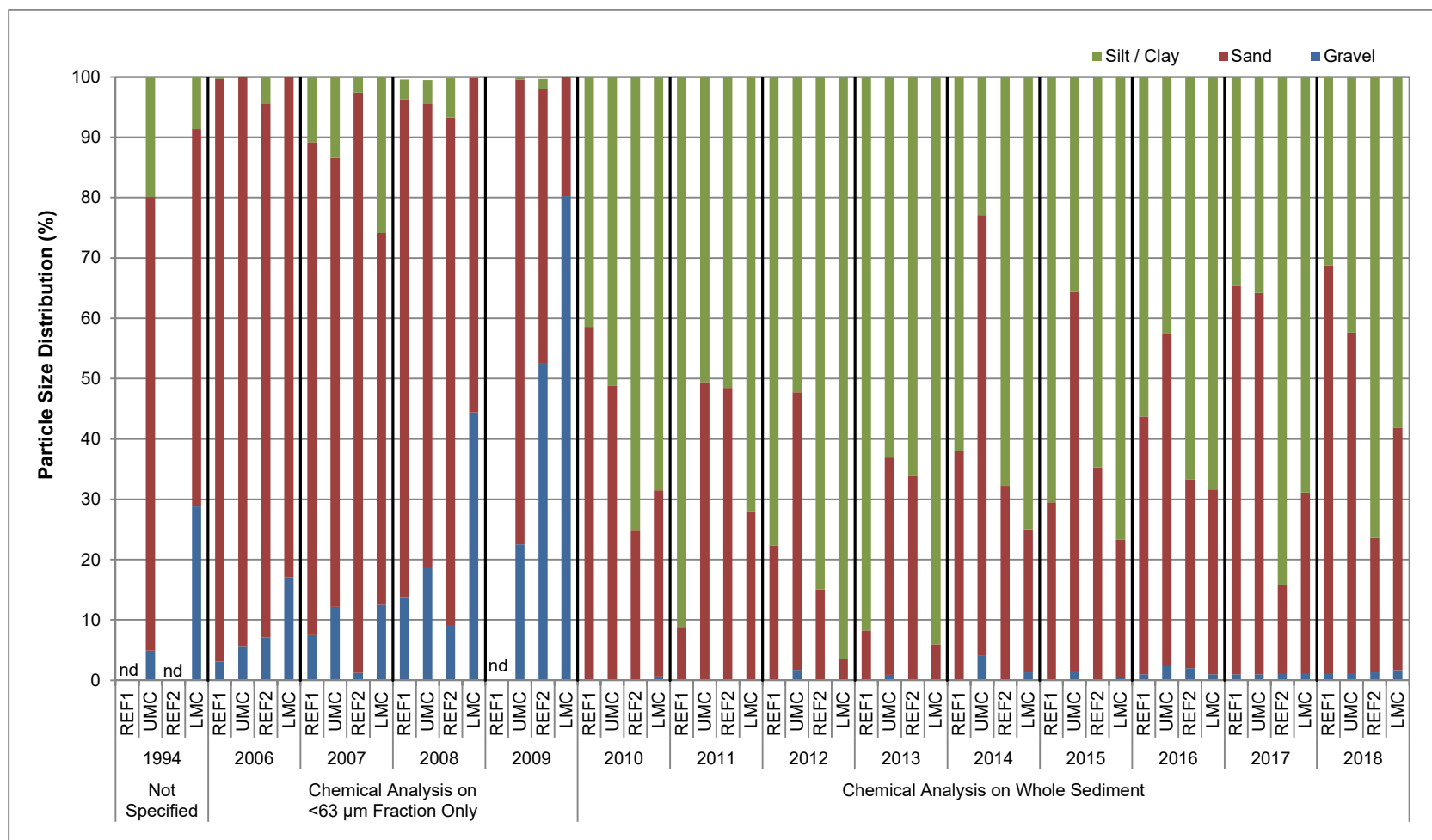


Figure 4.1: Particle Size Distribution of Sediment Collected in Minto Creek and Reference Locations, 1994 to 2018¹

Notes:

Methods used in 1994 were not specified, fine sediment was collected in triplicate in the mainstem of Minto Creek (HKP 1994).

nd = no data.

¹ REF1 = Station W6 (south-flowing tributary) in 2006 to 2008 and McGinty Creek in 2010 to 2018; UMC = Upper Minto Creek; REF2 = Station W7 (north-flowing tributary) in 2006 to 2009 and Wolverine Creek in 2010 to 2018; LMC = Lower Minto Creek.

Table 4.1: Summary of Sediment Chemistry Data Collected at Reference and Exposed Areas, Minto Mine WUL, 2018

Analytes		Units	CSQG ^a		Upper McGinty Creek (Reference)				Upper Minto Creek (Exposed)				Lower Wolverine Creek (Reference)				Lower Minto Creek (Exposed)			
			ISQG	PEL	Mean	Standard Deviation	Minimum	Maximum	Mean	Standard Deviation	Minimum	Maximum	Mean	Standard Deviation	Minimum	Maximum	Mean	Standard Deviation	Minimum	Maximum
Particle size, TKN, carbon analytes and pH	Loss on Ignition	%	-	-	8.4	4.3	4.0	13	7.4	2.3	4.0	10	14	2.5	11	18	8.6	4.0	3.0	13
	pH (1:2 soil:water)	pH units	-	-	7.00	0.42	6.59	7.66	8.10	0.16	7.83	8.23	6.76	0.45	6.50	7.57	7.78	0.12	7.66	7.95
	% Gravel (>2 mm)	%	-	-	-	-	-	-	-	-	-	-	1.3	0.72	<1.0	2.6	1.7	1.5	<1.0	4.3
	% Sand (2.0 mm - 0.063 mm)	%	-	-	-	-	-	-	-	-	-	-	22	5.2	18	31	40	18	23	68
	% Silt (0.063 mm - 4 µm)	%	-	-	-	-	-	-	-	-	-	-	70	5.4	62	75	51	15	28	65
	% Clay (<4 µm)	%	-	-	-	-	-	-	-	-	-	-	7.4	1.8	5.7	11	8.3	2.6	3.8	10
	Total Kjeldahl Nitrogen	%	-	-	0.20	0.12	0.098	0.37	0.18	0.049	0.090	0.21	0.39	0.065	0.29	0.47	0.20	0.086	0.086	0.30
	Inorganic Carbon	%	-	-	0.099	0.034	0.071	0.15	0.12	0.033	0.071	0.15	0.15	0.013	0.13	0.17	0.15	0.049	0.076	0.21
	Inorganic Carbon (as CaCO ₃ Equivalent)	%	-	-	0.82	0.28	0.59	1.3	1.0	0.28	0.59	1.3	1.2	0.11	1.1	1.4	1.2	0.41	0.63	1.7
	Total Carbon by Combustion	%	-	-	3.9	2.0	2.1	6.5	3.0	1.1	1.5	4.1	6.5	0.90	5.1	7.5	4.2	2.1	1.6	6.6
	Total Organic Carbon	%	-	-	3.8	1.9	2.0	6.3	2.9	1.1	1.4	4.0	6.4	0.90	5.0	7.3	4.1	2.0	1.5	6.4
Total Metals	Aluminum (Al)	mg/kg	-	-	10,300	2,608	6,770	13,100	12,280	1,921	10,600	15,400	17,620	2,338	14,100	20,000	13,820	1,993	11,000	15,800
	Antimony (Sb)	mg/kg	-	-	0.34	0.058	0.27	0.42	0.48	0.18	0.34	0.79	0.49	0.11	0.39	0.68	0.49	0.082	0.36	0.57
	Arsenic (As)	mg/kg	5.9	17	7.7	1.7	5.3	10	5.9	1.1	4.8	7.6	6.8	2.2	5.2	10	7.7	1.4	5.8	9.1
	Barium (Ba)	mg/kg	-	-	183	53	113	254	255	86	159	333	264	65	201	367	237	49	175	299
	Beryllium (Be)	mg/kg	-	-	0.30	0.075	0.21	0.39	0.44	0.082	0.37	0.57	0.73	0.10	0.63	0.87	0.48	0.074	0.39	0.58
	Bismuth (Bi)	mg/kg	-	-	<0.2	0	<0.20	<0.20	<0.2	0	<0.20	<0.20	<0.2	0	<0.20	<0.20	<0.2	0	<0.20	<0.20
	Boron (B)	mg/kg	-	-	<5.0	0	<5.0	<5.0	<5.0	0	<5.0	<5.0	5.0	0.045	<5.0	5.1	<5.0	0	<5.0	<5.0
	Cadmium (Cd)	mg/kg	0.60	3.5	0.14	0.055	0.086	0.20	0.25	0.10	0.13	0.37	0.27	0.063	0.22	0.37	0.21	0.040	0.17	0.27
	Calcium (Ca)	mg/kg	-	-	7,380	2,287	5,250	10,700	8,818	1,564	7,590	11,500	10,808	3,064	7,850	15,900	9,654	1,697	7,770	11,900
	Chromium (Cr)	mg/kg	37	90	21	4.6	16	27	30	1.6	28	32	47	6.7	40	56	32	4.8	24	37
	Cobalt (Co)	mg/kg	-	-	8.3	1.9	6.2	11	11	2.2	8.9	14	14	1.1	13	16	11	0.88	9.9	12
	Copper (Cu)	mg/kg	36	197	18	5.7	11	24	210	136	72	403	38	20	25	74	45	16	20	60
	Iron (Fe)	mg/kg	-	-	23,640	4,191	17,800	29,500	25,140	3,424	21,600	29,900	29,840	3,208	25,700	33,800	26,320	2,296	23,500	29,100
	Lead (Pb)	mg/kg	35	91	3.9	0.83	2.9	4.9	5.7	0.86	4.8	7.0	6.7	0.82	5.7	7.7	5.6	0.59	4.9	6.3
	Lithium (Li)	mg/kg	-	-	6.0	1.4	4.1	7.7	8.2	1.4	6.9	10	11	1.3	9.0	12	9.2	0.97	7.9	10
	Magnesium (Mg)	mg/kg	-	-	4,106	802	3,030	5,070	6,996	984	5,980	8,620	9,746	813	8,670	10,700	7,436	994	5,910	8,610
	Manganese (Mn)	mg/kg	-	-	570	258	280	953	2,855	1,912	897	4,830	718	732	243	1,980	1,106	322	619	1,500
	Mercury (Hg)	mg/kg	0.17	0.49	0.056	0.050	0.022	0.14	0.025	0.0086	0.018	0.039	0.051	0.0069	0.043	0.059	0.044	0.016	0.032	0.071
	Molybdenum (Mo)	mg/kg	-	-	0.57	0.074	0.45	0.64	1.9	0.96	0.86	2.8	0.70	0.20	0.49	1.0	0.71	0.14	0.49	0.84
	Nickel (Ni)	mg/kg	-	-	16	3.1	12	20	29	3.8	25	35	39	2.7	36	43	29	3.7	23	32
	Phosphorus (P)	mg/kg	-	-	903	159	638	1,040	1,022	55	979	1,100	1,124	155	1,010	1,390	879	87	770	976
	Potassium (K)	mg/kg	-	-	664	130	490	820	1,366	334	1,020	1,840	1,162	237	850	1,500	1,154	257	760	1,410
	Selenium (Se)	mg/kg	-	-	0.54	0.21	0.35	0.87	0.60	0.28	0.33	0.99	0.51	0.29	0.28	1.0	0.53	0.19	0.28	0.80
	Silver (Ag)	mg/kg	-	-	<0.10	0	<0.10	<0.10	0.13	0.037	<0.010	0.19	0.12	0.021	<0.10	0.15	0.10	0	<0.10	0.10
	Sodium (Na)	mg/kg	-	-	202	37	149	240	350	45	312	426	405	54	339	455	308	30	261	342
	Strontium (Sr)	mg/kg	-	-	62	14	48	85	96	22	73	128	116	38	82	180	107	22	81	133
	Thallium (Tl)	mg/kg	-	-	0.060	0.010	<0.050	0.075	0.088	0.017	0.072	0.11	0.098	0.021	<0.050	0.12	0.085	0.019	0.057	0.10
	Tin (Sn)	mg/kg	-	-	<2.0	0	<2.0	<2.0	<2.0	0	<2.0	<2.0	<2.0	0	<2.0	<2.0	<2.0	0	<2.0	<2.0
	Titanium (Ti)	mg/kg	-	-	639	101	507	750	705	75	636	824	860	107	720	969	730	77	626	808
	Uranium (U)	mg/kg	-	-	1.2	0.71	0.59	2.4	0.92	0.36	0.68	1.5	2.5	0.42	1.9	3.0	1.2	0.29	0.86	1.6
	Vanadium (V)	mg/kg	-	-	46	6.5	40	55	57	6.2	50	63	69	5.4	62	75	57	4.6	52	62
	Zinc (Zn)	mg/kg	123	315	41	8.3	30	51	66	14	51	85	69	5.0	63	75	59	6.4	53	66

- Indicates sediment concentration exceeding CSQG ISQG.
- Indicates sediment concentration exceeding CSQG PEL.
- Indicates sediment concentration exceeding higher reference mean by more than two times.
- Indicates sediment concentration exceeding higher reference mean by more than two times and higher than CSQG ISQG and/or PEL.

^a Canadian Sediment Quality Guidelines: ISQG = interim sediment quality guideline; PEL = probable effect level (CCME 1999).

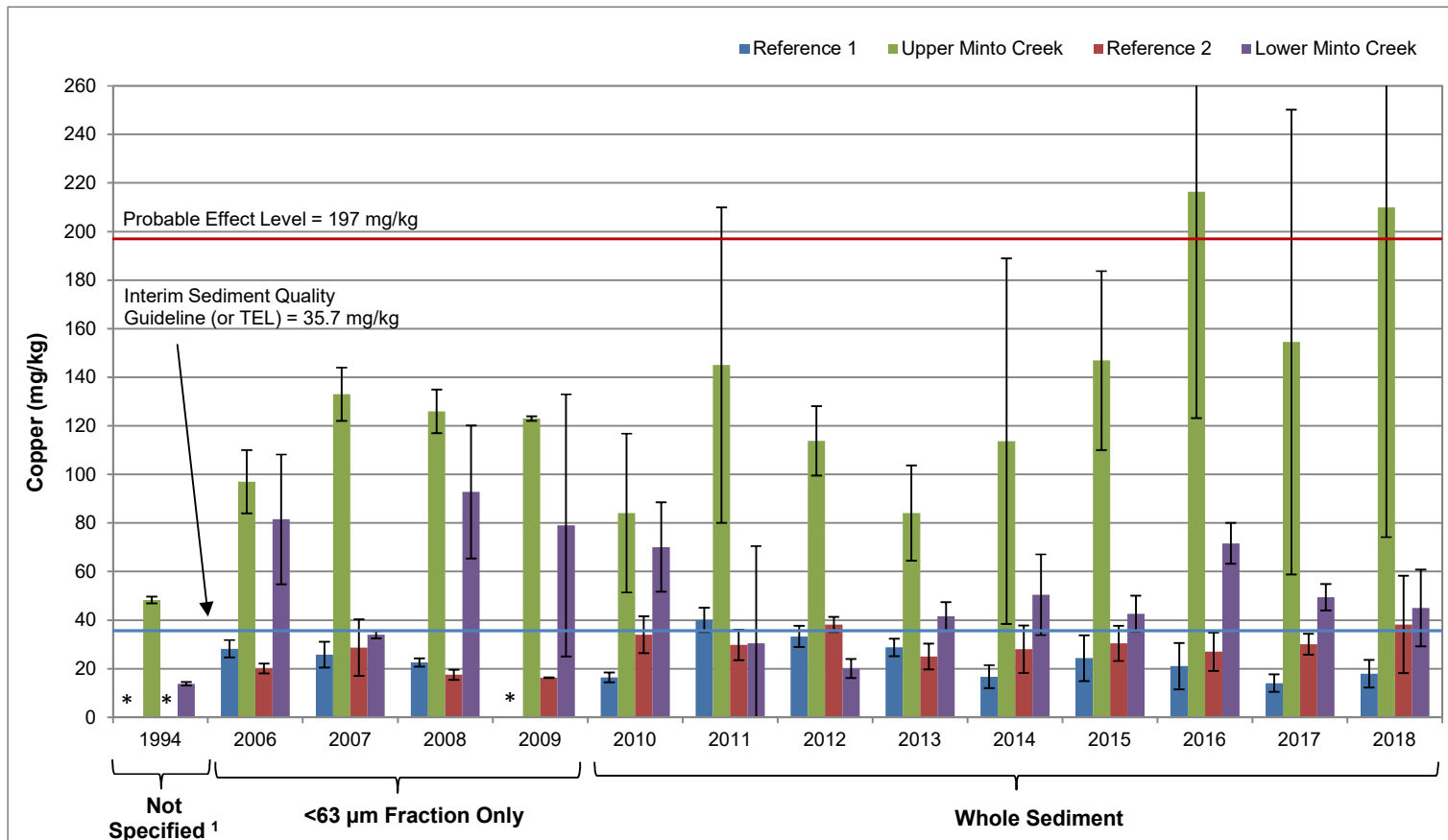


Figure 4.2: Copper Concentrations (Mean $\pm$ Standard Deviation) in Sediment Collected in Minto Creek and Reference Locations, 1994 to 2018 ²

Note: TEL = Threshold Effect Level.

¹ Methods were not specified, fine sediment was collected in triplicate in the mainstem of Minto Creek (HKP 1994).

² Reference 1 = Station W6 (south-flowing tributary) in 2006 to 2008 and McGinty Creek in 2010 to 2018; Reference 2 = Station W7 (north-flowing tributary) in 2006 to 2009 and Wolverine Creek in 2010 to 2018.

* = no data.

the Minto Mine as concentrations were within the historical range and sampling methodology applied in 1994 was unspecified.

4.3 Sediment Toxicity

Sediment toxicity test conditions and associated supporting water quality parameters were all within the range outlined in the test protocols, and testing was judged to be acceptable (Appendix A). Survival and growth were evaluated using the 10-day test of *C. dilutus* (midge) and the 14-day test of *H. azteca* (amphipod).

No effects to *H. azteca* survival or growth were observed (Table 4.2). *H. azteca* results (no effects in 2018) were similar to those of 2011 and 2015 to 2017 (Minnow 2012, 2016, 2017, 2018a). Survival of *C. dilutus* was significantly lower in sediment collected from lower Minto Creek than in laboratory control sediment (sand) and field reference sediment (lower Wolverine Creek; Table 4.2). Survival at lower Minto Creek was leveraged by one station that had higher mortalities (50%) than the remaining four stations with lower mortalities (20% to 30%). Growth of *C. dilutus* was not significantly different between lower Minto Creek and the reference sediment. In previous years, growth was only significantly different in 2017, whereas survival was significantly different between areas in 2017 and 2018 but not in 2011, 2015, and 2016. Temporal comparisons show differences in responses despite similar sediment chemistry.

4.4 Summary

Overall, concentrations of metals in Minto Creek sediments were similar to reference and lower than sediment quality guidelines with the exception of copper. Concentrations of copper in Minto Creek (both upper and lower) were greater than the sediment quality guideline and reference. Copper concentrations in sediment were similar to results seen after the methodology change and lower than concentrations in 2008. Sediment toxicity testing of *C. dilutus* suggested adverse effects to survival (but not growth) in lower Minto Creek sediment when compared to the laboratory control and the field reference (lower Wolverine Creek). No effects to *H. azteca* were observed.



Table 4.2: Minto Mine Sediment Toxicity Test Results for Lower Wolverine and Lower Minto Creeks, September 2018

Area	<i>Hyalella azteca</i>		<i>Chironomus dilutus</i>	
	Survival (%)	Dry Weight (mg)	Survival (%)	Dry Weight (mg)
Control Sediment	96 ± 5.5	0.21 ± 0.020	92 ± 4.5	2.20 ± 0.090
Lower Wolverine Creek (Reference)	100 ± 0	0.26 ± 0.060	88 ± 8.4	2.64 ± 0.51
Lower Minto Creek (Exposed)	94 ± 5.5	0.27 ± 0.020	70 ± 12.2	2.98 ± 0.31

- Significantly different than control sediment.
- Significantly different than reference sediment.
- Significantly different than reference and control sediment.

Note: Data presented as mean ± standard deviation.

5 PERIPHYTON COMMUNITY

5.1 Primary Metrics and Community Composition

The quality of periphyton community data was assessed prior to data analysis and interpretation and judged as good (Appendix A). Analysis of the periphyton community on the basis of density (cells/cm²) indicated that all five periphyton community metrics (density, taxon richness, Simpson's Diversity and Evenness, and Bray-Curtis index) were not significantly differently between lower Minto and lower Wolverine creeks (Table 5.1a, Appendix Tables D.1 and D.3). This indicates that periphyton community at lower Minto Creek was not significantly different from reference areas.

Analysis of the periphyton community based on biomass (µg/cm²) indicated that three out of five metrics (density, Simpson's Evenness, and Bray-Curtis index) were significantly different at lower Minto Creek compared to lower Wolverine Creek. Lower Minto Creek had higher density, lower evenness, and higher Bray-Curtis Index (indication of differences in community structure; Table 5.1b, Appendix Tables D.2 and D.4).

Dominant phyla in lower Minto and Wolverine creeks were Bacillariophyceae (diatoms) and Cyanophyta (blue-green algae). Bacillariophyceae was dominant at lower Minto Creek (85% of community) and lower Wolverine Creek (82% of the community; Figure 5.1). Little information is available regarding sensitivities of specific periphyton taxon groups and tolerances to mining activities to assist in interpretation (Deniseger et al. 1986, De Jonge et al. 2008).

5.2 Temporal Comparisons

Substantial temporal variability in periphyton community composition was evident among samples taken in Minto Creek and reference since 1994 (Figure 5.1). For example, at lower Minto Creek, Bacillariophyceae (diatoms) were dominant in 1994, 2013, 2014, 2016, and 2018, Rhodophyta (red algae) in 2012, and Cyanophyta (blue-green algae) in 2011, 2015, and 2017 (Figure 5.1). This lack of temporal consistency was also observed at lower Wolverine Creek, with Cyanophyta dominant in 2011 and 2013 and Bacillariophyceae in 2012 and 2014 to 2018 (Figure 5.1).

5.3 Summary

Evaluation of periphyton community biomass (µg/cm²) indicated significant differences in a number of metrics in lower Minto Creek relative to the lower Wolverine Creek reference. Based on biomass (but not cells/cm²), the periphyton community of lower Minto Creek and lower Wolverine Creek had different density, evenness, and community structures. However, substantial differences in periphyton community summary metrics and community composition were apparent among years at both lower Minto and lower Wolverine creeks, indicating



Table 5.1: Statistical Contrasts of Periphyton Density (cells/cm²) and Biomass (µg/cm²) based Community Metrics between Lower Wolverine Creek and Lower Minto Creek Areas, Minto Mine WUL, 2018

A) Density based (cells/cm²)

Endpoint	Data Transformation	Test	Test P-value	Measure of Central Tendency ^a		Magnitude of Difference ^b (LMC - LWC)/SD
				LWC (Reference)	LMC (Exposed)	
Density	none	T	0.186	32,424	44,510	-
Taxon Richness	log	T	0.329	15	14	-
Simpson's Evenness	none	T	0.317	0.37	0.41	-
Simpson's Diversity	-	MW	0.602	0.84	0.83	-
Bray-Curtis Index	fourth root	T _{unequal}	0.129	0.32	0.53	-

B) Biomass based (µg/cm²)

Endpoint	Data Transformation	Test	Test P-value	Measure of Central Tendency ^a		Magnitude of Difference ^b (LMC - LWC)/SD
				LWC (Reference)	LMC (Exposed)	
Density	log	T	0.008	21	37	2.2
Taxon Richness	none	T	1.000	14	14	-
Simpson's Evenness	none	T	0.069	0.30	0.18	-1.3
Simpson's Diversity	-	MW	0.117	0.77	0.60	-
Bray-Curtis Index	log	T	0.027	0.34	0.71	1.7

Notes:

Observed effect size = (exposure mean - reference mean)/pooled standard deviation.

T = two-sample t-test, MW = Mann Whitney test, T_{unequal} = two-sample t-test for unequal variances, SD = standard deviation.

 P-value < 0.10.

 Effect size magnitude > 2.

^a Measure of Central Tendency = back-transformed mean for two-sample t-tests and medians for MW tests.

^b Magnitude of difference computed on transformed means and SD on transformed scale. Means and SD are replaced with medians and the median absolute deviation (MAD) for the MW test.

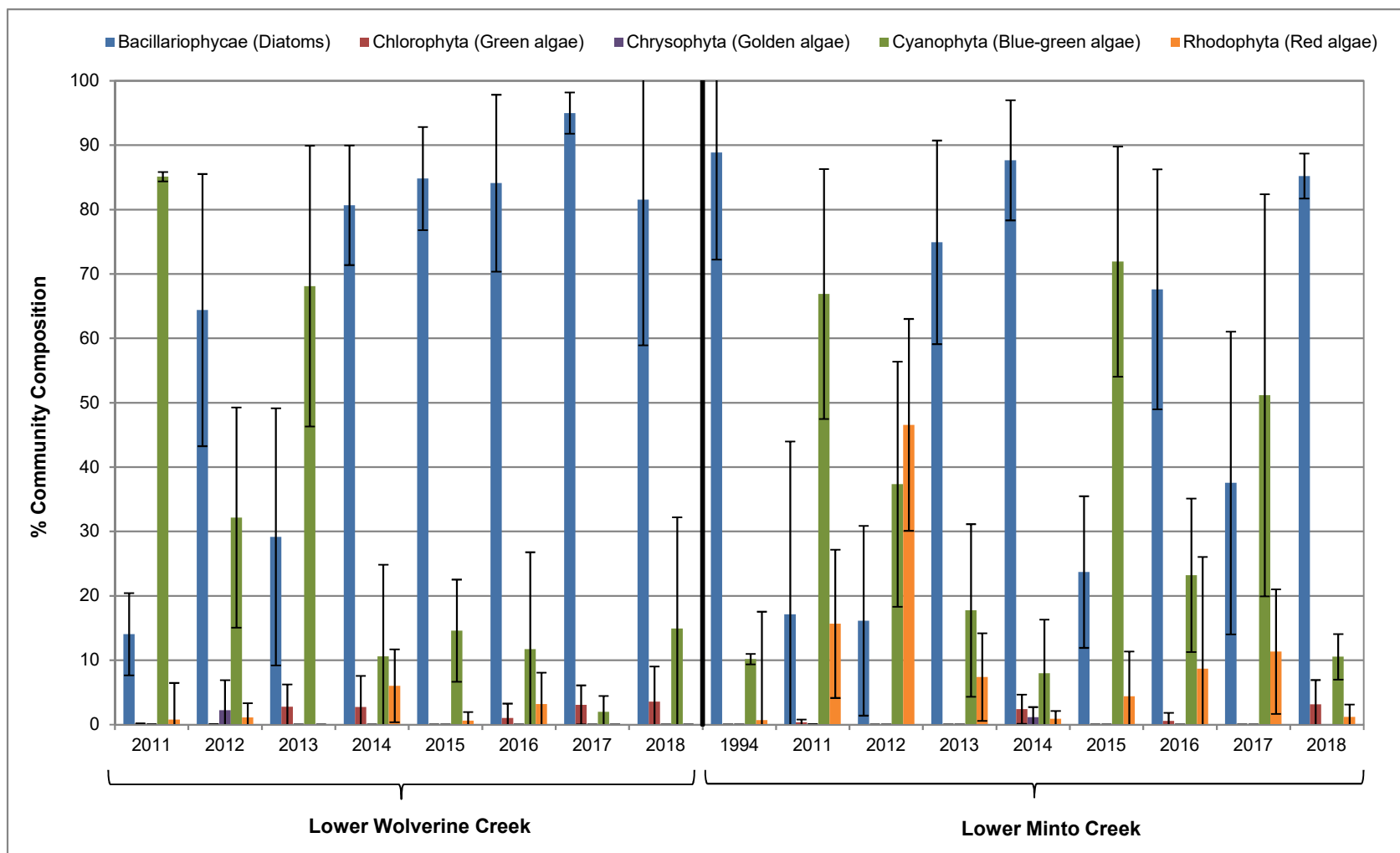


Figure 5.1: Periphyton Community (cells/cm²) Composition in Lower Minto Creek (1994, 2011 to 2018) and Lower Wolverine Creek (2011 to 2018)

Note: Data presented as mean $\pm$ standard deviation.

substantial temporal variability. The differences observed in the periphyton communities of lower Minto Creek and lower Wolverine Creek in 2018 were within natural temporal variability and do not provide any resolution of potential mine influence.



6 BENTHIC INVERTEBRATE COMMUNITY

6.1 Primary Metrics and Community Composition

Benthic invertebrate community data quality was assessed prior to data analysis and interpretation, and was judged as good (Appendix A). Benthic invertebrate community metrics of density, number of taxa, and Simpson's Diversity and Evenness were not significantly different among areas (Table 6.1, Appendix Table E.3). Bray-Curtis index was significantly higher at lower Minto Creek than both reference areas (Table 6.1, Figure 6.1). Overall, the primary metrics suggest a limited mine influence (Table 6.1, Appendix Table E.3).

Dominant taxonomic groups in lower Minto, lower Wolverine, and lower Big creeks included EPT taxa and chironomids (non-biting midges). Oligochaetes and acari were also dominant at individual stations. Percent EPT was significantly higher and percent chironomids was significantly lower at lower Minto Creek compared to lower Wolverine Creek (Figure 6.2, Table 6.1, Appendix Tables E.1 to E.3). The significantly higher proportion of EPT and lower proportion of chironomids suggests limited mine influence on benthic invertebrate community (Chapman et al. 1982a,b, Rosenberg and Resh 1993, Taylor and Bailey 1997).

Correspondence Analysis (CA) explained 57.0% of the total community variance in the first two CA axes (Appendix Table E.5). The first CA axis explained 42.3% of the total variation in the original benthic abundance data, and significantly separated lower Minto Creek from lower Wolverine and lower Big creeks (Table 6.1, Figure 6.3). Lower Minto Creek had strong negative CA Axis-1 scores and stations were separated from lower Wolverine and lower Big creeks by high relative abundance of the *Diamesa* (Family Chironomidae), *Nemoura* (stonefly), *Ostracerca* (stonefly), and *Baetis rhodani* group (mayfly; Figure 6.3, Appendix Tables E.4 and E.5). The reference areas had strong positive CA Axis-1 scores that were dominated by *Zapada cinctipes* (stonefly) and *Drunella spinifera* (mayfly; Figure 6.3, Appendix Tables E.4 and E.5). The reference areas were separated on CA Axis-2 (which explained 14.7% of the total variation) and lower Minto Creek had significantly lower CA Axis-2 scores compared to lower Big Creek and not significantly different compared to lower Wolverine Creek (Table 6.1, Figure 6.3). The Bray-Curtis index shows that lower Minto Creek has a different community composition than lower Wolverine and lower Big creeks. The CA Axis-1 shows that lower Minto Creek and the reference areas are separated by different Ephemeroptera and Plecoptera species. Even though the areas consist of different communities, the organisms that belong in these communities are typically sensitive to pollution, which suggests limited mine influence.



Table 6.1: Statistical Comparisons of Benthic Invertebrate Community Metrics among Lower Minto Creek and Reference Areas, Minto Mine WUL, 2018

Metric	Comparison		Area Mean or Median ^a		Statistical Contrasts		
	Exposure Site	Reference Site			Significant Difference between areas?	Direction	P-value ^b
Density (organisms/m ²)	lower Minto Creek	lower Wolverine Creek	1,382	501	NO	-	0.106
		lower Big Creek		782	NO	-	
Number of Taxa	lower Minto Creek	lower Wolverine Creek	15.8	15.2	NO	-	0.422
		lower Big Creek		18.6	NO	-	
BC Index to Combined Reference Median	lower Minto Creek	lower Wolverine Creek	0.905	0.356	YES	Minto > Wolverine	0.007
		lower Big Creek		0.392	YES	Minto > Big	0.014
Simpson's Diversity ^c	lower Minto Creek	lower Wolverine Creek	0.785	0.722	NO	-	0.157
		lower Big Creek		0.669	NO	-	
Simpson's Evenness ^c	lower Minto Creek	lower Wolverine Creek	0.315	0.269	NO	-	0.134
		lower Big Creek		0.168	NO	-	
Ephemeroptera (%)	lower Minto Creek	lower Wolverine Creek	8.24	11.4	NO	-	0.558
		lower Big Creek		24.8	YES	Minto < Big	0.010
Plecoptera (%)	lower Minto Creek	lower Wolverine Creek	28.4	3.66	YES	Minto > Wolverine	<0.001
		lower Big Creek		7.46	YES	Minto > Big	0.007
Trichoptera (%)	lower Minto Creek	lower Wolverine Creek	0.0548	0.225	NO	-	0.722
		lower Big Creek		0.394	NO	-	
EPT (%) ^d	lower Minto Creek	lower Wolverine Creek	42.4	19.2	YES	Minto > Wolverine	0.069
		lower Big Creek		34.1	NO	-	0.660
Chironomids (%)	lower Minto Creek	lower Wolverine Creek	33.1	61.1	YES	Minto < Wolverine	0.068
		lower Big Creek		55.8	NO	-	0.149
Oligochaetes (%)	lower Minto Creek	lower Wolverine Creek	3.74	7.55	NO	-	0.526
		lower Big Creek		5.18	NO	-	
Acari (%)	lower Minto Creek	lower Wolverine Creek	2.58	0.326	NO	-	0.468
		lower Big Creek		1.61	NO	-	
CA Axis-1 (42.3%)	lower Minto Creek	lower Wolverine Creek	-1.07	0.539	YES	Minto > Wolverine	<0.001
		lower Big Creek		0.534	YES	Minto > Big	<0.001
CA Axis-2 (14.7%)	lower Minto Creek	lower Wolverine Creek	0.0205	0.302	NO	-	0.358
		lower Big Creek		-0.468	YES	Minto < Big	0.028

■ Indicates a statistically significant difference between exposed and reference areas, $p = 0.10$.

^a For transformed data, the back-transformed mean is reported; for ranked data, the median is reported.

^b The overall p-value of the 3 group comparison used if there were no significant differences between all areas.

^c Calculated as recommended by Environment Canada 2012.

^d Percent Ephemeroptera (mayfly), Plecoptera (stonefly), Trichoptera (caddisfly).

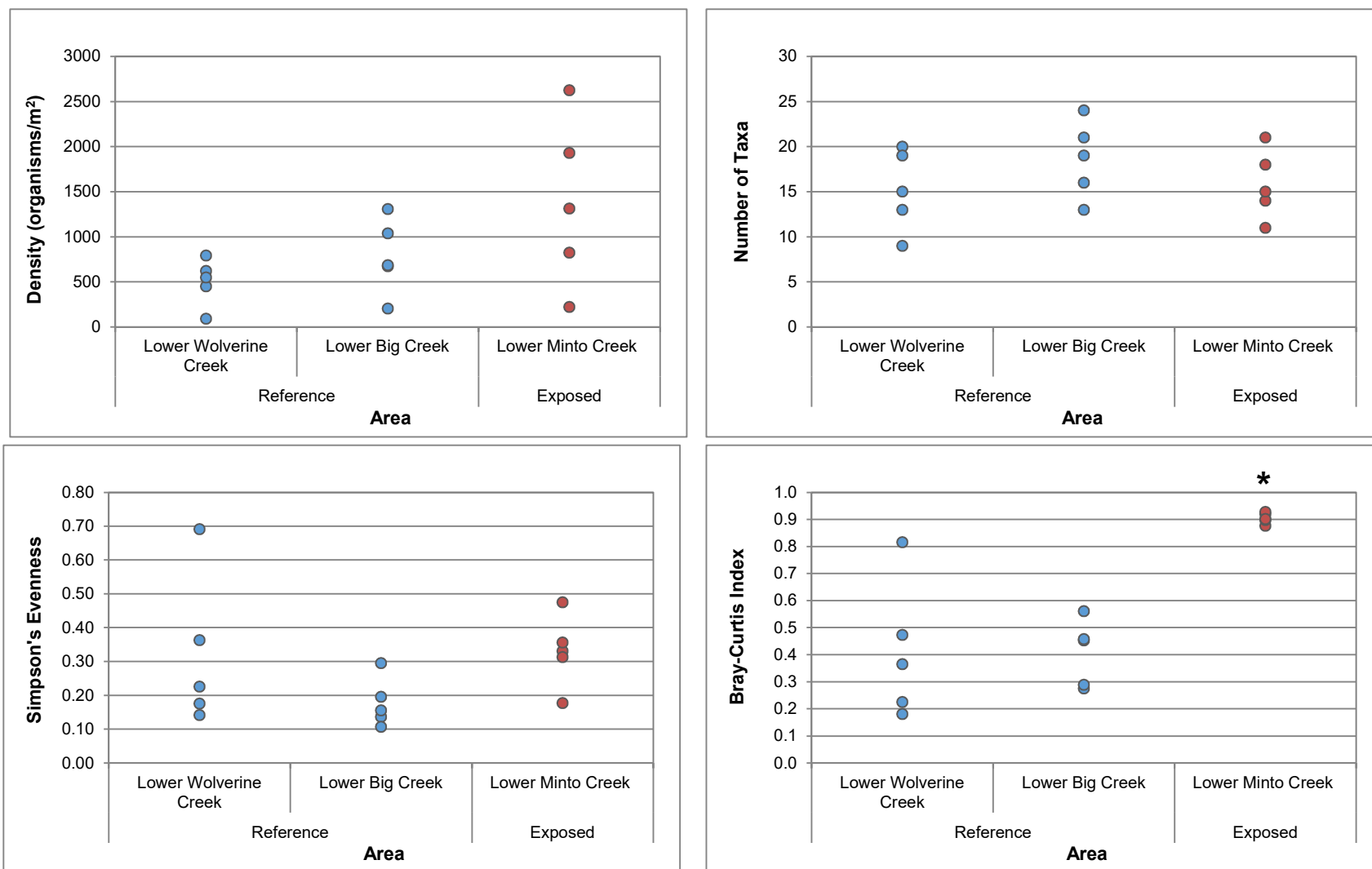


Figure 6.1: Comparison of Benthic Invertebrate Primary Metrics among Lower Minto Creek and Reference Areas, Minto Mine, 2018

Notes: An Asterisk (*) above lower Minto Creek indicates exposed area was significantly different ($p < 0.10$) from both reference areas.

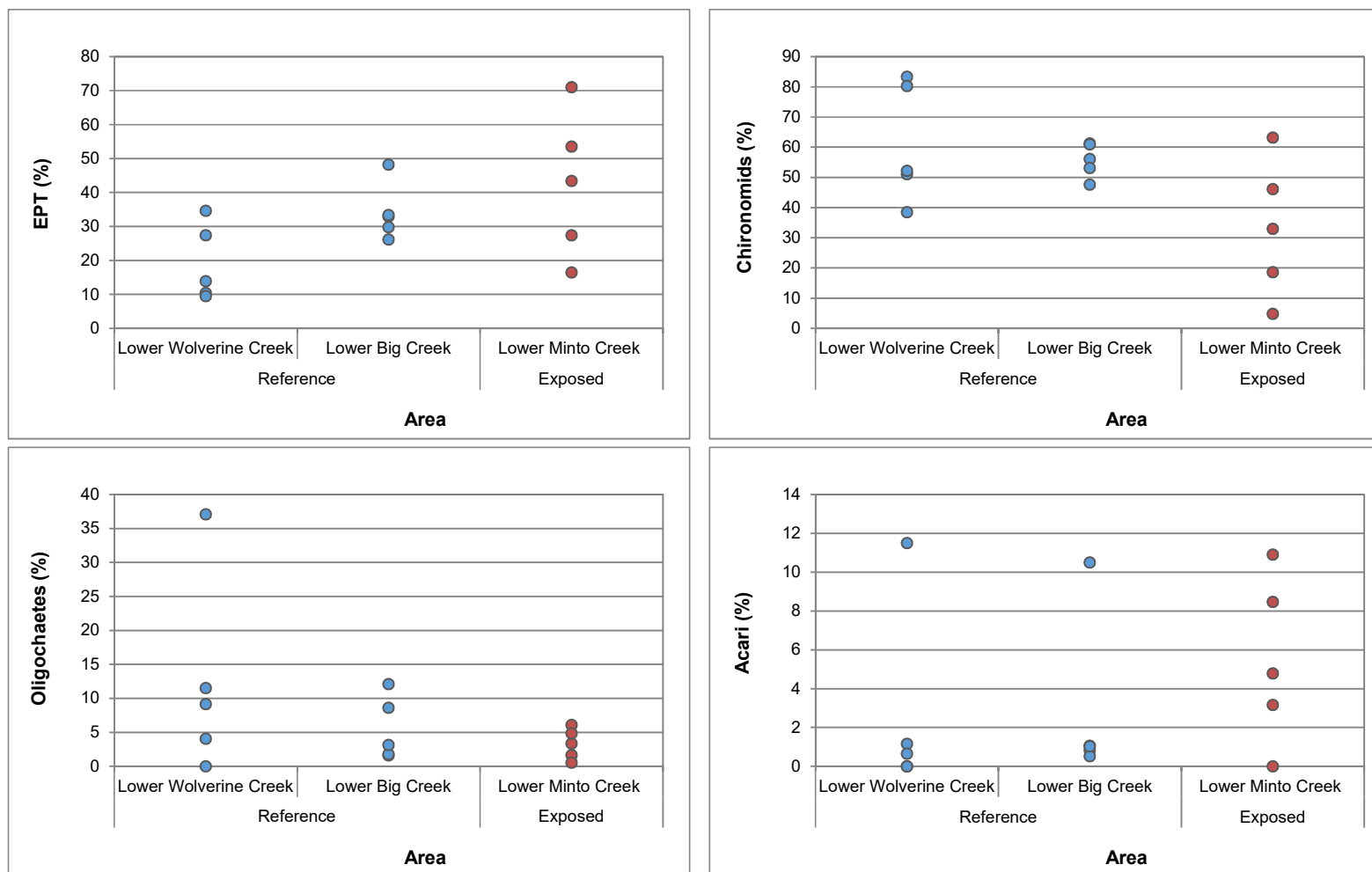


Figure 6.2: Comparison of Benthic Invertebrate Supporting Metrics among Lower Minto Creek and Reference Areas, Minto Mine, 2018

Notes: An Asterisk (*) above lower Minto Creek indicates exposed area was significantly different ($p < 0.10$) from both reference areas. EPT = Ephemeroptera (mayfly), Plecoptera (stonefly), and Trichoptera (caddisfly).

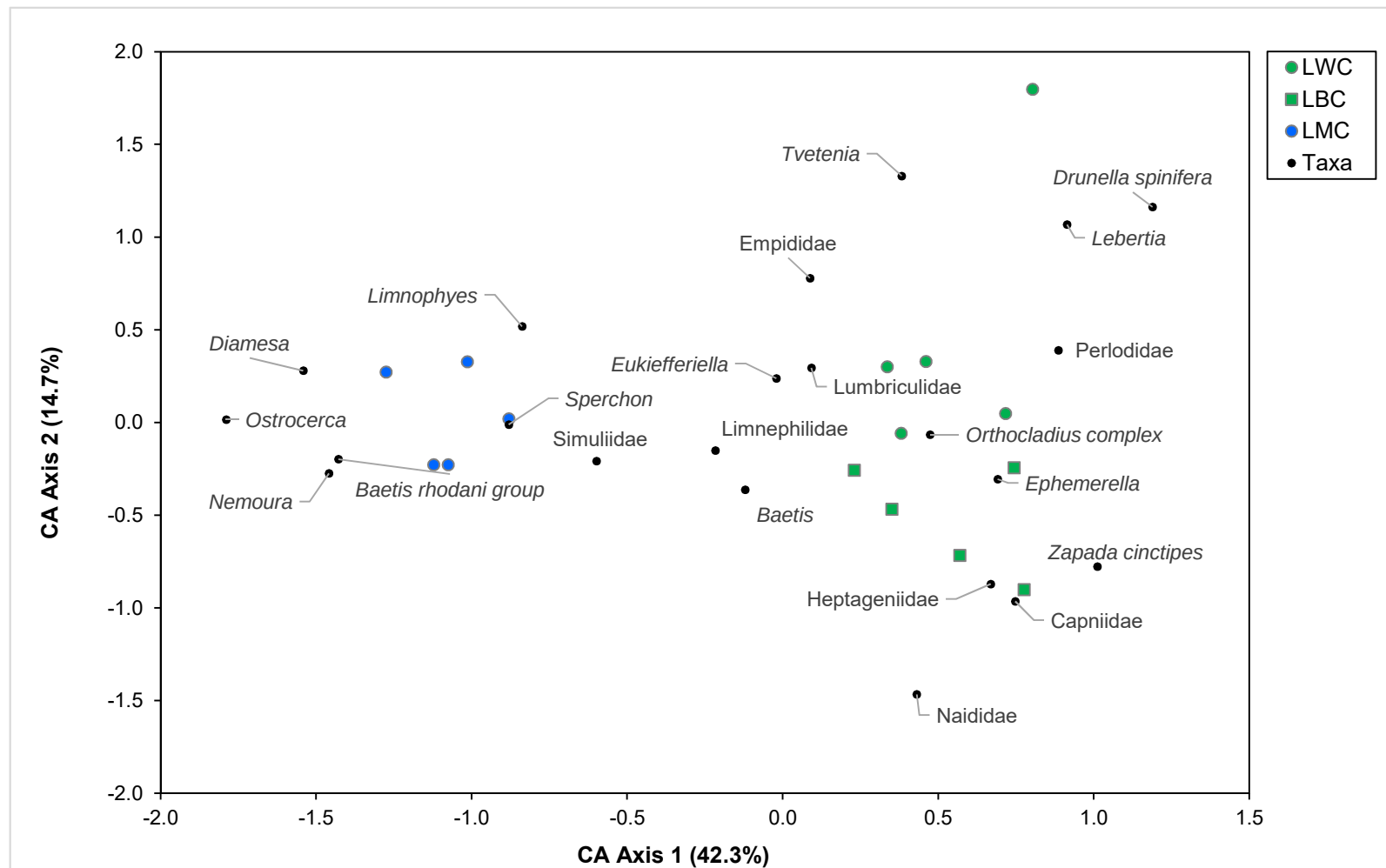


Figure 6.3: Correspondence Analysis (CA) Scatterplot for Benthic Invertebrate Relative Densities at Lower Minto Creek and Associated Reference Areas, Minto Mine, 2018

Notes: Relative taxa densities were 4th root transformed before CA calculations. Taxa present at two or fewer stations or accounted for less than 10% of the total abundance at any station were removed from the analysis.

6.2 Correlation Analysis

Correlation analysis between seven benthic indices and three supporting measurements resulted in seven significant correlations at a p-level of 0.050, of which three were significant at the Bonferroni-corrected p-level of 0.0024 (Table 6.2). It is important to consider that illustration of a significant or suggestive degree of correlation between two variables does not necessarily imply a cause-and-effect relationship, although it is cause to investigate further and to consider known biological responses to environmental differences.

All three correlations significant at the Bonferroni-corrected p-level were with specific conductance (Table 6.2, Figure 6.4). Bray-Curtis index and percent Plecoptera were positively correlated and CA Axis-1 was negatively correlated with specific conductance (Table 6.2, Figure 6.4). High specific conductance is a mine influence but the CA Axis-1 score indicates both areas are separated by Ephemeroptera and Plecoptera organisms. These species are typically associated with being sensitive to pollution so positive associations suggest limited mine influence.

6.3 Temporal Comparisons

Temporal comparisons of the benthic invertebrate community condition of lower Minto Creek were made in order to augment data interpretation, but their power was tempered by temporal changes in sampling location, sampling methodology, level of replication, and analytical processing techniques. Baseline data (1994) were collected near the mouth of Minto Creek as three single grab samples, 2006 data were collected at Station W2 in the same manner, 2008 and 2010 data were collected at Station W2 as three-grab composites whereas 2011 to 2018 data were collected as five replicate three-grab samples from a large area upstream of Station W2. Only in the later years (2011 to 2018) do data represent an area (i.e., lower Minto Creek) rather than a station. In addition, data collected in 2013 to 2018 were sieved using 500 µm mesh as recommended for federal EEM (Environment Canada 2012), whereas all years prior to 2011 used 250 µm (both mesh sizes were used in 2012 to assist in transition). This was expected to result in lower densities from 2013 and later.

Benthic invertebrate density at lower Minto Creek in 2018 was the highest observed over the 2012 to 2018 period (500 µm) and within the natural variability (Figure 6.5). Number of taxa at lower Minto Creek in 2018 was lower than in 1994 and within the historical range from 2006 onwards (Figure 6.5). Simpson's Evenness was within the historical range documented after methodological change in 2011 (Figure 6.5). Over the 2012 to 2018 period, benthic invertebrate community metrics were stable.



Table 6.2: Correlations between Benthic Invertebrate Metrics and Supporting Environmental Measurements at Minto Mine WUL, 2018

		Temperature (°C)	Specific Conductivity (µS/cm)	pH
BC Index to Combined Reference Median	Pearson Correlation	-0.718	0.777	0.0646
	Sig. (2-tailed)	0.003	0.0007	0.819
	N	15	15	15
Ephemeroptera (%)	Pearson Correlation	0.500	-0.0866	-0.399
	Sig. (2-tailed)	0.057	0.759	0.141
	N	15	15	15
Plecoptera (%)	Pearson Correlation	-0.490	0.777	0.444
	Sig. (2-tailed)	0.064	0.0007	0.098
	N	15	15	15
Chironomids (%)	Pearson Correlation	0.635	-0.523	-0.0865
	Sig. (2-tailed)	0.011	0.045	0.759
	N	15	15	15
EPT (%)	Pearson Correlation	-0.292	0.519	0.194
	Sig. (2-tailed)	0.292	0.048	0.487
	N	15	15	15
CA Axis-1 (42.3%)	Pearson Correlation	0.675	-0.785	-0.527
	Sig. (2-tailed)	0.006	0.0005	0.044
	N	15	15	15
CA Axis-2 (14.7%)	Pearson Correlation	-0.545	-0.177	-0.409
	Sig. (2-tailed)	0.036	0.528	0.130
	N	15	15	15

Note: Correlations only conducted with endpoints that were significantly different among areas.

Correlation scatterplot inspected: $p < 0.050$.

Significant after Bonferroni correction; $p < 0.0024$ ($p = 0.050$ adjusted for 21 comparisons).

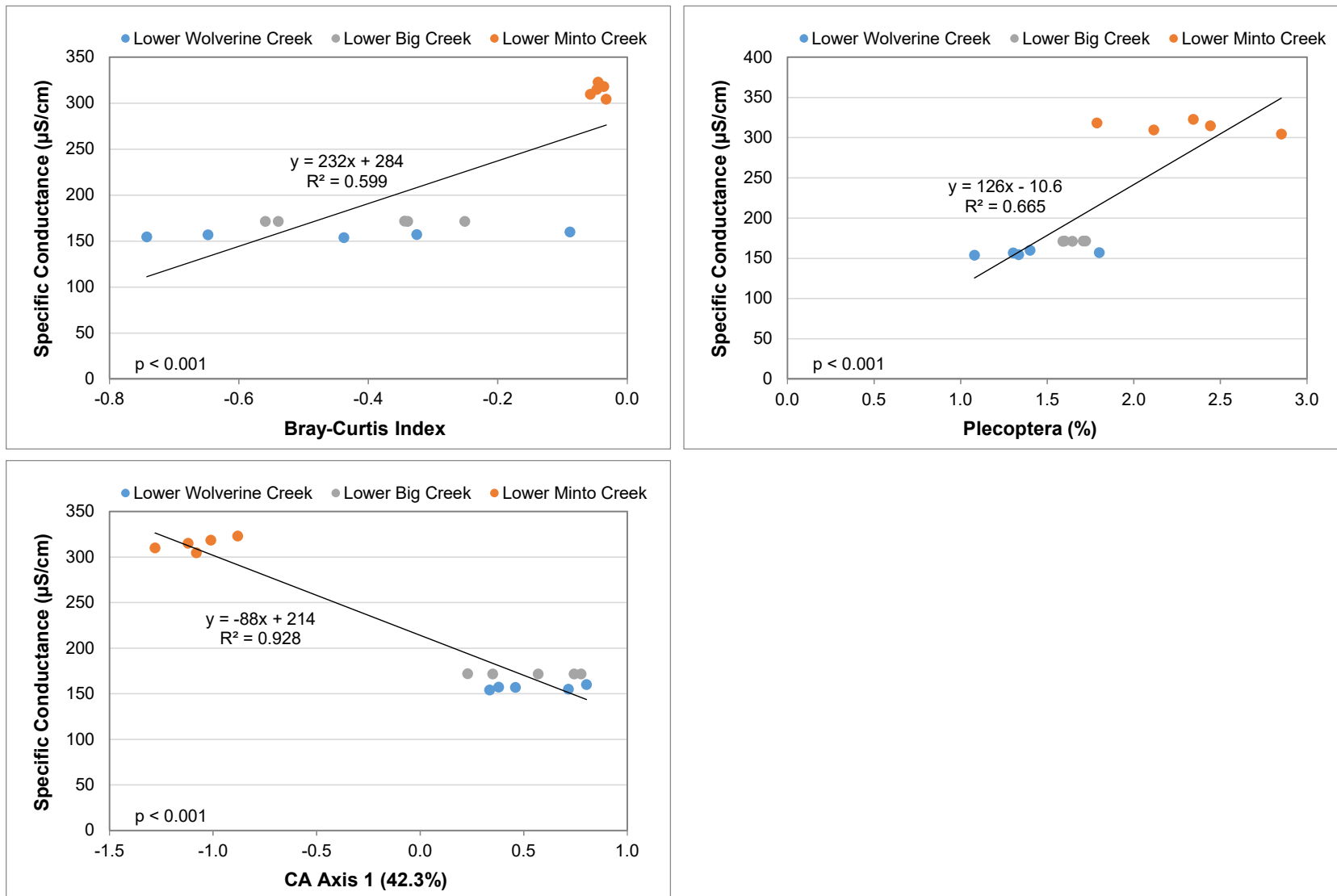


Figure 6.4: Scatterplots of Significant Relationships (Bonferroni Corrected; $p < 0.0024$), Minto Mine WUL, 2018

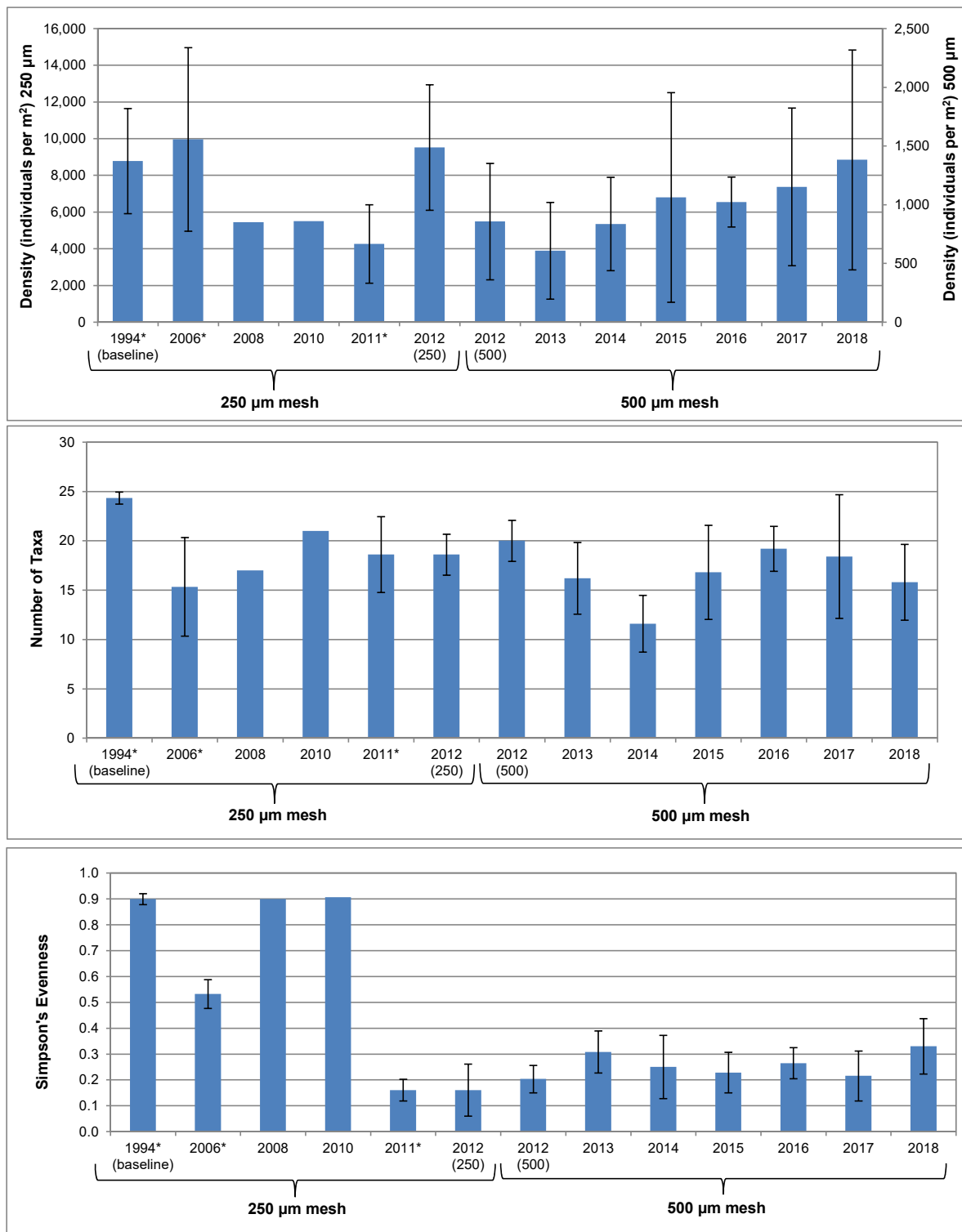


Figure 6.5: Primary Benthic Invertebrate Community Metrics at Lower Minto Creek, 1994 to 2018

Notes: Data presented as mean ± standard deviation where replicated. Asterisk (*) indicates a year the mine was not discharging.

6.4 Summary

The erosional benthic invertebrate community of lower Minto Creek differed from reference communities for Bray-Curtis index, percent EPT, Plecoptera, Ephemeroptera, and Chironomids, and CA Axis-1 and Axis-2. A potential decrease in number of taxa from 2012 to 2014 identified in previous reporting (Minnow 2015) appears to have been natural variability since number of taxa increased from 2014 to 2016 and decreased in 2018 (Minnow 2015, 2016, 2017). Bray-Curtis index shows lower Minto Creek has a different community composition than the reference areas, but the CA Axis-1 indicates that the differences are between pollution sensitive organisms (Ephemeroptera and Plecoptera). The similarity of the benthic community of lower Minto Creek to reference communities and the temporal stability in the benthic community of lower Minto Creek suggest limited mine influence.



7 TISSUE CHEMISTRY

7.1 Overview

As indicated in Section 2.6, tissue chemistry data are provided here simply to report the ancillary data collected along with the selenium data reported separately. Data interpretation were therefore limited to basic comparisons of metal concentrations in tissue collected at the exposure area (lower Minto Creek) to those collected at reference creeks (lower Wolverine and lower Big creeks).

7.2 Periphyton Tissue

The quality of periphyton tissue data was assessed prior to data analysis and interpretation, and was assessed as good (Appendix A).

Concentrations of eight analytes in periphyton tissue were significantly greater at lower Minto Creek than at both reference areas (Table 7.1, Appendix Table C.2). Analytes of concern such as copper and selenium were significantly different from both reference (Table 7.1). No significant differences were observed between areas for selenium in 2013 (Figure 7.1), whereas from 2014 to 2018, periphyton selenium concentrations were significantly greater at lower Minto Creek than at the reference areas (only between lower Big Creek in 2017; Figure 7.1). Significantly higher concentrations of selenium at lower Minto Creek compared to reference areas over the last three years suggest an influence of the mine on Minto Creek.

7.3 Benthic Invertebrate Tissue

Benthic invertebrate tissue data quality were assessed prior to data analysis and interpretation, and were judged to be of good quality, with the exception that field duplicate samples lacked close agreement for several analytes (Appendix A). Of the analytes that lacked close agreement, only two analytes differed significantly at lower Minto Creek compared to both references areas (Figure 7.1, Appendix A).

Four analytes had significantly higher concentrations of benthic invertebrate tissue at lower Minto Creek compared to both reference areas (Table 7.1, Appendix Table C.3). Cadmium, cobalt, and rubidium were significantly lower at Minto Creek and bismuth was intermediate between reference areas (Table 7.1, Appendix Table C.3). Selenium in benthic invertebrate tissue was significantly higher at lower Minto Creek compared to lower Big Creek but did not differ significantly when compared to lower Wolverine Creek (Table 7.1, Figure 7.2, Appendix Table C.3). Selenium concentration has previously been significantly higher at lower Minto Creek compared to either reference since 2014, except in 2016 when lower Minto Creek was significantly lower than lower Wolverine Creek (Figure 7.2). Selenium at all areas were below guidelines indicating limited mine



Table 7.1: Periphyton and Benthic Invertebrate Tissue Chemistry Results, Minto Mine WUL, September 2018

Analyte	Units	Periphyton						Benthic Invertebrates					
		Lower Wolverine Creek (Reference)		Lower Big Creek (Reference)		Lower Minto Creek (Exposed)		Lower Wolverine Creek (Reference)		Lower Big Creek (Reference)		Lower Minto Creek (Exposed)	
		n = 5		n = 5		n = 5		n = 5		n = 5		n = 5	
		Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Aluminum (Al) ^a	mg/kg dwt	15,687	3,058	15,877	2,347	18,125	2,236	1,967	1,629	1,480	886	1,561	356
Antimony (Sb) ^{a,b}	mg/kg dwt	0.042	0.016	0.196	0.127	0.063	0.016	0.056	0.015	0.135	0.021	0.069	0.010
Arsenic (As) ^{a,b}	mg/kg dwt	4.94	0.946	22.6	7.08	9.79	1.98	1.92	0.682	4.10	1.70	2.19	0.353
Barium (Ba) ^a	mg/kg dwt	216	48.2	266	39.9	358	58.3	115	107	62.1	31.1	54.5	12.4
Beryllium (Be) ^a	mg/kg dwt	0.694	0.141	0.616	0.083	0.616	0.073	0.157	0.110	0.098	0.048	0.067	0.014
Bismuth (Bi) ^{b,c}	mg/kg dwt	0.089	0.019	1.08	0.518	0.147	0.022	0.014	0.00244	0.124	0.037	0.024	0.00572
Boron (B) ^{c,d}	mg/kg dwt	2.24	0.375	1.85	-	5.13	1.18	3.79	2.07	1.18	0.858	1.58	1.10
Cadmium (Cd) ^e	mg/kg dwt	0.195	0.056	0.326	0.071	0.292	0.043	1.24	0.366	2.22	0.696	0.360	0.035
Calcium (Ca) ^a	mg/kg dwt	9,090	1,879	8,336	679	13,294	1,304	2,213	805	2,216	481	2,502	473
Cesium (Cs) ^b	mg/kg dwt	1.21	0.284	2.60	0.751	1.04	0.211	0.280	0.090	0.461	0.219	0.220	0.054
Chromium (Cr) ^a	mg/kg dwt	44.3	8.38	34.2	4.30	41.5	4.73	11.7	7.26	5.77	2.17	9.15	4.32
Cobalt (Co) ^a	mg/kg dwt	13.6	1.75	11.4	1.26	14.2	1.85	3.43	1.56	2.71	0.860	1.57	0.285
Copper (Cu) ^a	mg/kg dwt	23.6	6.77	37.4	11.2	56.3	6.95	27.7	8.64	29.7	4.35	22.2	3.24
Iron (Fe) ^{a,b}	mg/kg dwt	25,943	3,746	26,388	3,456	32,182	4,543	4,520	2,634	3,279	1,938	3,436	687
Lead (Pb) ^a	mg/kg dwt	6.46	1.08	12.1	2.14	8.05	1.04	1.13	0.381	1.80	0.915	1.18	0.231
Lithium (Li) ^a	mg/kg dwt	12.0	2.16	12.1	1.56	15.1	1.76	1.41	0.855	1.62	1.42	1.36	0.410
Magnesium (Mg) ^a	mg/kg dwt	9,768	1,015	8,113	740	9,102	953	2,516	1,226	1,851	463	1,838	349
Manganese (Mn) ^{a,b}	mg/kg dwt	760	211	803	131	2,484	748	831	801	330	115	353	67.6
Mercury (Hg) ^a	mg/kg dwt	0.038	0.014	0.056	0.016	0.044	0.00503	0.035	0.011	0.051	0.021	0.047	0.043
Molybdenum (Mo) ^b	mg/kg dwt	0.417	0.070	1.28	0.473	0.825	0.137	0.906	0.141	1.05	0.195	1.06	0.218
Nickel (Ni) ^a	mg/kg dwt	37.5	4.79	29.4	3.89	37.1	4.00	8.88	5.99	4.85	2.25	7.07	2.83
Phosphorus (P) ^b	mg/kg dwt	1,214	87.9	1,434	297	1,366	166	7,958	742	6,733	1,258	7,739	913
Potassium (K) ^{b,e}	mg/kg dwt	1,197	175	1,968	749	1,923	403	7,180	803	5,887	130	6,943	1,045
Rubidium (Rb)	mg/kg dwt	12.8	2.78	15.7	3.17	15.1	2.27	7.08	2.41	8.29	1.58	3.69	0.390
Selenium (Se) ^d	mg/kg dwt	0.340	0.120	0.247	0.097	1.11	0.256	1.75	0.324	1.45	0.413	2.40	0.509
Sodium (Na) ^b	mg/kg dwt	395	24.4	504	68.7	369	43.7	2,903	544	2,093	249	2,781	401
Strontium (Sr) ^{a,b}	mg/kg dwt	94.6	21.0	90.9	10.5	145	18.8	37.4	35.6	25.8	8.43	27.4	6.05
Tellurium (Te) ^{c,d}	mg/kg dwt	< 0.0310	-	0.065	0.026	< 0.0410	-	< 0.0140	-	0.010	-	< 0.0110	-
Thallium (Tl) ^a	mg/kg dwt	0.094	0.021	0.160	0.034	0.137	0.021	0.025	0.00760	0.037	0.00751	0.019	0.00439
Tin (Sn) ^{c,d}	mg/kg dwt	0.228	0.037	0.235	-	0.263	0.022	0.418	0.304	0.110	0.024	0.146	0.105
Uranium (U) ^{a,f}	mg/kg dwt	1.58	0.401	1.80	0.126	1.20	0.095	0.456	0.089	0.973	0.454	0.276	0.073
Vanadium (V) ^{a,b}	mg/kg dwt	58.7	7.73	56.9	5.98	63.6	8.05	11.7	8.85	8.13	5.58	7.23	1.24
Zinc (Zn)	mg/kg dwt	66.0	10.5	81.3	11.9	79.5	8.54	93.5	20.9	111	9.04	93.1	14.9
Zirconium (Zr) ^a	mg/kg dwt	14.5	3.16	11.7	2.06	15.4	2.24	4.48	4.68	1.92	0.893	1.97	0.463

Note: Standard deviation was not calculated if all samples are < MDL.

Indicates a mean concentration in lower Minto Creek that is significantly different than the mean concentration in lower Wolverine Creek (ANOVA; p = 0.050).

Indicates a mean concentration in lower Minto Creek that is significantly different than the mean concentration in lower Big Creek (ANOVA; p = 0.050).

Indicates a mean concentration in lower Minto Creek that is significantly different than the mean concentration in lower Wolverine and lower Big creeks (ANOVA; p = 0.050).

^a Benthic invertebrate tissue data were normalized by log transformation (ANOVA, p = 0.050).

^b Periphyton tissue data were normalized by log transformation (ANOVA, p = 0.050).

^c Benthic invertebrate tissue data were analyzed using a non-parametric Wilcoxon Score Test (p = 0.050).

^d Periphyton tissue data were analyzed using a non-parametric Wilcoxon Score Test (p = 0.050).

^e Benthic invertebrate tissue data were analyzed using a Kruskal-Wallis test (p = 0.050).

^f Periphyton tissue data were analyzed using a Kruskal-Wallis test (p = 0.050).

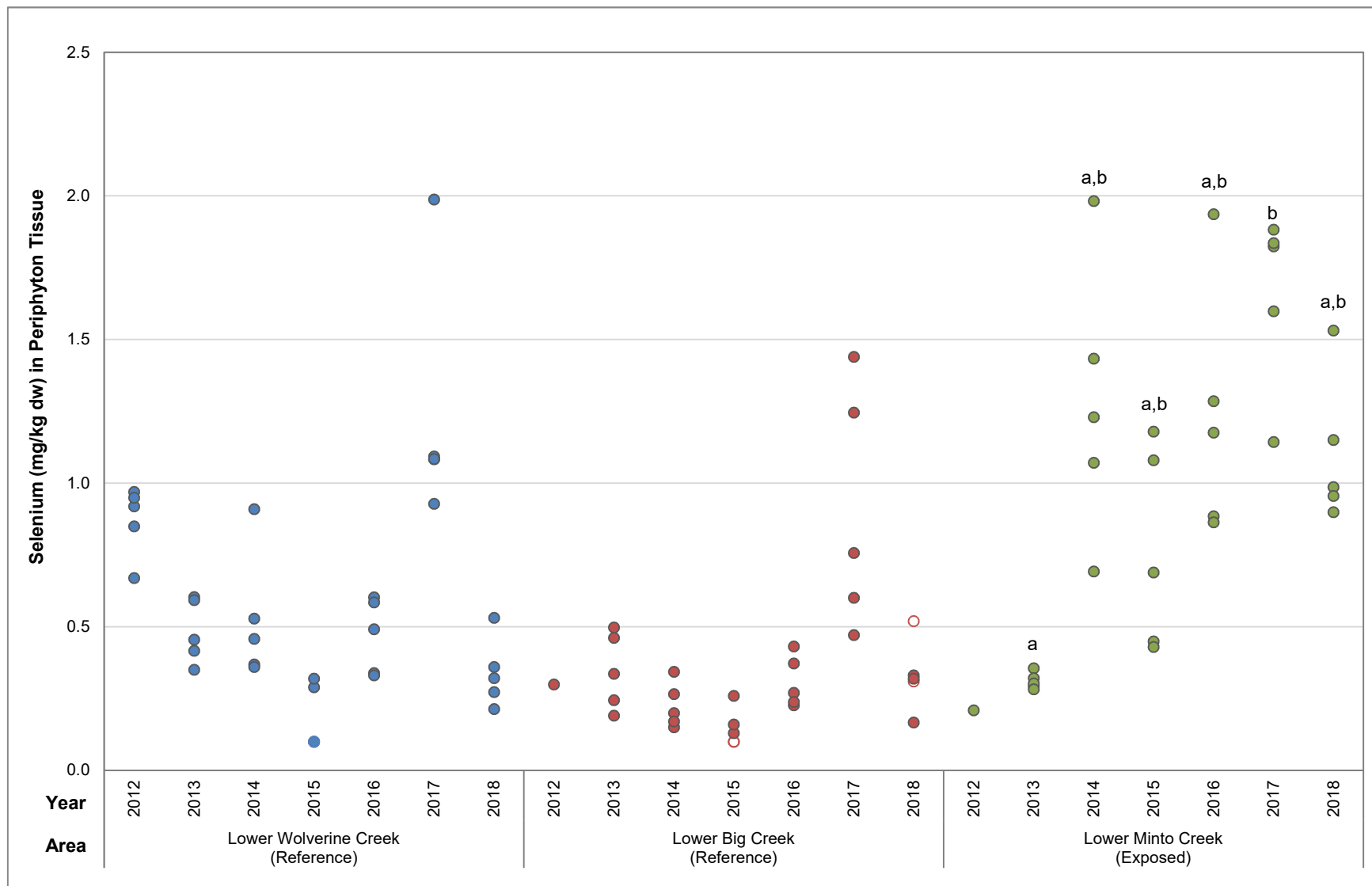


Figure 7.1: Periphyton Tissue Selenium Concentrations, 2012 to 2018

Notes: Mean concentrations at exposure areas that differ significantly ($p < 0.05$) within year from a reference area are marked with an "a" for differences relative to lower Wolverine Creek and "b" for differences relative to lower Big Creek, $n = 5$, except in lower Minto and lower Big creeks in 2012 ($n = 1$). Unfilled circles represent samples $<$ laboratory reporting limits.

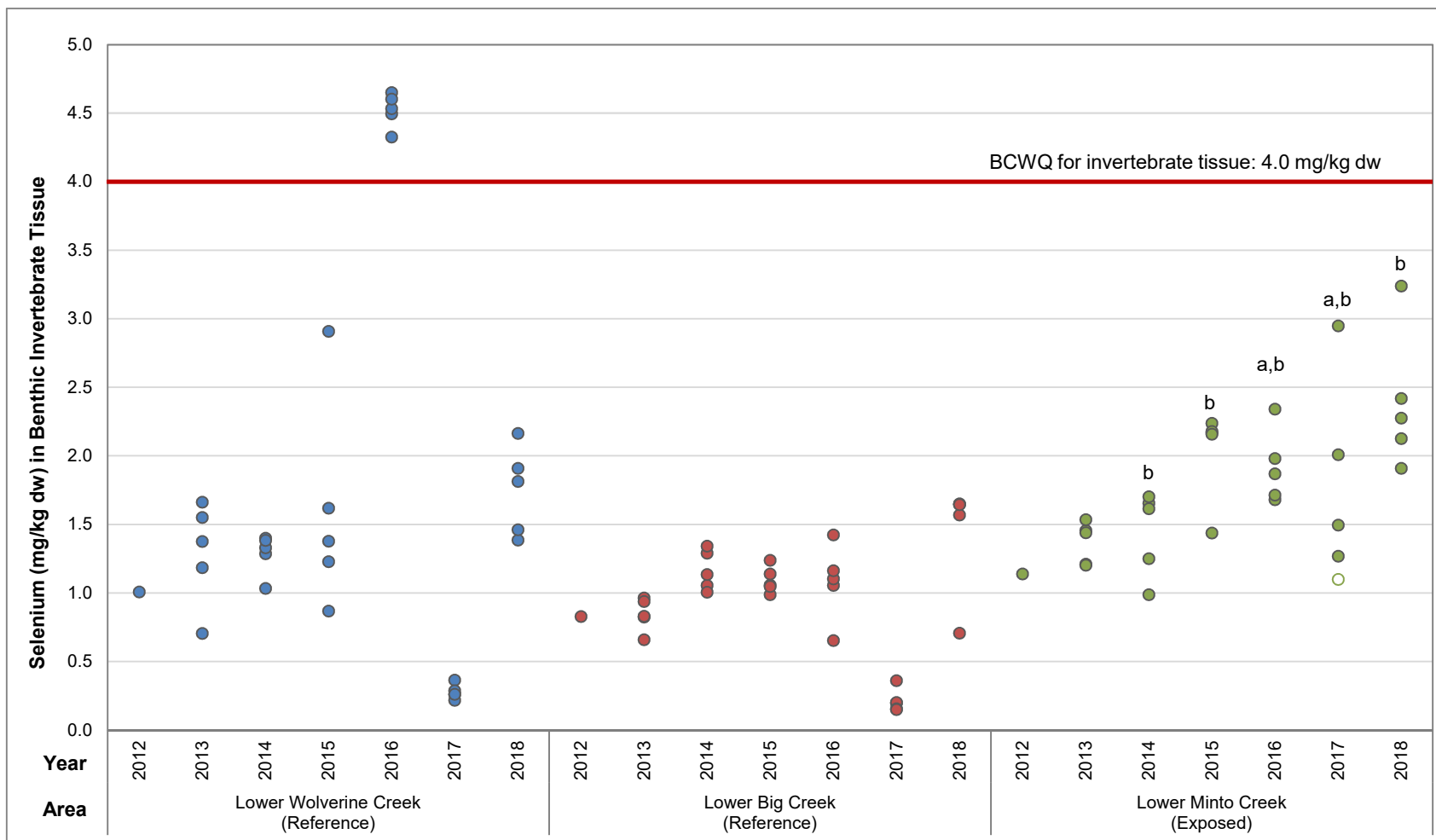


Figure 7.2: Benthic Invertebrate Tissue Selenium Concentrations, 2012 to 2018

Notes: Mean concentrations at exposure areas that differ significantly ($p < 0.05$) within year from a reference area are marked with an "a" for differences between lower Wolverine Creek and "b" for differences between lower Big Creek, $n = 5$, except in 2012 ($n = 1$). Statistics not conducted in 2012 due to low sample size. Unfilled circles represent samples $<$ laboratory reporting limits.

influence. Concentration of copper at lower Minto Creek was not significantly different from lower Wolverine and lower Big creeks. Variability in concentrations of copper in benthic invertebrate tissue has been high among years. In 2013, 2016, and 2017 copper was significantly higher in benthic invertebrates from lower Minto Creek compared to lower Wolverine Creek, but in 2014 and 2018 copper was not significantly different among areas (Figure 7.3). In 2015, copper was significantly lower at lower Minto Creek compared to lower Big Creek (Figure 7.3). This lack of consistency suggests observed differences likely represent natural variability.



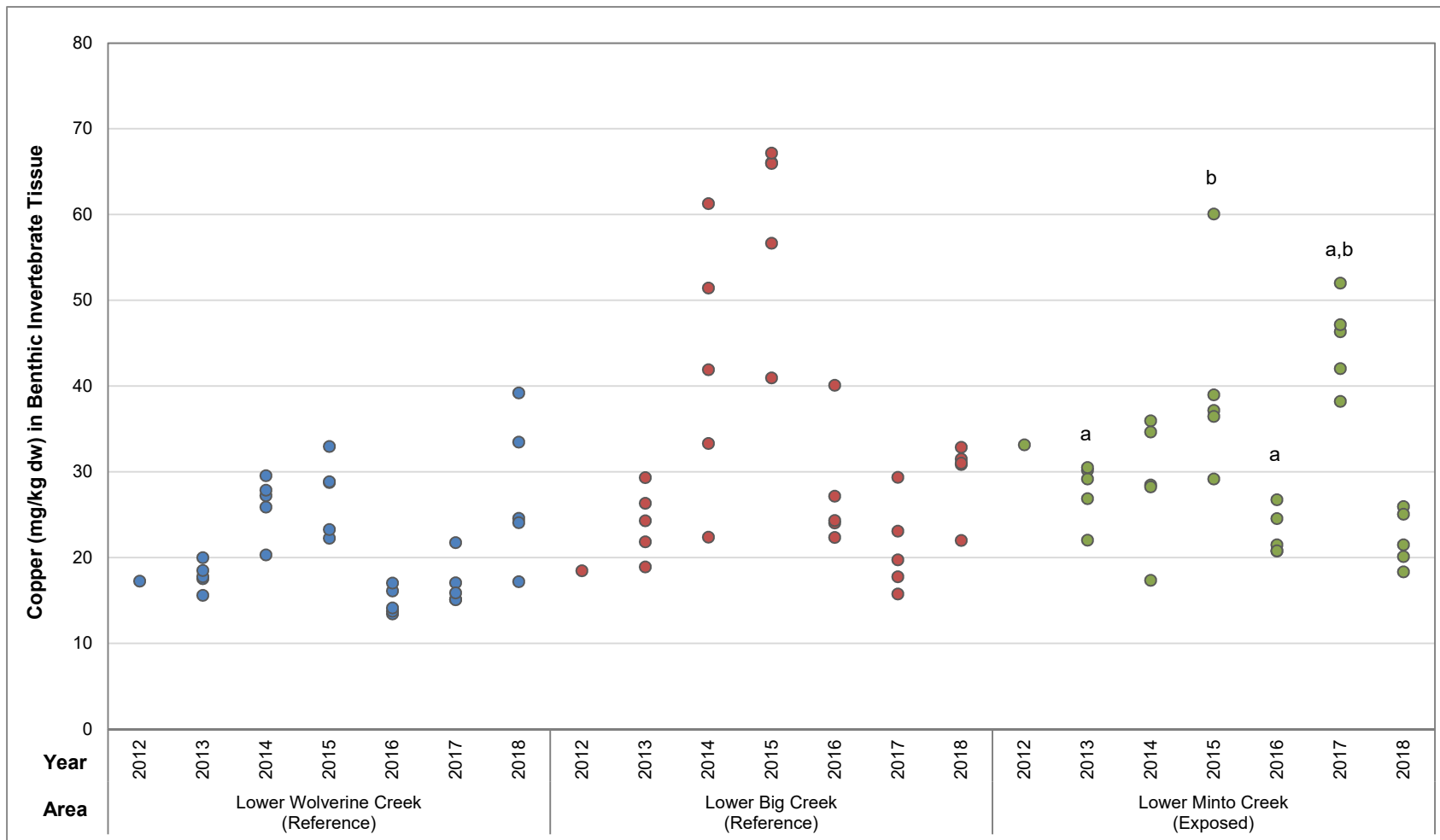


Figure 7.3: Benthic Invertebrate Tissue Copper Concentrations, 2012 to 2018

Notes: Mean concentrations at exposure areas that differ significantly ($p < 0.05$) within year from a reference area are marked with an "a" for differences relative to lower Wolverine Creek and "b" for differences relative to lower Big Creek, $n = 5$, except in 2012 ($n = 1$). Statistics not conducted in 2012 due to low sample size. Unfilled circles represent samples < laboratory reporting limits.

8 CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

The Minto Mine sediment, periphyton, and benthic assessment undertaken from September 5 to 12, 2018 serves to compare water quality (field measures and chemistry), sediment quality, periphyton and benthic invertebrate community, and tissue quality of Minto Creek to reference creeks and previous data.

Supporting measures collected in September 2018 indicated good Minto Creek water quality. The influence of the Minto Mine was evident in higher specific conductance and pH than in reference creeks; however, water quality met SSWQO. Concentration of total copper at upper Minto Creek was above CWQG and higher than at reference areas but dissolved copper was below the SSWQO. Moving downstream, copper concentrations at lower Minto Creek were below CWQG but concentrations were above CWQG at reference areas. Mean concentrations of chlorophyll-a at lower Minto and lower Wolverine creeks were not significantly different and were below BCWQG. In 2018, trophic status in lower Minto and lower Wolverine creeks were classified as mesotrophic, differing from 2017 where lower Minto and lower Wolverine creeks were classified as mesotrophic and oligotrophic, respectively (Dodds et al. 1998).

Concentrations of metals in Minto Creek sediments were similar to reference and lower than sediment quality guidelines with the exception of copper. Concentrations of copper in Minto Creek (both upper and lower) were greater than the sediment quality guideline and reference, but were similar to concentrations observed in previous years. Sediment toxicity testing of *C. dilutus* indicated an adverse survival response in lower Minto Creek sediment when compared to the laboratory control and the field reference (lower Wolverine Creek) sediment. However, no growth response was observed, nor were there responses to survival and growth in tests of *H. azteca*.

Periphyton community evaluated on the basis of biomass ($\mu\text{g}/\text{cm}^2$) indicated significant differences in a number of metrics in lower Minto Creek relative to the lower Wolverine Creek reference. In general, lower Minto Creek had a significantly lower density, higher evenness, and different community structure compared to lower Wolverine Creek. However, inconsistent periphyton community summary metrics and community composition among years at both lower Minto Creek and lower Wolverine Creek indicated substantial temporal variability. The differences observed in the periphyton communities of lower Minto Creek and lower Wolverine Creek in 2018 were within natural temporal variability and do not provide any resolution of potential mine influence.

The erosional benthic invertebrate community of lower Minto Creek differed from both references on the basis of Bray-Curtis index but not density, taxon richness, Simpson's Diversity, or



Simpson's Evenness. The CA Axis analysis suggested that the Bray-Curtis index separated lower Minto Creek and reference areas by differing Ephemeroptera and Plecoptera species. High temporal variability has been observed at the exposure and reference areas (e.g., Minnow 2015, 2016, 2017, 2018a), presumably due to inter-annual variability in environmental conditions (e.g., flow, ice scour).

Concentration of selenium in periphyton tissue collected at mine-exposed lower Minto Creek was significantly higher than at both reference areas. Selenium concentrations were only significantly higher in benthic invertebrate tissue at lower Minto Creek when compared to lower Big Creek. High concentration of selenium in periphyton and benthic invertebrate tissue over time could indicate a mine influence but concentrations were below the benthic invertebrate guideline for the protection of aquatic life indicating no effects would be expected.

8.2 Recommendations

Based on results and conclusions of the 2018 Minto Mine sediment, periphyton, and benthic assessment, it is recommended that the program is repeated in 2019. It is recommended that both lower Wolverine Creek and lower Big Creek continue to be sampled as reference areas for the benthic invertebrate community assessment to provide perspective on whether any of the observed differences are actually due to mine influence or simply due to natural differences among creeks. It is also recommended that periphyton community monitoring be removed from the WUL monitoring program as results are highly variable and are not effective in determining potential mine-related effects.



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APPENDIX A

DATA QUALITY REVIEW

APPENDIX A DATA QUALITY REVIEW

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A1 INTRODUCTION

This Data Quality Review (DQR) provides an evaluation of data collected as part of the 2018 Minto Creek Sediment, Periphyton, and Benthic Invertebrate Community Assessment Report. The objective of the DQR is to define the overall quality of the data presented in the report, and, by extension, the confidence with which the data can be used to derive conclusions.

A1.1 Background

A variety of factors can influence the chemical and biological measurements made in an environmental study and thus affect the accuracy and/or precision of the data. Inconsistencies in sampling or laboratory methods, use of instruments that are inadequately calibrated or which cannot measure to the desired level of accuracy or precision, and contamination of samples in the field or laboratory are just some of the potential factors that can lead to the reporting of data that do not accurately reflect actual environmental conditions. Depending on the magnitude of the problem, inaccuracy or imprecision have the potential to affect the reliability of any conclusions made from the data. Therefore, it is important to ensure that monitoring programs incorporate appropriate steps to control the non-natural sources of data variability (i.e., minimize the variability that does not reflect natural spatial and temporal variability in the environment) and thus assure the quality of the data.

Data quality as a concept is meaningful only when it relates to the intended use of the data. That is, one must know the context in which the data will be interpreted in order to establish a relevant basis for judging whether or not the data set is adequate. The DQR involves comparison of actual field and laboratory measurement performance to data quality objectives (DQOs) established for a particular study, such as evaluation of laboratory reporting limits (LRL), blank sample data, data precision (based on field and laboratory duplicate samples), and data accuracy (based on matrix spike recoveries and/or analysis of standards or certified reference materials). Trusted analytical laboratories certified by Canadian Association for Laboratory Accreditation (CALA) with rigorous internal quality assurance programs were selected to ensure the highest possible quality.

DQOs were established either at the outset of the field program or by the laboratories and reflect reasonable and achievable performance expectations. The LRLs were set at the outset of the field program for water, sediment, and tissue quality. Only results that were below the LRL were evaluated against target detection limits. Target detection limits should be at least as low as applicable guidelines, ideally $\leq 1/10$ th guideline values. Tissue samples were compared to the LRL the laboratory quoted they could achieve. Programs involving a large number of samples and analytes usually result in some analytes that exceed the DQOs. This



is particularly so for multi-element scans (e.g., ICP scans for metals) since the analytical conditions are not necessarily optimal for every element included in the scan. Generally, scan results may be considered acceptable if no more than 20% of the parameters fail to meet the DQOs. Overall, the intent of comparing data to DQOs was not to reject any measurement that did not meet the DQO, but to ensure that any questionable data received more scrutiny to determine what effect, if any, this had on interpretation of results within the context of this project.

A1.2 Types of Quality Control Samples

Several types of quality control (QC) samples were assessed based on samples collected (or prepared) in the field and laboratory. These samples included the following:

- **Blanks** are samples of de-ionized water and/or appropriate reagent(s) that are handled and analyzed the same way as regular samples. These samples will reflect any contamination that occurred in the field (in the case of field or travel blanks) or the laboratory (in the case of laboratory or method blanks). Analyte concentrations should be non-detectable although a DQO of twice the LRL allows for slight “noise” around the LRL.
- **Field Duplicates** are sub-sample pairs collected from a randomly selected field station using identical collection and handling methods that are then analyzed separately in the laboratory. The duplicate samples are handled and analyzed in an identical manner in the laboratory. The data from field duplicate samples reflect natural variability, as well as the variability associated with sample collection methods, and therefore provide a measure of field precision.
- **Laboratory Duplicates** are sub-sample pairs created in the laboratory from randomly selected field samples which are sub-sampled and then analyzed independently using identical analytical methods. The laboratory duplicate sample results reflect any variability introduced during laboratory sample handling and analysis and thus provide a measure of laboratory precision.
- **Spike Recovery Samples** are created in the laboratory by adding a known amount/concentration of a given analyte (or mixture of analytes) to a randomly selected test sample previously divided to create two sub-samples. The spiked and regular sub-samples are then analyzed in an identical manner. The spike recovery represents the difference between the measured spike amount (total amount in spiked sample minus amount in original sample) relative to the known spike amount (as a percentage). Two types of spike recovery samples are commonly analyzed. Spiked blanks (or blank spikes) are created using laboratory control materials whereas matrix spikes are



created using field-collected samples. The analysis of spiked samples provides an indication of the accuracy of analytical results.

- **Certified Reference Materials** are samples containing known chemical concentrations that are processed and analyzed along with batches of environmental samples. The sample results are then compared to target results to provide a measure of analytical accuracy. The results are reported as the percent of the known amount that was recovered in the analysis.

The following QC was applied to benthic invertebrate community samples as follows:

- **Organism Recovery Checks** for benthic invertebrate community samples involve the re-processing of previously sorted material from a randomly selected sample to determine the number of invertebrates that were not recovered during the original sample processing. The reprocessing is conducted by an analyst not involved during the original processing to reduce any bias. This check allows the determination of accuracy through assessment of recovery efficiency.
- **Laboratory Subsamples** are community samples prepared by the laboratory to ensure that the fraction of the total sample examined was actually an accurate representation of the total number of organisms. By comparing the amount recovered between at least two sub-samples, one can assess the analytical precision. In addition, comparisons of the sub-samples from the whole community sample allows for an evaluation of sub-sampling accuracy.



A2 WATER SAMPLES

A2.1 Laboratory Reporting Limits

The LRL for total mercury and total zinc were higher than targeted LRL but were lower than guideline levels (Table A.1). Therefore, data for this project can be reliably interpreted relative to guidelines.

A2.2 Laboratory Blank Sample Analysis

Three blank samples were detectable including nitrate, total aluminum, and total barium (Appendix B). Under ALS's DQO, nitrate was considered reliable and total aluminum and barium limits of reporting were adjusted (Appendix B). The samples were associated with no inadvertent contamination of samples within the laboratory during analysis.

A2.3 Data Precision

Relative percent differences (RPDs) between field duplicate samples were greater than 25% for 12 analytes including total suspended solids, turbidity, total phosphorus, and total aluminum, chromium, copper, iron, selenium, silicon, sulfur, titanium, and dissolved cadmium (Table A.2). These differences could be due to multi-element scans but only 12% of the field duplicate samples failed the DQO, therefore the samples were associated with good field precision.

Agreement was achieved between all laboratory duplicate samples (Appendix B). This indicates that samples were associated with good analytical precision.

A2.4 Data Accuracy

Analyte recoveries for spiked blanks all met the DQO indicating excellent analytical accuracy for the water sample analyses (Appendix B).

The analyte recoveries for matrix spiked samples failed to meet the DQO for ten analytes including dissolved organic carbon, total inorganic and organic carbon, and total and dissolved barium, calcium, magnesium, manganese, sodium, strontium, and dissolved sulphur. Recovery of these analytes could not be accurately calculated due to high analyte background in the samples. The matrix spiked samples indicate good analytical accuracy for the water sample analyses (Appendix B).

Recoveries of certified reference materials all met the DQO indicating excellent analytical accuracy (Appendix B).



Table A.1: Laboratory Reporting Limits (LRLs) Relative to Targets and Water Quality Guidelines, Minto Mine, 2018 ^a

Analyte		Units	Laboratory Reporting		Water Use Licence Objectives	CCME Water Quality	
			Target	Achieved		Long-term	Short-term
Physical Tests	Total Suspended Solids	mg/L	-	3.0	-	-	-
Anions and Nutrients	Total Ammonia (as N)	mg/L	0.025	0.0050	0.25	0.41 ^c	-
	Bromide (Br)	mg/L	-	0.050	-	-	-
	Chloride (Cl)	mg/L	12	0.50	-	120	640
	Nitrite (as N)	mg/L	0.0060	0.0010	0.060	0.060	-
Cyanides	Total Cyanide	mg/L	-	0.0050	-	-	-
Total Metals	Total Antimony (Sb)	mg/L	-	0.00010	-	-	-
	Total Beryllium (Be)	mg/L	-	0.00010	-	-	-
	Total Bismuth (Bi)	mg/L	-	0.000050	-	-	-
	Total Boron (B)	mg/L	0.15	0.010	-	1.5	29
	Total Cadmium (Cd)	mg/L	0.000090	0.0000050	-	0.00012 ^d	0.0014 ^d
	Total Cesium (Cs)	mg/L	-	0.000010	-	-	-
	Total Cobalt (Co)	mg/L	-	0.00010	-	-	-
	Total Lead (Pb)	mg/L	0.00020	0.000050	-	0.00195 ^d	-
	Total Lithium (Li)	mg/L	-	0.0010	-	-	-
	Total Mercury (Hg)	mg/L	0.0000026	0.0000050	-	0.000026	-
	Total Phosphorus (P)	mg/L	-	0.050	-	-	-
	Total Rubidium (Rb)	mg/L	-	0.00020	-	-	-
	Total Silver (Ag)	mg/L	0.000025	0.000010	-	0.00025	-
	Total Tellirium (Te)	mg/L	-	0.00020	-	-	-
	Total Thallium (Tl)	mg/L	0.000080	0.000010	-	0.00080	-
	Total Thorium (Th)	mg/L	-	0.0010	-	-	-
	Total Tin (Sn)	mg/L	-	0.00010	-	-	-
	Total Titanium (Ti)	mg/L	-	0.00030 - 0.0027	-	-	-
	Total Tungsten (W)	mg/L	-	0.0010	-	-	-
	Total Vanadium (V)	mg/L	-	0.00050	-	-	-
	Total Zinc (Zn)	mg/L	0.00070	0.0030	-	0.024 ^e	0.11 ^e
Dissolved Metals	Dissolved Aluminum (Al)	mg/L	0.010	0.0010 - 0.0040	0.10	-	-
	Dissolved Antimony (Sb)	mg/L	-	0.00010	-	-	-
	Dissolved Beryllium (Be)	mg/L	-	0.00010	-	-	-
	Dissolved Bismuth (Bi)	mg/L	-	0.000050	-	-	-
	Dissolved Boron (B)	mg/L	-	0.010	-	-	-
	Dissolved Cadmium (Cd)	mg/L	0.000016	0.0000050	0.00016 ^f	-	-
	Dissolved Cesium (Cs)	mg/L	-	0.00010	-	-	-
	Dissolved Chromium (Cr)	mg/L	0.00010	0.00010	0.0010	-	-
	Dissolved Cobalt (Co)	mg/L	-	0.00010	-	-	-
	Dissolved Lead (Pb)	mg/L	0.00040	0.000050	0.0040	-	-
	Dissolved Lithium (Li)	mg/L	-	0.0010	-	-	-
	Dissolved Mercury (Hg)	mg/L	-	0.0000050	-	-	-
	Dissolved Phosphorus (P)	mg/L	-	0.050	-	-	-
	Dissolved Rubidium (Rb)	mg/L	0.00020	0.00020	0.0020	-	-
	Dissolved Silver (Ag)	mg/L	0.000010	0.000010	0.00010	-	-
	Dissolved Tellurium (Te)	mg/L	-	0.00020	-	-	-
	Dissolved Thallium (Tl)	mg/L	-	0.000010	-	-	-
	Dissolved Thorium (Th)	mg/L	-	0.00010	-	-	-
	Dissolved Tin (Sn)	mg/L	-	0.00010	-	-	-
	Dissolved Titanium (Ti)	mg/L	-	0.00030 - 0.00090	-	-	-
	Dissolved Tungsten (W)	mg/L	-	0.00010	-	-	-
	Dissolved Vanadium (V)	mg/L	-	0.00050	-	-	-
	Dissolved Zinc (Zn)	mg/L	0.0030	0.0010	0.030	-	-

 Value greater than target.

^a Only analytes with reported values less than LRL were presented.

^b CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Environmental Quality Guidelines. 1999 (plus updates), Canadian Council of Ministers of the Environment, Winnipeg. See Appendix Table B.6 for explanatory notes on selected water quality guidelines.

^c Based on lowest guideline using highest temperature and pH.

^d Based on lowest guideline using lowest hardness.

^e Based on guideline using 25th percentile of hardness, DOC, and field pH.

^f Dissolved Cadmium (µg/L) calculations based on the following formula using the lowest hardness: $e^{(0.736(\ln(\text{Hardness})-4.943))}$.

Table A.2: Field Duplicate Results for Analysis of Water Quality, Minto Mine, 2018

Analytes		Units	Lab Report L2161443		
			UMC	UMCX	RPD (%)
			11-Sep-18	11-Sep-18	
Physical Tests	Conductivity	µS/cm	556	558	0.36
	Hardness (as CaCO ₃)	mg/L	256	270	5.3
	pH	pH Units	8.3	8.3	0
	Total Suspended Solids	mg/L	3.3	4.9	39
	Total Dissolved Solids	mg/L	344	349	1.4
	Turbidity	NTU	0.13	0.19	38
Anions and Nutrients	Total Alkalinity (as CaCO ₃)	mg/L	249	248	0.40
	Total Ammonia (as N)	mg/L	<0.0050	<0.0050	0
	Bromide (Br)	mg/L	<0.050	<0.050	0
	Chloride (Cl)	mg/L	4.5	4.5	0
	Fluoride (F)	mg/L	0.53	0.54	1.5
	Nitrate (as N)	mg/L	0.107	0.108	0.93
	Nitrite (as N)	mg/L	<0.0010	<0.0010	0
	Total dissolved Phosphorus (P)	mg/L	0.0052	0.0051	1.9
	Total Phosphorus (P)	mg/L	0.024	0.0053	128
Other	Sulfate (SO ₄)	mg/L	58	58	0
	Total Cyanide	mg/L	<0.0050	<0.0050	0
	Dissolved Organic Carbon	mg/L	6.4	6.4	0.94
	Total Inorganic Carbon	mg/L	60	57	5.6
Total Metals	Total Organic Carbon	mg/L	6.2	6.3	1.0
	Total Aluminum (Al)	mg/L	0.010	0.045	127
	Total Antimony (Sb)	mg/L	<0.00010	<0.00010	0
	Total Arsenic (As)	mg/L	0.00026	0.00027	3.8
	Total Barium (Ba)	mg/L	0.064	0.065	1.6
	Total Beryllium (Be)	mg/L	<0.00010	<0.00010	0
	Total Bismuth (Bi)	mg/L	<0.000050	<0.000050	0
	Total Boron (B)	mg/L	0.023	0.023	0
	Total Cadmium (Cd)	mg/L	<0.0000050	<0.0000050	0
	Total Calcium (Ca)	mg/L	58	57	1.0
	Total Cesium (Cs)	mg/L	<0.000010	<0.000010	0
	Total Chromium (Cr)	mg/L	0.00019	0.00050	90
	Total Cobalt (Co)	mg/L	<0.00010	<0.00010	0
	Total Copper (Cu)	mg/L	0.0041	0.013	104
	Total Iron (Fe)	mg/L	0.019	0.085	127
	Total Lead (Pb)	mg/L	<0.000050	<0.000050	0
	Total Lithium (Li)	mg/L	0.0030	0.0031	3.3
	Total Magnesium (Mg)	mg/L	31	29	5.0
	Total Manganese (Mn)	mg/L	0.040	0.043	6.0
	Total Mercury (Hg)	mg/L	<0.0000050	<0.0000050	0
	Total Molybdenum (Mo)	mg/L	0.0046	0.0047	3.2
	Total Nickel (Ni)	mg/L	0.00099	0.0010	4.0
	Total Phosphorus (P)	mg/L	<0.050	<0.050	0
	Total Potassium (K)	mg/L	2.38	2.36	0.84
	Total Rubidium (Rb)	mg/L	0.00032	0.00041	25
	Total Selenium (Se)	mg/L	0.00017	0.00028	50
	Total Silicon (Si)	mg/L	3.8	6.1	47
	Total Silver (Ag)	mg/L	<0.000010	<0.000010	0
	Total Sodium (Na)	mg/L	19	19	3.2
	Total Strontium (Sr)	mg/L	0.71	0.72	1.3
	Total Sulfur (S)	mg/L	11	20	58
	Total Tellurium (Te)	mg/L	<0.00020	<0.00020	0
	Total Thallium (Tl)	mg/L	<0.000010	<0.000010	0
	Total Tin (Sn)	mg/L	<0.00010	<0.00010	0
	Total Titanium (Ti)	mg/L	0.00034	0.0025	153
	Total Uranium (U)	mg/L	0.00278	0.00284	2.1
	Total Vanadium (V)	mg/L	<0.00050	0.00056	11
	Total Zinc (Zn)	mg/L	<0.0030	<0.0030	0
	Total Zirconium (Zr)	mg/L	0.00011	0.00010	11
Dissolved Metals	Dissolved Aluminum (Al)	mg/L	<0.0020	<0.0020	0
	Dissolved Antimony (Sb)	mg/L	<0.00010	<0.00010	0
	Dissolved Arsenic (As)	mg/L	0.00025	0.00025	0
	Dissolved Barium (Ba)	mg/L	0.068	0.068	0
	Dissolved Beryllium (Be)	mg/L	<0.00010	<0.00010	0
	Dissolved Bismuth (Bi)	mg/L	<0.000050	<0.000050	0
	Dissolved Boron (B)	mg/L	0.022	0.024	8.7
	Dissolved Cadmium (Cd)	mg/L	0.0000062	0.0000080	25
	Dissolved Calcium (Ca)	mg/L	55	60	7.6
	Dissolved Cesium (Cs)	mg/L	<0.000010	<0.000010	0
	Dissolved Chromium (Cr)	mg/L	<0.00010	<0.00010	0
	Dissolved Cobalt (Co)	mg/L	<0.00010	<0.00010	0
	Dissolved Copper (Cu)	mg/L	0.0028	0.0029	2.5
	Dissolved Iron (Fe)	mg/L	0.014	0.014	0
	Dissolved Lead (Pb)	mg/L	<0.000050	<0.000050	0
	Dissolved Lithium (Li)	mg/L	0.0029	0.0030	3.4
	Dissolved Magnesium (Mg)	mg/L	29	29	2.4
	Dissolved Manganese (Mn)	mg/L	0.037	0.038	2.4
	Dissolved Mercury (Hg)	mg/L	<0.0000050	<0.0000050	0
	Dissolved Molybdenum (Mo)	mg/L	0.0050	0.0049	2.8
	Dissolved Nickel (Ni)	mg/L	0.00092	0.00093	1.1
	Dissolved Phosphorus (P)	mg/L	<0.050	<0.050	0
	Dissolved Potassium (K)	mg/L	2.3	2.3	2.6
	Sdissolved Rubidium (Rb)	mg/L	0.00028	0.00023	20
	Dissolved Selenium (Se)	mg/L	0.00033	0.00032	3.1
	Dissolved Silicon (Si)	mg/L	5.8	6.1	4.4
	Dissolved Silver (Ag)	mg/L	<0.000010	<0.000010	0
	Dissolved Sodium (Na)	mg/L	17.5	18.0	2.8
	Dissolved Strontium (Sr)	mg/L	0.77	0.78	1.0
	Dissolved Sulfur (S)	mg/L	19	21	6.0
	Dissolved Tellurium (Te)	mg/L	<0.00020	<0.00020	0
	Dissolved Thallium (Tl)	mg/L	<0.000010	<0.000010	0
	Dissolved Thorium (Th)	mg/L	<0.00010	<0.00010	0
	Dissolved Tin (Sn)	mg/L	<0.00010	<0.00010	0
	Dissolved Titanium (Ti)	mg/L	<0.00030	<0.00030	0
	Dissolved Tungsten (W)	mg/L	<0.00010	<0.00010	0
	Dissolved Uranium (U)	mg/L	0.0027	0.0027	1.9
	Dissolved Vanadium (V)	mg/L	<0.00050	<0.00050	0
	Dissolved Zinc (Zn)	mg/L	<0.0010	<0.0010	0
	Dissolved Zirconium (Zr)	mg/L	0.000090	0.000090	0

> 25% Relative Percent Difference (RPD).

A3 SEDIMENT SAMPLES

A3.1 Laboratory Reporting Limits

Results for six analytes were reported as less than LRL but had no associated guidelines. Analytes with guidelines were all detectable indicating that the data can be reliably interpreted.

A3.2 Laboratory Blank Sample Analysis

All blank samples contained non-detectable analyte concentrations indicating no inadvertent contamination of samples within the laboratory during analysis (Appendix C).

A3.3 Data Precision

The RPD between field duplicate samples had 35% of samples that exceeded the DQO (Table A.3). The analytes that exceeded the DQO were loss on ignition, particle size, total Kjeldahl nitrogen, carbon analytes, and total copper, manganese, potassium, selenium, and thallium. High field variability can also be observed in replicate samples within areas. This will be considered during interpretation of the results.

Agreement was achieved between all laboratory duplicate samples as the RPDs were lower than the laboratory DQO (Appendix C). This indicates that reported sample results were associated with excellent analytical precision.

A3.4 Data Accuracy

Analyte recoveries for spiked blanks all met the DQO indicating excellent analytical accuracy for the sediment sample analyses (Appendix C).

Recoveries of all analytes in certified reference materials met the DQO (Appendix C). These data indicated excellent analytical accuracy associated with the analysis of sediment samples.



Table A.3: Field Duplicate Results for Analysis of Sediment Quality, Minto Mine, 2018

Analytes		Units	Lab Report L2163149		
			LMC-3	LMC-3X	RPD (%)
			10-Sep-2018	10-Sep-2018	
Physical Tests	Loss on Ignition	%	3.0	19	145
	pH (1:2 soil:water)	pH	7.7	7.9	2.4
Particle Size	Gravel (> 2 mm)	%	<1.0	1.8	57
	Sand (2.0 mm - 0.063 mm)	%	68	13	136
	Silt (0.063 mm - 4 µm)	%	28	73	89
	Clay (4 µm)	%	3.8	12	105
Other	Total Kjeldahl Nitrogen	%	0.086	0.52	143
	Inorganic Carbon	%	0.076	0.25	106
	Inorganic Carbon (as CaCO ₃ Equivalent)	%	0.63	2.1	106
	Total Carbon by Combustion	%	1.6	8.6	137
	Total Organic Carbon	%	1.5	8.4	139
Total Metals	Total Aluminum (Al)	mg/kg	12,600	14,700	15
	Total Antimony (Sb)	mg/kg	0.36	0.48	29
	Total Arsenic (As)	mg/kg	5.8	7.9	31
	Total Barium (Ba)	mg/kg	175	252	36
	Total Beryllium (Be)	mg/kg	0.58	0.49	17
	Total Bismuth (Bi)	mg/kg	<0.20	<0.20	0
	Total Boron (B)	mg/kg	<5.0	<5.0	0
	Total Cadmium (Cd)	mg/kg	0.18	0.24	27
	Total Calcium (Ca)	mg/kg	7,770	10,800	33
	Total Chromium (Cr)	mg/kg	37	34	9.1
	Total Cobalt (Co)	mg/kg	12	12	1.7
	Total Copper (Cu)	mg/kg	20	56	96
	Total Iron (Fe)	mg/kg	25,100	26,800	6.6
	Total Lead (Pb)	mg/kg	5.2	6.2	19
	Total Lithium (Li)	mg/kg	8.5	10	20
	Total Magnesium (Mg)	mg/kg	8,610	7,410	15
	Total Manganese (Mn)	mg/kg	619	1,240	67
	Total Mercury (Hg)	mg/kg	0.032	0.038	18
	Total Molybdenum (Mo)	mg/kg	0.49	0.73	39
	Total Nickel (Ni)	mg/kg	32	30	5.5
	Total Phosphorus (P)	mg/kg	976	928	5.0
	Total Potassium (K)	mg/kg	760	1,230	47
	Total Selenium (Se)	mg/kg	0.28	0.61	74
	Total Silver (Ag)	mg/kg	<0.10	<0.10	0
	Total Sodium (Na)	mg/kg	306	306	0
	Total Strontium (Sr)	mg/kg	81	105	26
	Total Thallium (Tl)	mg/kg	0.057	0.093	48
	Total Tin (Sn)	mg/kg	<2.0	<2.0	0
	Total Titanium (Ti)	mg/kg	672	704	4.7
	Total Uranium (U)	mg/kg	1.6	1.1	33
	Total Vanadium (V)	mg/kg	59	57	3.4
	Total Zinc (Zn)	mg/kg	53	64	19

 > 40% Relative Percent Difference (RPD).

A4 SEDIMENT TOXICITY TESTING

Results for the reference toxicant tests for both the 10-day *Chironomus dilutus* and the 14-day *Hyalella azteca* tests were within the acceptability range for organism performance of mean and two standard deviations (Appendix C – Nautilus Environmental Report). Water quality parameters remained within the acceptability criteria throughout testing. The sensitivity of the organisms was deemed to be appropriate when compared to historical results obtained by the laboratory (Appendix C – Nautilus Environmental Report).



A5 PERIPHYTON COMMUNITY

Close agreement was achieved between laboratory duplicate samples for both density (cells/cm²; Table A.4) and biomass (µg/cm²; Table A.5). This indicates that data can be reliably interpreted.



Table A.4: Laboratory Duplicate Results for Analysis of Periphyton Group Density (cells/cm²)

Algal Density (cells/cm ²)	LWC-3	LWC-3R	RPD (%)
Cyanobacteria	2,297	3,015	27
Bacillariophyceae	46,655	46,799	0.31
Total	48,952	49,813	1.7

 > 30% Relative Percent Difference (RPD).

Table A.5: Laboratory Duplicate Results for Analysis of Periphyton Group Biomass (µg/cm²)

Algal Biomass (µg/cm ²)	LWC-3	LWC-3R	RPD (%)
Cyanobacteria	4.2	5.1	19
Bacillariophyceae	25	24	4.7
Total	29	29	0.94

 > 30% Relative Percent Difference (RPD).

A6 BENTHIC INVERTEBRATE COMMUNITY

Two re-sorted samples met the objective for percent organism recovery; both of which had a percent recovery of 98% (Table A.6). All benthic invertebrate samples were analyzed whole except for LMC-5 (50%; Table A.7), and sub-sampling variability was required. Sub-sampling of sample LMC-5 met the DQO of 20% (Table A.8). This indicates that the data can be reliably interpreted.



Table A.6: Percent Sorting Efficiency of Benthic Invertebrates, Minto Mine, 2018

Station	Initial Sort	Re-sort	Percent sorting efficiency ^a
LBC-2	57	1	98%
LWC-5	154	3	98%

 Sorting efficiency < 90%.

^a Percent sorting efficiency = $(1 - (\# \text{ in QA/AC re-sort} / (\# \text{ sorted originally} + \# \text{ in QA/QC re-sort}))) * 100$.

Table A.7: Percent of Benthic Invertebrate Sample Analyzed for Each Station, Minto Mine, 2018

Area	Station				
	1	2	3	4	5
LWC	100%	100%	100%	100%	100%
LBC	100%	100%	100%	100%	100%
LMC	100%	100%	100%	100%	50%

Table A.8: Percent Subsampling Error for Benthic Invertebrate Samples, Minto Mine, 2018

Sample	Number of organisms in fraction 1 (50%)	Number of organisms in fraction 2 (50%)	Actual density	Precision (range of RPD %) ^a		Accuracy (range expressed as %) ^b	
LMC-5	375	356	731	5.1	5.1	2.6	2.6

 Value exceeded the < 20% data quality objective.

^a Relative percent difference (RPD) among subsamples.

^b Range of deviation of abundance estimates derived from sub-samples compared to analysis of entire sample (expressed as % of total organisms present).

A7 TISSUE SAMPLES

A7.1 Laboratory Reporting Limits

Four periphyton tissue analytes were below LRLs and did not meet target detection limits, including boron, selenium, tellurium, and tin (Table A.9). Target concentrations are not based on guidelines; rather represent detection limits quoted by the laboratory.

Four benthic invertebrate tissue analytes were below LRLs and did not meet targets: total bismuth, boron, tellurium, and tin. For each analyte, 6 out of 16 samples exceeded targets (Table A.10). Target concentrations are not guidelines but represent detection limits quoted by the laboratory. Data for this project can be reliably interpreted.

All chlorophyll-a periphyton samples were detectable and interpretable.

A7.2 Laboratory Blank Sample Analysis

Periphyton (chlorophyll-a, tissue) blank samples contained non-detectable analyte concentrations indicating no inadvertent contamination of samples within the laboratory during analysis (Appendix C). Benthic invertebrate tissue blank samples contained non-detectable analyte concentrations except for two samples, percent moisture, and chromium (Appendix C). Fewer than 20% of the field duplicate samples failed the DQO and samples were associated with good field precision.

A7.3 Data Precision

Periphyton field duplicate samples showed close agreement among analytes except for two analytes: cesium and selenium. Only 5.7% of the field duplicate samples failed the DQO and samples were associated with good field precision (Table A.11).

Laboratory duplicate periphyton tissue samples showed good agreement among all duplicate analyte concentrations (Appendix C). Periphyton samples were associated with good analytical precision.

Benthic invertebrate field duplicate samples did not meet the DQO for most analytes (Table A.12). Tissue samples can be highly variable (consistent with field replicates) and this will be considered when analyzing the data.

The RPD between the field duplicate periphyton chlorophyll-a samples was 22%, indicating that the data was associated with good laboratory precision (Table A.13).



Table A.9: Laboratory Reporting Limits (LRL) for Periphyton Tissue Samples Relative to Targets, Minto Mine, 2018 ^a

Analyte	Units	Method Detection Limits	
		Target	Achieved
Total Boron (B)	mg/kg ww	0.20	1.0 - 2.0
Total Selenium (Se)	mg/kg ww	0.010	0.10 - 0.20
Total Tellurium (Te)	mg/kg ww	0.0040	0.020 - 0.040
Total Tin (Sn)	mg/kg ww	0.020	0.10 - 0.20

 Target LRL were exceeded.

^a Only analytes with reported values less than LRL were presented.

Table A.10: Laboratory Reporting Limits (LRL) for Benthic Invertebrate Tissue Samples Relative to Targets, Minto Mine, 2018 ^a

Analyte	Units	Method Detection Limits	
		Target	Achieved
Total Bismuth (Bi)	mg/kg ww	0.0020	0.0020 - 0.0060
Total Boron (B)	mg/kg ww	0.20	0.20 - 0.60
Total Tellurium (Te)	mg/kg ww	0.0040	0.0040 - 0.012
Total Tin (Sn)	mg/kg ww	0.020	0.020 - 0.060

 Target LRL were exceeded.

^a Only analytes with reported values less than LRL were presented.

Table A.11: Field Duplicate Results for Analysis of Periphyton Tissue Quality, Minto Mine, 2018

Analyte		Units	Lab Report L2163146		
			LWC-5	LWC-5X	RPD (%)
			8-Sep-2018	8-Sep-2018	
Physical Tests	% Moisture	%	35	33	4.4
Metals	Total Aluminum (Al)	mg/kg ww	7,140	6,530	8.9
	Total Antimony (Sb)	mg/kg ww	0.019	0.021	10
	Total Arsenic (As)	mg/kg ww	2.78	2.77	0
	Total Barium (Ba)	mg/kg ww	93	80	15
	Total Beryllium (Be)	mg/kg ww	0.32	0.34	6.6
	Total Bismuth (Bi)	mg/kg ww	0.040	0.031	25
	Total Boron (B)	mg/kg ww	1.1	<1.0	9.5
	Total Cadmium (Cd)	mg/kg ww	0.077	0.071	8.1
	Total Calcium (Ca)	mg/kg ww	4,070	3,860	5.3
	Total Cesium (Cs)	mg/kg ww	0.58	0.84	37
	Total Chromium (Cr)	mg/kg ww	21	19	10
	Total Cobalt (Co)	mg/kg ww	7.3	7.1	3.3
	Total Copper (Cu)	mg/kg ww	9.4	8.9	5.2
	Total Iron (Fe)	mg/kg ww	13,900	13,800	0.72
	Total Lead (Pb)	mg/kg ww	3.1	2.8	9.7
	Total Lithium (Li)	mg/kg ww	5.5	5.1	7.5
	Total Magnesium (Mg)	mg/kg ww	5,440	5,310	2.4
	Total Manganese (Mn)	mg/kg ww	347	326	6.2
	Total Mercury (Hg)	mg/kg ww	0.012	0.010	11
	Total Molybdenum (Mo)	mg/kg ww	0.28	0.22	22
	Total Nickel (Ni)	mg/kg ww	20	22	6.2
	Total Phosphorus (P)	mg/kg ww	725	664	8.8
	Total Potassium (K)	mg/kg ww	698	622	12
	Total Rubidium (Rb)	mg/kg ww	5.7	5.3	7.7
	Total Selenium (Se)	mg/kg ww	0.14	<0.10	33
	Total Sodium (Na)	mg/kg ww	245	215	13
	Total Strontium (Sr)	mg/kg ww	43	36	16
	Total Tellurium (Te)	mg/kg ww	<0.020	<0.020	0
	Total Thallium (Tl)	mg/kg ww	0.041	0.038	8.7
	Total Tin (Sn)	mg/kg ww	0.13	0.10	26
	Total Uranium (U)	mg/kg ww	0.66	0.59	11
	Total Vanadium (V)	mg/kg ww	33	31	6.6
	Total Zinc (Zn)	mg/kg ww	32	33	2.8
	Total Zirconium (Zr)	mg/kg ww	6.6	6.6	0.91

 > 30% Relative Percent Differences (RPD).

Table A.12: Field Duplicate Results for Analysis of Benthic Invertebrate Tissue Quality, Minto Mine, 2018

Analyte		Units	Lab Report (L2163142)		
			LWC-1	LWC-1X	RPD (%)
			10-Sep-2018	10-Sep-2018	
Physical Tests	% Moisture	%	65	79	19
Metals	Total Aluminum (Al)	mg/kg ww	374	648	54
	Total Antimony (Sb)	mg/kg ww	0.018	0.018	1.7
	Total Arsenic (As)	mg/kg ww	0.55	0.66	18
	Total Barium (Ba)	mg/kg ww	50	63	23
	Total Beryllium (Be)	mg/kg ww	0.031	0.042	30
	Total Bismuth (Bi)	mg/kg ww	0.0049	<0.0060	20
	Total Boron (B)	mg/kg ww	1.97	1.96	0.51
	Total Cadmium (Cd)	mg/kg ww	0.26	0.37	33
	Total Calcium (Ca)	mg/kg ww	646	915	34
	Total Cesium (Cs)	mg/kg ww	0.073	0.047	43
	Total Chromium (Cr)	mg/kg ww	2.2	2.5	13
	Total Cobalt (Co)	mg/kg ww	0.76	1.4	56
	Total Copper (Cu)	mg/kg ww	6.0	9.0	40
	Total Iron (Fe)	mg/kg ww	1,070	1,770	49
	Total Lead (Pb)	mg/kg ww	0.29	0.30	2.4
	Total Lithium (Li)	mg/kg ww	0.34	0.51	40
	Total Magnesium (Mg)	mg/kg ww	640	1,100	53
	Total Manganese (Mn)	mg/kg ww	462	570	21
	Total Mercury (Hg)	mg/kg ww	0.0080	0.0068	16
	Total Molybdenum (Mo)	mg/kg ww	0.25	0.29	15
	Total Nickel (Ni)	mg/kg ww	1.8	3.0	49
	Total Phosphorus (P)	mg/kg ww	2,730	3,160	15
	Total Potassium (K)	mg/kg ww	2,630	3,700	34
	Total Rubidium (Rb)	mg/kg ww	1.3	1.5	9.3
	Total Selenium (Se)	mg/kg ww	0.48	0.52	6.2
	Total Sodium (Na)	mg/kg ww	855	1,120	27
	Total Strontium (Sr)	mg/kg ww	9.7	11	11
	Total Tellurium (Te)	mg/kg ww	<0.0080	<0.012	40
	Total Thallium (Tl)	mg/kg ww	0.0060	0.0069	15
	Total Tin (Sn)	mg/kg ww	0.29	0.18	48
	Total Uranium (U)	mg/kg ww	0.11	0.12	11
	Total Vanadium (V)	mg/kg ww	2.3	4.0	54
	Total Zinc (Zn)	mg/kg ww	22	28	25
	Total Zirconium (Zr)	mg/kg ww	0.92	0.87	5.6

 > 30% Relative Percent Differences (RPD).

Table A.13: Field Duplicate Results for Analysis of Chlorophyll-a Quality, Minto Mine, 2018

Analytes	Units	Lab Report L2163103		
		LWC-5	LWC-5X	RPD (%)
		8-Sep-2018	8-Sep-2018	
Chlorophyll-a	mg/m ²	374	465	22

 > 30% Relative Percent Difference (RPD).

A7.4 Data Accuracy

Analyte recoveries for spiked blanks all met the DQO indicating excellent analytical accuracy for periphyton (chlorophyll-a, tissue) and benthic invertebrate tissue (Appendix C).

Certified reference material met the DQO for periphyton and benthic invertebrate tissue indicating good analytical accuracy (Appendix C).



A8 DATA QUALITY STATEMENT

Water, periphyton tissue and community, and benthic community data were all of good quality compared to DQO indicating that they can be reliably interpreted. Sediment was of good quality but field variability was high. Lack of agreement between field duplicate benthic invertebrate tissue samples were observed. Over 20% of the analytes measured for benthic invertebrate duplicate tissue samples had RPDs that were greater than 30%, failing the DQO. However, variability within an area for sediment and benthic invertebrate samples is common and the basis for statistical contrasts, and is therefore considered when analyzing the data. The overall quality of data for this project was good to serve the project objectives.



APPENDIX B

SUPPORTING INFORMATION AND DATA

Figures and Tables

Laboratory Reports

APPENDIX B
SUPPORTING INFORMATION AND DATA

Figures and Tables

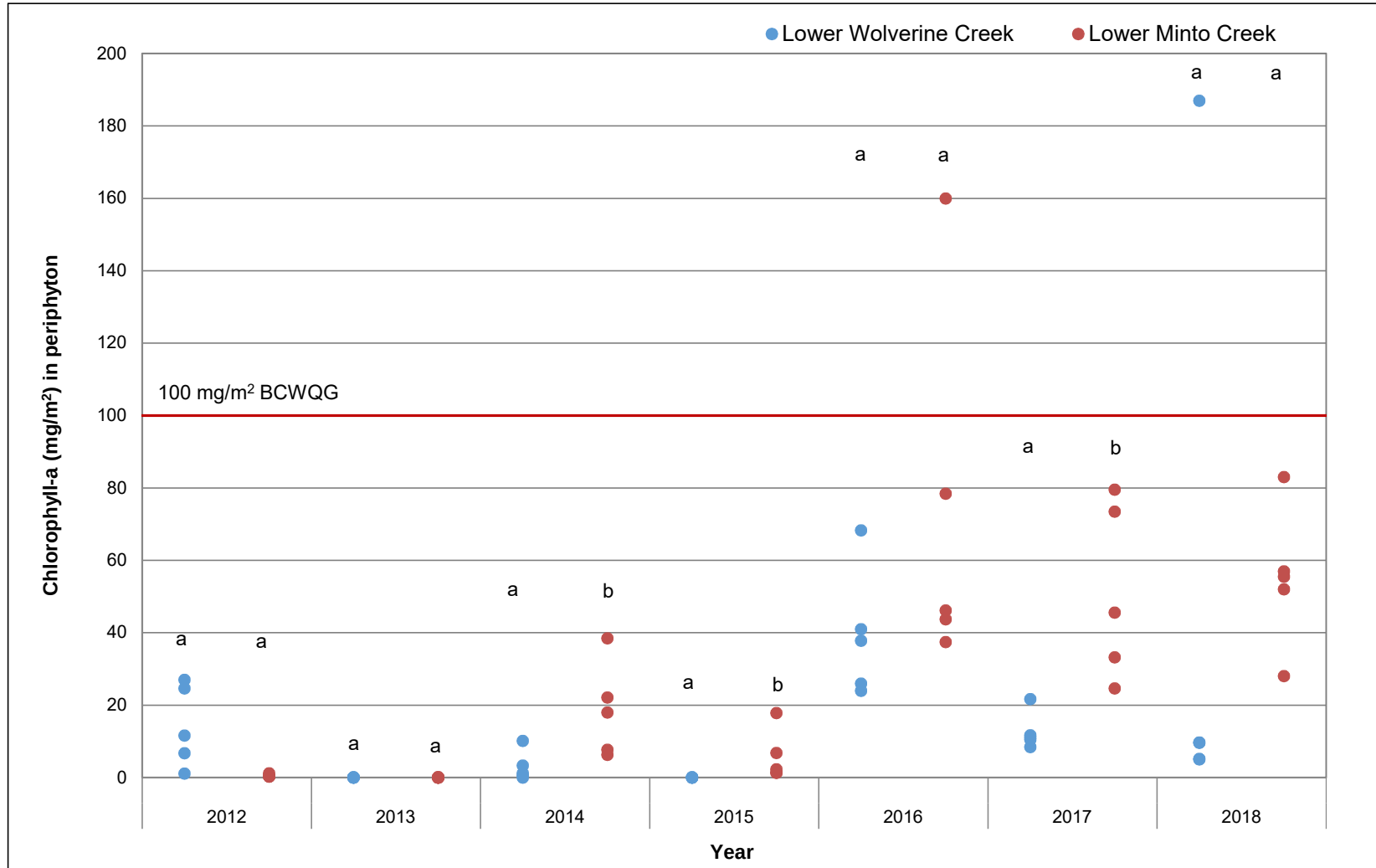


Figure B.1: Concentrations of Chlorophyll-a in Periphyton Measured in Lower Wolverine and Lower Minto Creeks, Minto Mine WUL, 2012 to 2018

Note: Different letters represent significant differences between sites within years.

Table B.1: Habitat Characteristics for Benthic Invertebrate Areas, Minto Mine, September 2018

Characteristics		Lower Wolverine Creek (Reference)	Lower Big Creek (Reference)	Lower Minto Creek (Exposed)
UTM (NAD83, Zone 8V)	Easting	382467	396635	392216
	Northing	6954827	6942456	6948008
Approximate Length of Reach Assessed (m)		150	200	25
Gradient (%)		1.5	1.0	2.0
Velocity (m/s)	Mean (min-max)	0.24 (0.21 - 0.25)	0.24 (0.22 - 0.26)	0.24 (0.22 - 0.27)
Depth (cm)	Mean	23	26	8
	Maximum	45	45	9.8
Width (m)	Wetted	8.0	20	0.84
	Bankfull	20	52	2.9
General Morphology	% pool	5	20	5
	% riffle	85	50	20
	% run	10	30	75
Bank Condition		Moderate	Moderate (some undercut banks)	Moderate (some undercut banks)
Substrate Coverage	% bedrock	0	0	0
	% boulder	10	10	1
	% cobble	65	70	24
	% gravel	5	10	5
	% sand and finer	20	10	70
Instream Cover (% total Surface)	undercut banks	30	5	30
	boulder	10	10	1
	woody debris	30	5	10
	deep pool	10	10	2
	macrophytes	0	0	0
	other	0	0	0
Overhead Canopy (%Surface)	Dense	0	0	95
	Partially Open	0	0	5
	Open	100	100	0
Aquatic Vegetation (% areal coverage)	Emergent	0	0	0
	Submergent	0	0	0
	Floating	0	0	0
	Attached Algae	0	0	0
Riparian vegetation		spruce, birch, willow	willow, birch, spruce	birch, willow, grasses
Surrounding Land Use		forested	forested	mine, forested, powerline overhead
Evidence of Anthropogenic Disturbance		none	bridge downstream, mine access road	mine upstream

Table B.2: Supporting Information for Erosional Benthic Invertebrate Grab Sample Collections, Minto Mine, September 2018

Characteristics		Lower Wolverine Creek (Reference)				
		LWC-1	LWC-2	LWC-3	LWC-4	LWC-5
Date		10-Sep-18	10-Sep-18	8-Sep-18	8-Sep-18	8-Sep-18
Time		10:34	8:17	15:23	13:06	11:06
UTM (NAD83, Zone 8V)	Easting	382423	382418	382468	382547	382557
	Northing	695612	6594721	6954827	6955028	6955139
Sampling Device		Surber	Surber	Surber	Surber	Surber
Sampler Size (m ²)		0.093	0.093	0.093	0.093	0.093
Mesh Size (µm)		500	500	500	500	500
Grabs in Composite		3	3	3	3	3
Water Velocity (m/s)		0.25	0.21	0.25	0.23	0.24
Depth (m)		5.0	6.3	4.7	5.7	6.3
Number of Jars		1	1	1	1	1
Average Depth (cm) (Sampler pushed into substrate)		1	1	1	1	1
Average Depth (cm) (Substrate is sampled/cleaned)		2	3	3	3	3
Average Sampling Time per Grab (min)		5	5	5	5	6
Macrophytes (in sample)		none	none	none	none	none
Algae (in sample)		sparse (bryophytes)	sparse (brown algae)	common (brown algae)	none	none
Sample Texture	% cobble	80	85	85	85	85
	% gravel	10	5.0	5.0	5.0	5.0
	% sand and finer	10	10	10	10	10
	% organic	0	0	0	0	0

Table B.2: Supporting Information for Erosional Benthic Invertebrate Grab Sample Collections, Minto Mine, September 2018

Characteristics		Lower Big Creek (Reference)				
		LBC-1	LBC-2	LBC-3	LBC-4	LBC-5
Date		7-Sep-18	7-Sep-18	7-Sep-18	7-Sep-18	7-Sep-18
Time		15:32	14:05	12:07	10:27	8:21
UTM (NAD83, Zone 8V)	Easting	396404	396498	396635	396626	369489
	Northing	6942224	6942216	6942456	6942531	6942696
Sampling Device		Surber	Surber	Surber	Surber	Surber
Sampler Size (m ²)		0.093	0.093	0.093	0.093	0.093
Mesh Size (µm)		500	500	500	500	500
Grabs in Composite		3	3	3	3	3
Water Velocity (m/s)		0.23	0.25	0.24	0.26	0.22
Depth (m)		6.0	6.3	5.7	5.0	6.0
Number of Jars		1	1	1	1	1
Average Depth (cm) (Sampler pushed into substrate)		1	1	1	1	2
Average Depth (cm) (Substrate is sampled/cleaned)		3	2	3	3	4
Average Sampling Time per Grab (min)		4	4	4	5	6
Macrophytes (in sample)		none	none	none	none	none
Algae (in sample)		none	none	sparse (green algae)	sparse (brown and green algae)	sparse (green filamentous algae)
Sample Texture	% cobble	85	70	80	85	85
	% gravel	5.0	10	10	5.0	5.0
	% sand and finer	10	20	10	10	10
	% organic	0	0	0	0	0

Table B.2: Supporting Information for Erosional Benthic Invertebrate Grab Sample Collections, Minto Mine, September 2018

Characteristics		Lower Minto Creek (Exposed)				
		LMC-1	LMC-2	LMC-3	LMC-4	LMC-5
Date		11-Sep-18	6-Sep-18	6-Sep-18	6-Sep-18	6-Sep-18
Time		8:43	14:58	13:01	11:00	8:37
UTM (NAD83, Zone 8V)	Easting	392106	392129	392216	392235	392265
	Northing	6948053	6948039	6948008	6948024	6948077
Sampling Device		Surber	Surber	Surber	Surber	Surber
Sampler Size (m ²)		0.093	0.093	0.093	0.093	0.093
Mesh Size (µm)		500	500	500	500	500
Grabs in Composite		3	3	3	3	3
Water Velocity (m/s)		0.25	0.24	0.22	0.24	0.27
Depth (m)		6.0	5.0	5.0	4.7	5.0
Number of Jars		1	1	1	1	1
Average Depth (cm) (Sampler pushed into substrate)		1	1	1	1	1
Average Depth (cm) (Substrate is sampled/cleaned)		3	2	3	3	3
Average Sampling Time per Grab (min)		4	5	5	5	5
Macrophytes (in sample)		none	sparse (leaves and roots)	sparse (leaves)	sparse (leaves)	common (leaves)
Algae (in sample)		none	common (brown algae)	sparse (brown and green algae)	common (brown algae)	common (brown algae)
Sample Texture	% cobble	90	80	85	80	85
	% gravel	5.0	5.0	5.0	10	5.0
	% sand and finer	5.0	15	10	10	10
	% organic	0	0	0	0	0

Table B.3: *In situ* Water Quality Measures at Sediment Sampling Stations, Minto Mine WUL, September 2018

Area	Variable	Temperature	Specific Conductance	Dissolved Oxygen	Dissolved Oxygen	pH
	Unit	°C	µS/cm	mg/L	%	pH units
	CCME Water Quality Guidelines	-	-	6.5 - 9.5	54	6.5 - 9.0 ^a
Upper McGinty Creek (Reference)	URC-1	1.9	115.4	12.07	87.0	7.62
	URC-2	1.9	116.0	11.85	85.8	7.58
	URC-3	1.9	117.2	11.74	84.8	7.55
	URC-4	1.9	117.7	11.87	85.7	7.47
	URC-5	1.9	128.2	11.28	81.2	7.21
	Mean	1.9	118.9	11.76	84.9	7.49
	Standard Deviation	0	5.3	0.29	2.2	0.16
Upper Minto Creek (Exposed)	UMC-1	2.8	484.9	9.75	72.2	7.94
	UMC-2	2.8	484.8	10.04	74.0	8.04
	UMC-3	2.6	482.9	10.01	73.6	8.06
	UMC-4	2.5	483.0	10.20	74.9	8.04
	UMC-5	2.2	471.3	7.60	55.5	7.77
	Mean	2.6	481.4	9.52	70.0	7.97
	Standard Deviation	0.25	5.7	1.09	8.2	0.12
Lower Wolverine Creek (Reference)	LWC-1	5.8	180.2	3.90	30.0	7.32
	LWC-2	5.6	177.4	5.33	42.0	7.44
	LWC-3	4.7	159.2	11.02	84.3	7.87
	LWC-4	6.6	160.8	1.68	13.3	7.19
	LWC-5	4.6	171.2	2.70	21.0	7.19
	Mean	5.5	169.8	4.93	38.1	7.40
	Standard Deviation	0.83	10	3.67	27.9	0.28
Lower Minto Creek (Exposed)	LMC-1	3.9	323.9	10.75	81.9	8.18
	LMC-2	4.0	308.3	10.06	76.8	8.14
	LMC-3	4.3	334.6	12.11	87.1	8.29
	LMC-4	4.8	316.3	12.20	95.0	8.17
	LMC-5	5.3	363.7	11.13	86.6	7.49
	Mean	4.5	329.4	11.25	85.5	8.05
	Standard Deviation	0.59	22	0.91	6.8	0.32

 Value does not meet the water quality guideline.

^a Range for the Water Use Licence is 6.0 - 9.0.

Table B.4: *In situ* Water Quality Measures at Benthic Invertebrate Sampling Stations, Minto Mine WUL, September 2018

Area	Variable	Temperature	Specific Conductance	Dissolved Oxygen	Dissolved Oxygen	pH	Mean Depth	Mean Velocity
	Unit	°C	µS/cm	mg/L	%	pH units	m	m/s
	CCME Water Quality Guidelines	-	-	6.5 - 9.5	54	6.5 - 9.0 ^a	-	-
Lower Wolverine Creek (Reference)	LWC-1	2.9	154.0	11.01	81.8	7.94	5.0	0.25
	LWC-2	3.2	160.1	10.77	80.5	6.96	6.3	0.21
	LWC-3	6.0	154.8	12.26	98.3	8.14	4.7	0.25
	LWC-4	5.4	156.9	11.99	95.1	7.95	5.7	0.23
	LWC-5	4.6	157.3	12.17	94.6	7.52	6.3	0.24
	Mean	4.4	156.6	11.64	90.1	7.70	5.6	0.24
	Standard Deviation	1.35	2.4	0.70	8.3	0.47	0.73	0.017
Lower Big Creek (Reference)	LBC-1	8.0	171.5	11.76	99.4	8.28	6.0	0.23
	LBC-2	7.2	171.8	12.01	99.4	8.25	6.3	0.25
	LBC-3	6.2	171.7	11.94	96.4	8.25	5.7	0.24
	LBC-4	5.8	171.5	11.71	93.7	8.13	5.0	0.26
	LBC-5	5.9	171.7	13.34	106.9	8.16	6.0	0.22
	Mean	6.6	171.6	12.15	99.2	8.21	5.8	0.24
	Standard Deviation	0.95	0.13	0.68	4.9	0.065	0.49	0.016
Lower Minto Creek (Exposed)	LMC-1	3.1	318.3	11.22	83.6	8.32	6.0	0.25
	LMC-2	3.2	309.8	14.83	111.0	8.64	5.0	0.24
	LMC-3	2.5	304.5	13.66	100.3	8.54	5.0	0.22
	LMC-4	2.2	315.0	13.70	99.7	8.31	4.7	0.24
	LMC-5	2.2	323.0	11.56	84.5	7.93	5.0	0.27
	Mean	2.6	314.1	12.99	95.8	8.35	5.1	0.24
	Standard Deviation	0.48	7.2	1.54	11.7	0.27	0.50	0.018

 Value does not meet the water quality guideline.

^a Range for the Water Use Licence is 6.0 - 9.0.

Table B.5: Water Quality Results at Reference and Exposed Areas, Minto Mine WUL, September 2018

Analyte		Units	URC (Reference)	UMC (Exposed)	LWC (Reference)	LBC (Reference)	LMC (Exposed)
			9-Sep-18	11-Sep-18	9-Sep-18	12-Sep-18	11-Sep-18
Physical Tests	Conductivity	µS/cm	146	556	179	209	367
	Hardness (as CaCO ₃)	mg/L	68	256	82	95	179
	pH	pH Units	7.9	8.3	8.0	8.2	8.4
	Total Suspended Solids	mg/L	8.8	3.3	<3.0	<3.0	3.7
	Total Dissolved Solids	mg/L	121	344	144	147	237
	Turbidity	NTU	1.2	0.13	0.73	1.7	0.59
Anions and Nutrients	Total Alkalinity	mg/L	61	249	81	96	178
	Total Ammonia (as N)	mg/L	<0.0050	<0.0050	0.0053	<0.0050	<0.0050
	Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl)	mg/L	<0.50	4.5	<0.50	<0.50	1.6
	Fluoride (F)	mg/L	0.26	0.53	0.12	0.11	0.42
	Nitrate (as N)	mg/L	0.054	0.11	0.020	0.063	0.053
	Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Total Dissolved Phosphorus (P)	mg/L	0.011	0.0052	0.0072	0.0037	0.0061
	Total Phosphorus (P)	mg/L	0.012	0.024	0.010	0.0042	0.0069
Cyanides	Sulphate (SO ₄)	mg/L	10	58	13	15	22
Organic/inorganic carbon	Total Cyanide	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Dissolved Organic Carbon	mg/L	17	6.4	17	7.8	8.7
	Total Inorganic Carbon	mg/L	14	60	17	22	41
Total Metals	Total Organic Carbon	mg/L	16	6.2	18	7.6	8.7
	Total Aluminum (Al)	mg/L	0.028	0.010	0.076	0.062	0.0088
	Total Antimony (Sb)	mg/L	<0.00010	<0.00010	0.00010	0.00015	<0.00010
	Total Arsenic (As)	mg/L	0.00041	0.00026	0.00047	0.00086	0.00049
	Total Barium (Ba)	mg/L	0.029	0.064	0.034	0.062	0.059
	Total Beryllium (Be)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Total Bismuth (Bi)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Total Boron (B)	mg/L	<0.010	0.023	<0.010	<0.010	<0.010
	Total Cadmium (Cd)	mg/L	<0.0000050	<0.0000050	<0.0000050	0.0000062	<0.0000050
	Total Calcium (Ca)	mg/L	18	58	18	22	43
	Total Cesium (Cs)	mg/L	<0.000010	<0.000010	<0.000010	0.000015	<0.000010
	Total Chromium (Cr)	mg/L	0.00039	0.00019	0.00058	0.00044	0.00031
	Total Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Total Copper (Cu)	mg/L	0.0014	0.0041	0.0023	0.0022	0.0018
	Total Iron (Fe)	mg/L	0.23	0.019	0.21	0.086	0.059
	Total Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	0.000056	<0.000050
	Total Lithium (Li)	mg/L	<0.0010	0.0030	0.0015	0.0014	0.0016
	Total Magnesium (Mg)	mg/L	5.9	31	10	9.0	17
	Total Manganese (Mn)	mg/L	0.013	0.040	0.0071	0.0093	0.0022
	Total Mercury (Hg)	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Total Molybdenum (Mo)	mg/L	0.00091	0.0046	0.00042	0.0012	0.0016
	Total Nickel (Ni)	mg/L	0.00096	0.00099	0.0018	0.0011	0.00090
	Total Phosphorus (P)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050
	Total Potassium (K)	mg/L	0.41	2.4	0.58	0.78	1.5
	Total Rubidium (Rb)	mg/L	<0.00020	0.00032	0.00044	0.00075	0.00052
	Total Selenium (Se)	mg/L	0.00026	0.00017	0.00013	0.000067	0.00015
	Total Silicon (Si)	mg/L	5.8	3.8	5.3	5.8	5.6
	Total Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Total Sodium (Na)	mg/L	3.9	19	6.5	6.6	10
	Total Strontium (Sr)	mg/L	0.13	0.71	0.16	0.23	0.43
	Total Sulfur (S)	mg/L	3.0	11	4.4	4.2	6.8
	Total Tellurium (Te)	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Total Thallium (Tl)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Total Thorium (Th)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Total Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Total Titanium (Ti)	mg/L	<0.00090	0.00034	<0.0027	0.0017	<0.00060
	Total Tungsten (W)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Total Uranium (U)	mg/L	0.00035	0.0028	0.00052	0.0023	0.0020
	Total Vanadium (V)	mg/L	0.00055	<0.00050	0.0011	0.00084	0.00075
	Total Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Total Zirconium (Zr)	mg/L	0.00041	0.00011	0.00055	0.00024	0.00015
Dissolved Metals	Dissolved Aluminum (Al)	mg/L	0.025	<0.0020	0.029	0.016	<0.0040
	Dissolved Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	0.00014	<0.00010
	Dissolved Arsenic (As)	mg/L	0.00039	0.00025	0.00043	0.00074	0.00045
	Dissolved Barium (Ba)	mg/L	0.028	0.068	0.030	0.060	0.059
	Dissolved Beryllium (Be)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Dissolved Bismuth (Bi)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Dissolved Boron (B)	mg/L	<0.010	0.022	<0.010	<0.010	<0.010
	Dissolved Cadmium (Cd)	mg/L	<0.0000050	0.0000062	0.0000052	0.0000064	<0.0000050
	Dissolved Calcium (Ca)	mg/L	18	55	17	22	44
	Dissolved Cesium (Cs)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Dissolved Chromium (Cr)	mg/L	0.00038	<0.00010	0.00048	0.00019	0.00019
	Dissolved Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Dissolved Copper (Cu)	mg/L	0.0014	0.0028	0.0020	0.0019	0.0016
	Dissolved Iron (Fe)	mg/L	0.19	0.014	0.14	0.032	0.040
	Dissolved Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Dissolved Lithium (Li)	mg/L	<0.0010	0.0029	0.0014	0.0013	0.0015
	Dissolved Magnesium (Mg)	mg/L	5.5	29	9.5	9.7	17
	Dissolved Manganese (Mn)	mg/L	0.012	0.037	0.0045	0.0067	0.00087
	Dissolved Mercury (Hg)	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Dissolved Molybdenum (Mo)	mg/L	0.00088	0.0050	0.00045	0.0012	0.0017
	Dissolved Nickel (Ni)	mg/L	0.00094	0.00092	0.0016	0.00088	0.00084
	Dissolved Phosphorus (P)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050
	Dissolved Potassium (K)	mg/L	0.41	2.3	0.55	0.78	1.5
	Dissolved Rubidium (Rb)	mg/L	<0.00020	0.00028	0.00033	0.00063	0.00050
	Dissolved Selenium (Se)	mg/L	0.00028	0.00033	0.000077	0.000071	0.00016
	Dissolved Silicon (Si)	mg/L	5.7	5.8	5.0	5.9	5.9
	Dissolved Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Dissolved Sodium (Na)	mg/L	3.7	18	6.1	6.7	9.8
	Dissolved Strontium (Sr)	mg/L	0.12	0.77	0.16	0.25	0.46
	Dissolved Sulfur (S)	mg/L	3.0	19	4.2	4.8	7.9
	Dissolved Tellurium (Te)	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Dissolved Thallium (Tl)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Dissolved Thorium (Th)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Dissolved Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Dissolved Titanium (Ti)	mg/L	0.00061	<0.00030	<0.00090	<0.00030	<0.00030
	Dissolved Tungsten (W)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Dissolved Uranium (U)	mg/L	0.00035	0.0027	0.00048	0.0022	0.0019
	Dissolved Vanadium (V)	mg/L	<0.00050	<0.00050	0.00088	0.00070	0.00059
	Dissolved Zinc (Zn)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Dissolved Zirconium (Zr)	mg/L	0.00040	0.000090	0.00049	0.00024	0.00015

Table B.6: Explanatory Notes for Selected Water Quality Guidelines, Minto Mine WUL, 2018

Analyte		Water Quality Guidelines	Unit	CCME ^a
Physical, anion and nutrient analytes	Total Ammonia	0.41	mg/L	Ammonia guideline is based on highest field pH of 8.32 and highest temperature of 6.3°C
	Fluoride	0.12	mg/L	Guideline is an interim level
Total Metals	Aluminum	0.10	mg/L	Guideline is based on pH of > 6.5
	Cadmium	0.00012 / 0.0014 ^b	mg/L	Guideline is based on lowest hardness of 68.1 mg/L
	Chromium	0.0010	mg/L	Guideline is based hexavalent chromium (Cr VI)
	Copper	0.0020	mg/L	Guideline is based on lowest hardness of 68.1 mg/L
	Lead	0.0020	mg/L	Guideline is based on lowest hardness of 68.1 mg/L
	Nickel	0.071	mg/L	Guideline is based on lowest hardness of 68.1 mg/L
	Zinc	0.024 / 0.11 ^b	mg/L	Guidelines are based on 25% percentile hardness, pH, and DOC

^a CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Environmental Quality Guidelines. 1999 (plus updates), Canadian Council of Ministers of the Environment, Winnipeg.

^b Long-term / Short-term guidelines.

Table B.7: Comparison of Water Quality Results at Reference and Exposed Areas in 2017 and 2018, Minto Mine WUL

Analyte		Units	CCME Water Quality Guidelines ^a		WUL Objectives at W2	2017					2018				
			Long-term	Short-term		Upper McGinty Creek (Reference)	Upper Minto Creek (Exposed)	Lower Wolverine Creek (Reference)	Lower Big Creek (Reference)	Lower Minto Creek (Exposed)	Upper McGinty Creek (Reference)	Upper Minto Creek (Exposed)	Lower Wolverine Creek (Reference)	Lower Big Creek (Reference)	Lower Minto Creek (Exposed)
Physical Tests	Total Suspended Solids	mg/L	-	-	-	<3.0	<3.0	3.1	<3.0	3.5	8.8	3.3	<3.0	<3.0	3.7
Total Metals	Total Aluminum (Al)	mg/L	0.10 ^b	-	-	0.022	0.0055	0.038	0.038	0.018	0.028	0.010	0.076	0.062	0.0088
	Total Antimony (Sb)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	0.00014	<0.00010	<0.00010	<0.00010	0.00010	0.00015	<0.00010
	Total Arsenic (As)	mg/L	0.0050	-	-	0.00042	0.00025	0.00045	0.00081	0.00048	0.00041	0.00026	0.00047	0.00086	0.00049
	Total Barium (Ba)	mg/L	-	-	-	0.032	0.068	0.041	0.066	0.060	0.029	0.064	0.034	0.062	0.059
	Total Beryllium (Be)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Total Bismuth (Bi)	mg/L	-	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Total Boron (B)	mg/L	1.5	29	-	<0.010	0.025	<0.010	<0.010	<0.010	<0.010	0.023	<0.010	<0.010	<0.010
	Total Cadmium (Cd)	mg/L	0.00012 ^c	0.0014 ^c	-	<0.0000050	<0.0000050	<0.0000050	0.0000078	<0.0000050	<0.0000050	<0.0000050	<0.0000050	0.0000062	<0.0000050
	Total Calcium (Ca)	mg/L	-	-	-	24	59	24	26	45	18	58	18	22	43
	Total Cesium (Cs)	mg/L	-	-	-	-	-	-	-	-	<0.000010	<0.000010	<0.000010	0.000015	<0.000010
	Total Chromium (Cr)	mg/L	0.0010 Cr(VI)	-	-	0.00034	<0.00010	0.00052	0.00030	0.00024	0.00039	0.00019	0.00058	0.00044	0.00031
	Total Cobalt (Co)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Total Copper (Cu)	mg/L	0.0020 ^c	-	-	0.0012	0.0025	0.0019	0.0019	0.0016	0.0014	0.0041	0.0023	0.0022	0.0018
	Total Iron (Fe)	mg/L	0.30	-	-	0.26	0.025	0.13	0.079	0.067	0.23	0.019	0.21	0.086	0.059
	Total Lead (Pb)	mg/L	0.0020 ^c	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000056	<0.000050
	Total Lithium (Li)	mg/L	-	-	-	<0.0010	0.0032	0.0016	0.0012	0.0014	<0.0010	0.0030	0.0015	0.0014	0.0016
	Total Magnesium (Mg)	mg/L	-	-	-	6.6	29	13	10	16	5.9	31	10	9.0	17
	Total Manganese (Mn)	mg/L	-	-	-	0.021	0.047	0.0058	0.015	0.0034	0.013	0.040	0.0071	0.0093	0.0022
	Total Mercury (Hg)	mg/L	0.000026	-	-	<0.0000050	<0.0000050	<0.0000050	<0.000025	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Total Molybdenum (Mo)	mg/L	0.073	-	-	0.0013	0.0048	0.00057	0.0013	0.0016	0.00091	0.0046	0.00042	0.0012	0.0016
	Total Nickel (Ni)	mg/L	0.071 ^c	-	-	0.00091	0.00092	0.0017	0.0011	0.00097	0.00096	0.00099	0.0018	0.0011	0.00090
	Total Phosphorus (P)	mg/L	-	-	-	<0.30	<0.30	<0.30	<0.30	<0.30	<0.050	<0.050	<0.050	<0.050	<0.050
	Total Potassium (K)	mg/L	-	-	-	0.59	2.4	0.76	0.87	1.5	0.41	2.4	0.58	0.78	1.5
	Total Rubidium (Rb)	mg/L	-	-	-	-	-	-	-	-	<0.00020	0.00032	0.00044	0.00075	0.00052
	Total Selenium (Se)	mg/L	0.0010	-	-	0.00036	0.00031	0.00011	0.000072	0.000081	0.00026	0.00017	0.00013	0.000067	0.00015
	Total Silicon (Si)	mg/L	-	-	-	6.4	6.3	5.2	5.9	6.2	5.8	3.8	5.3	5.8	5.6
	Total Silver (Ag)	mg/L	0.00025	-	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Total Sodium (Na)	mg/L	-	-	-	4.4	19	8.5	7.8	10	3.9	19	6.5	6.6	10
	Total Strontium (Sr)	mg/L	-	-	-	0.16	0.77	0.22	0.28	0.45	0.13	0.71	0.16	0.23	0.43
	Total Sulfur (S)	mg/L	-	-	-	-	-	-	-	-	3.0	11	4.4	4.2	6.8
	Total Tellurium (Te)	mg/L	-	-	-	-	-	-	-	-	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Total Thallium (Tl)	mg/L	0.00080	-	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Total Thorium (Th)	mg/L	-	-	-	-	-	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Total Tin (Sn)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Total Titanium (Ti)	mg/L	-	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.00090	0.00034	<0.0027	0.0017	<0.00060
	Total Tungsten (W)	mg/L	-	-	-	-	-	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Total Uranium (U)	mg/L	0.015	0.033	-	0.00054	0.0026	0.00081	0.0028	0.0017	0.00035	0.0028	0.00052	0.0023	0.0020
	Total Vanadium (V)	mg/L	-	-	-	0.00056	<0.00050	0.00091	0.00081	0.00060	0.00055	<0.00050	0.0011	0.00084	0.00075
	Total Zinc (Zn)	mg/L	0.024 ^d	0.11 ^d	-	0.0051	<0.0030	<0.0030	<0.0030	0.0044	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Total Zirconium (Zr)	mg/L	-	-	-	-	-	-	-	-	0.00041	0.00011	0.00055	0.00024	0.00015

Water quality guideline not met.

Water use licence objectives not met.

^a CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Environmental Quality Guidelines. 1999 (plus updates), Canadian Council of Ministers of the Environment, Winnipeg. See Appendix Table B.6 for explanatory notes on selected water quality guidelines.

^b Based on lowest guideline using highest pH.

^c Based on lowest guideline using lowest hardness.

^d Based on guideline using 25th percentile of hardness, DOC, and field pH.

^e Dissolved Cadmium (µg/L) guidelines based on the following formula using the lowest hardness: $e^{(0.736(\ln(\text{Hardness})-4.943))}$.

^f Dissolved copper water quality objective depends on concentration of dissolved organic carbon (DOC). If DOC is > 10 mg/L/ DOC is ≤ 10 mg/L.

Table B.7: Comparison of Water Quality Results at Reference and Exposed Areas in 2017 and 2018, Minto Mine WUL

Analyte		Units	CCME Water Quality Guidelines ^a		WUL Objectives at W2	2017					2018				
			Long-term	Short-term		Upper McGinty Creek (Reference)	Upper Minto Creek (Exposed)	Lower Wolverine Creek (Reference)	Lower Big Creek (Reference)	Lower Minto Creek (Exposed)	Upper McGinty Creek (Reference)	Upper Minto Creek (Exposed)	Lower Wolverine Creek (Reference)	Lower Big Creek (Reference)	Lower Minto Creek (Exposed)
Dissolved Metals	Dissolved Aluminum (Al)	mg/L	-	-	0.10	0.0056	0.0029	0.020	0.013	0.0050	0.025	<0.0020	0.029	0.016	<0.0040
	Dissolved Antimony (Sb)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	0.00012	<0.00010	<0.00010	<0.00010	<0.00010	0.00014	<0.00010
	Dissolved Arsenic (As)	mg/L	-	-	0.0050	0.00019	0.00024	0.00041	0.00067	0.00046	0.00039	0.00025	0.00043	0.00074	0.00045
	Dissolved Barium (Ba)	mg/L	-	-	-	0.022	0.071	0.041	0.068	0.063	0.028	0.068	0.030	0.060	0.059
	Dissolved Beryllium (Be)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Dissolved Bismuth (Bi)	mg/L	-	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Dissolved Boron (B)	mg/L	-	-	-	<0.010	0.021	<0.010	<0.010	<0.010	<0.010	0.022	<0.010	<0.010	<0.010
	Dissolved Cadmium (Cd)	mg/L	-	-	0.00016 ^e	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	0.0000062	0.0000052	0.0000064	<0.0000050
	Dissolved Calcium (Ca)	mg/L	-	-	-	33	56	22	24	42	18	55	17	22	44
	Dissolved Cesium (Cs)	mg/L	-	-	-	-	-	-	-	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Dissolved Chromium (Cr)	mg/L	-	-	0.0010	0.00015	<0.00010	0.00041	0.00021	0.00019	0.00038	<0.00010	0.00048	0.00019	0.00019
	Dissolved Cobalt (Co)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Dissolved Copper (Cu)	mg/L	-	-	0.020/0.013 ^f	0.00032	0.0025	0.0033	0.0017	0.0015	0.0014	0.0028	0.0020	0.0019	0.0016
	Dissolved Iron (Fe)	mg/L	-	-	1.1	0.055	0.020	0.090	0.039	0.040	0.19	0.014	0.14	0.032	0.040
	Dissolved Lead (Pb)	mg/L	-	-	0.0040	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Dissolved Lithium (Li)	mg/L	-	-	-	<0.0010	0.0033	0.0019	0.0016	0.0017	<0.0010	0.0029	0.0014	0.0013	0.0015
	Dissolved Magnesium (Mg)	mg/L	-	-	-	9.2	29	13	10	17	5.5	29	9.5	9.7	17
	Dissolved Manganese (Mn)	mg/L	-	-	-	0.0060	0.047	0.0035	0.013	0.0022	0.012	0.037	0.0045	0.0067	0.00087
	Dissolved Mercury (Hg)	mg/L	-	-	-	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Dissolved Molybdenum (Mo)	mg/L	-	-	0.073	0.0029	0.0041	0.00049	0.0011	0.0014	0.00088	0.0050	0.00045	0.0012	0.0017
	Dissolved Nickel (Ni)	mg/L	-	-	0.11	<0.00050	0.00081	0.0016	0.00090	0.00086	0.00094	0.00092	0.0016	0.00088	0.00084
	Dissolved Phosphorus (P)	mg/L	-	-	-	<0.30	<0.30	<0.30	<0.30	<0.30	<0.050	<0.050	<0.050	<0.050	<0.050
	Dissolved Potassium (K)	mg/L	-	-	-	0.73	2.5	0.79	0.90	1.6	0.41	2.3	0.55	0.78	1.5
	Dissolved Rubidium (Rb)	mg/L	-	-	-	-	-	-	-	-	<0.00020	0.00028	0.00033	0.00063	0.00050
	Dissolved Selenium (Se)	mg/L	-	-	0.0020	0.00086	0.00032	0.00010	<0.000050	0.00010	0.00028	0.00033	0.000077	0.000071	0.00016
	Dissolved Silicon (Si)	mg/L	-	-	-	5.7	6.0	4.9	5.6	6.0	5.7	5.8	5.0	5.9	5.9
	Dissolved Silver (Ag)	mg/L	-	-	0.00010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Dissolved Sodium (Na)	mg/L	-	-	-	6.5	19	8.6	7.8	11	3.7	18	6.1	6.7	9.8
	Dissolved Strontium (Sr)	mg/L	-	-	-	0.25	0.71	0.20	0.26	0.43	0.12	0.77	0.16	0.25	0.46
	Dissolved Sulfur (S)	mg/L	-	-	-	-	-	-	-	-	3.0	19	4.2	4.8	7.9
	Dissolved Tellurium (Te)	mg/L	-	-	-	-	-	-	-	-	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Dissolved Thallium (Tl)	mg/L	-	-	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Dissolved Thorium (Th)	mg/L	-	-	-	-	-	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Dissolved Tin (Sn)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Dissolved Titanium (Ti)	mg/L	-	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	0.00061	<0.00030	<0.00090	<0.00030	<0.00030
	Dissolved Tungsten (W)	mg/L	-	-	-	-	-	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Dissolved Uranium (U)	mg/L	-	-	-	0.0012	0.0023	0.00069	0.0025	0.0016	0.00035	0.0027	0.00048	0.0022	0.0019
	Dissolved Vanadium (V)	mg/L	-	-	-	0.0011	<0.00050	0.00086	0.00074	0.00057	<0.00050	<0.00050	0.00088	0.00070	0.00059
	Dissolved Zinc (Zn)	mg/L	-	-	0.030	<0.0010	<0.0010	<0.0010	<0.0010	0.0027	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Dissolved Zirconium (Zr)	mg/L	-	-	-	-	-	-	-	-	0.00040	0.000090	0.00049	0.00024	0.00015

Water quality guideline not met.

Water use licence objectives not met.

^a CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Environmental Quality Guidelines. 1999 (plus updates), Canadian Council of Ministers of the Environment, Winnipeg. See Appendix Table B.6 for explanatory notes on selected water quality guidelines.

^b Based on lowest guideline using highest pH.

^c Based on lowest guideline using lowest hardness.

^d Based on guideline using 25th percentile of hardness, DOC, and field pH.

^e Dissolved Cadmium (µg/L) guidelines based on the following formula using the lowest hardness: $e^{(0.736(\ln(\text{Hardness})-4.943))}$.

^f Dissolved copper water quality objective depends on concentration of dissolved organic carbon (DOC). If DOC is > 10 mg/L/ DOC is ≤ 10 mg/L.

Table B.8: Concentration of Chlorophyll-a Measured at Five Benthic Stations in Lower Wolverine and Lower Minto Creeks, Minto Mine WUL, 2018

Lower Wolverine Creek (Reference)		Lower Minto Creek (Exposed)	
Station	mg/m ²	Station	mg/m ²
LWC-1	5.2	LMC-1	52
LWC-2	9.7	LMC-2	56
LWC-3	9.6	LMC-3	83
LWC-4	5.0	LMC-4	28
LWC-5	187	LMC-5	57
Mean	43	Mean	55
Standard Deviation	80	Standard Deviation	20

 Chlorophyll-a exceeded the BCWQG of 100 mg/m².

APPENDIX B
SUPPORTING INFORMATION AND DATA

Laboratory Reports



MINNOW ENVIRONMENTAL INC.
ATTN: Lisa Bowron
101 - 1025 Hillside Ave.
Victoria BC V8T 2A2

Date Received: 10-SEP-18
Report Date: 13-SEP-18 16:21 (MT)
Version: FINAL

Client Phone: 250-595-1627

Certificate of Analysis

Lab Work Order #: L2161443
Project P.O. #: NOT SUBMITTED
Job Reference: MINNOW PROJECT
C of C Numbers: 1 of 1
Legal Site Desc:

Can Dang
Senior Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2161443-1 Water 09-SEP-18 08:55 URC	L2161443-2 Water 09-SEP-18 16:10 LWC			
Grouping	Analyte						
WATER							
Physical Tests	Conductivity (uS/cm)		146	179			
	Hardness (as CaCO3) (mg/L)		68.1	82.3			
	pH (pH)		7.85	8.04			
	Total Suspended Solids (mg/L)		8.8	<3.0			
	Total Dissolved Solids (mg/L)		121	144			
	Turbidity (NTU)		1.22	0.73			
Anions and Nutrients	Alkalinity, Total (as CaCO3) (mg/L)		60.5	80.6			
	Ammonia, Total (as N) (mg/L)		<0.0050	0.0053			
	Bromide (Br) (mg/L)		<0.050	<0.050			
	Chloride (Cl) (mg/L)		<0.50	<0.50			
	Fluoride (F) (mg/L)		0.260	0.117			
	Nitrate (as N) (mg/L)		0.0535	0.0201			
	Nitrite (as N) (mg/L)		<0.0010	<0.0010			
	Phosphorus (P)-Total Dissolved (mg/L)		0.0114	0.0072			
	Phosphorus (P)-Total (mg/L)		0.0120	0.0101			
	Sulfate (SO4) (mg/L)		10.1	13.3			
Cyanides	Cyanide, Total (mg/L)		<0.0050	<0.0050			
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)		17.2	17.2			
	Total Inorganic Carbon (mg/L)		13.8	17.4			
	Total Organic Carbon (mg/L)		16.1	17.7			
Total Metals	Aluminum (Al)-Total (mg/L)		0.0282	0.0761			
	Antimony (Sb)-Total (mg/L)		<0.00010	0.00010			
	Arsenic (As)-Total (mg/L)		0.00041	0.00047			
	Barium (Ba)-Total (mg/L)		0.0285	0.0337			
	Beryllium (Be)-Total (mg/L)		<0.00010	<0.00010			
	Bismuth (Bi)-Total (mg/L)		<0.000050	<0.000050			
	Boron (B)-Total (mg/L)		<0.010	<0.010			
	Cadmium (Cd)-Total (mg/L)		<0.0000050	<0.0000050			
	Calcium (Ca)-Total (mg/L)		18.3	17.9			
	Cesium (Cs)-Total (mg/L)		<0.000010	<0.000010			
	Chromium (Cr)-Total (mg/L)		0.00039	0.00058			
	Cobalt (Co)-Total (mg/L)		<0.00010	<0.00010			
	Copper (Cu)-Total (mg/L)		0.00143	0.00234			
	Iron (Fe)-Total (mg/L)		0.226	0.214			
	Lead (Pb)-Total (mg/L)		<0.000050	<0.000050			
	Lithium (Li)-Total (mg/L)		<0.0010	0.0015			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2161443-1 Water 09-SEP-18 08:55 URC	L2161443-2 Water 09-SEP-18 16:10 LWC			
Grouping	Analyte						
WATER							
Total Metals	Magnesium (Mg)-Total (mg/L)	5.85	10.2				
	Manganese (Mn)-Total (mg/L)	0.0130	0.00711				
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050				
	Molybdenum (Mo)-Total (mg/L)	0.000911	0.000420				
	Nickel (Ni)-Total (mg/L)	0.00096	0.00177				
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050				
	Potassium (K)-Total (mg/L)	0.413	0.576				
	Rubidium (Rb)-Total (mg/L)	<0.00020	0.00044				
	Selenium (Se)-Total (mg/L)	0.000261	0.000133				
	Silicon (Si)-Total (mg/L)	5.80	5.33				
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010				
	Sodium (Na)-Total (mg/L)	3.89	6.47				
	Strontium (Sr)-Total (mg/L)	0.128	0.161				
	Sulfur (S)-Total (mg/L)	3.04	4.40				
	Tellurium (Te)-Total (mg/L)	<0.00020	<0.00020				
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010				
	Thorium (Th)-Total (mg/L)	<0.00010	<0.00010				
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010				
	Titanium (Ti)-Total (mg/L)	<0.00090 ^{DLM}	<0.0027 ^{DLM}				
	Tungsten (W)-Total (mg/L)	<0.00010	<0.00010				
	Uranium (U)-Total (mg/L)	0.000354	0.000522				
	Vanadium (V)-Total (mg/L)	0.00055	0.00110				
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030				
	Zirconium (Zr)-Total (mg/L)	0.000409	0.000548				
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD				
	Dissolved Metals Filtration Location	FIELD	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	0.0249	0.0294				
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010				
	Arsenic (As)-Dissolved (mg/L)	0.00039	0.00043				
	Barium (Ba)-Dissolved (mg/L)	0.0281	0.0300				
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010				
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050				
	Boron (B)-Dissolved (mg/L)	<0.010	<0.010				
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	0.0000052				
	Calcium (Ca)-Dissolved (mg/L)	18.2	17.2				
	Cesium (Cs)-Dissolved (mg/L)	<0.000010	<0.000010				
	Chromium (Cr)-Dissolved (mg/L)	0.00038	0.00048				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2161443-1 Water 09-SEP-18 08:55 URC	L2161443-2 Water 09-SEP-18 16:10 LWC			
Grouping	Analyte						
WATER							
Dissolved Metals	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010				
	Copper (Cu)-Dissolved (mg/L)	0.00136	0.00204				
	Iron (Fe)-Dissolved (mg/L)	0.185	0.136				
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050				
	Lithium (Li)-Dissolved (mg/L)	<0.0010	0.0014				
	Magnesium (Mg)-Dissolved (mg/L)	5.52	9.54				
	Manganese (Mn)-Dissolved (mg/L)	0.0116	0.00446				
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050				
	Molybdenum (Mo)-Dissolved (mg/L)	0.000883	0.000445				
	Nickel (Ni)-Dissolved (mg/L)	0.00094	0.00162				
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050				
	Potassium (K)-Dissolved (mg/L)	0.407	0.547				
	Rubidium (Rb)-Dissolved (mg/L)	<0.00020	0.00033				
	Selenium (Se)-Dissolved (mg/L)	0.000281	0.000077				
	Silicon (Si)-Dissolved (mg/L)	5.68	5.00				
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010				
	Sodium (Na)-Dissolved (mg/L)	3.70	6.07				
	Strontium (Sr)-Dissolved (mg/L)	0.124	0.155				
	Sulfur (S)-Dissolved (mg/L)	3.00	4.17				
	Tellurium (Te)-Dissolved (mg/L)	<0.00020	<0.00020				
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010				
	Thorium (Th)-Dissolved (mg/L)	<0.00010	<0.00010				
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010				
	Titanium (Ti)-Dissolved (mg/L)	0.00061	<0.00090 ^{DLM}				
	Tungsten (W)-Dissolved (mg/L)	<0.00010	<0.00010				
	Uranium (U)-Dissolved (mg/L)	0.000348	0.000483				
	Vanadium (V)-Dissolved (mg/L)	<0.00050	0.00088				
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010				
	Zirconium (Zr)-Dissolved (mg/L)	0.000396	0.000493				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Total Inorganic Carbon	MS-B	L2161443-1, -2
Matrix Spike	Total Inorganic Carbon	MS-B	L2161443-1, -2
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2161443-1, -2
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2161443-1, -2
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2161443-1, -2
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2161443-1, -2
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2161443-1, -2
Matrix Spike	Barium (Ba)-Total	MS-B	L2161443-1, -2
Matrix Spike	Calcium (Ca)-Total	MS-B	L2161443-1, -2
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2161443-1, -2
Matrix Spike	Sodium (Na)-Total	MS-B	L2161443-1, -2
Matrix Spike	Strontium (Sr)-Total	MS-B	L2161443-1, -2

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
BR-L-IC-N-WR	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CARBONS-TIC-VA	Water	Total inorganic carbon by CO2 purge	APHA 5310B TOTAL ORGANIC CARBON (TOC)
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".			
CARBONS-TOC-VA	Water	Total organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".			
CL-IC-N-WR	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
CN-T-CFA-VA	Water	Total Cyanide in water by CFA	ISO 14403:2002
This analysis is carried out using procedures adapted from ISO Method 14403:2002 "Determination of Total Cyanide using Flow Analysis (FIA and CFA)". Total or strong acid dissociable (SAD) cyanide is determined by in-line UV digestion along with sample distillation and final determination by colourimetric analysis. Method Limitation: This method is susceptible to interference from thiocyanate (SCN). If SCN is present in the sample, there could be a positive interference with this method, but it would be less than 1% and could be as low as zero.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
F-IC-N-WR	Water	Fluoride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)

Reference Information

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-WR Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

P-T-PRES-COL-VA Water Total P in Water by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.

Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

P-TD-COL-VA Water Total Dissolved P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorus is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-VA Water Total Dissolved Solids by Gravimetric APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

Reference Information

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

1 of 1

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lw - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



GENF 20.00 Front

8/0



MINNOW ENVIRONMENTAL INC.
ATTN: Lisa Bowron
101 - 1025 Hillside Ave.
Victoria BC V8T 2A2

Date Received: 12-SEP-18
Report Date: 17-SEP-18 18:50 (MT)
Version: FINAL

Client Phone: 250-595-1627

Certificate of Analysis

Lab Work Order #: L2163084
Project P.O. #: NOT SUBMITTED
Job Reference: MINNOW PROJECT 18-48
C of C Numbers: 1 of 1
Legal Site Desc:

Can Dang
Senior Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2163084-1 Water 11-SEP-18 14:10 UMC	L2163084-2 Water 11-SEP-18 14:10 UMCX	L2163084-3 Water 11-SEP-18 09:15 LMC	L2163084-4 Water 12-SEP-18 09:30 LBC	
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	556	558	367	209	
	Hardness (as CaCO3) (mg/L)	256	270	179	95.1	
	pH (pH)	8.28	8.28	8.41	8.16	
	Total Suspended Solids (mg/L)	3.3	4.9	3.7	<3.0	
	Total Dissolved Solids (mg/L)	344	349	237	147	
	Turbidity (NTU)	0.13	0.19	0.59	1.65	
Anions and Nutrients	Alkalinity, Total (as CaCO3) (mg/L)	249	248	178	95.9	
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Chloride (Cl) (mg/L)	4.53	4.53	1.62	<0.50	
	Fluoride (F) (mg/L)	0.529	0.537	0.422	0.114	
	Nitrate (as N) (mg/L)	0.107	0.108	0.0529	0.0632	
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Phosphorus (P)-Total Dissolved (mg/L)	0.0052 ^{HTD}	0.0051 ^{HTD}	0.0061 ^{HTD}	0.0037 ^{HTD}	
	Phosphorus (P)-Total (mg/L)	0.0240	0.0053	0.0069	0.0042	
	Sulfate (SO4) (mg/L)	58.0	58.0	21.7	14.5	
Cyanides	Cyanide, Total (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	6.41	6.35	8.67	7.82	
	Total Inorganic Carbon (mg/L)	60.3	57.0	40.6	21.6	
	Total Organic Carbon (mg/L)	6.19	6.25	8.71	7.58	
Total Metals	Aluminum (Al)-Total (mg/L)	0.0100	0.0449	0.0088	0.0622	
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	0.00015	
	Arsenic (As)-Total (mg/L)	0.00026	0.00027	0.00049	0.00086	
	Barium (Ba)-Total (mg/L)	0.0635	0.0645	0.0589	0.0624	
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Total (mg/L)	0.023	0.023	<0.010	<0.010	
	Cadmium (Cd)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	0.0000062	
	Calcium (Ca)-Total (mg/L)	57.5	56.9	42.8	21.9	
	Cesium (Cs)-Total (mg/L)	<0.000010	<0.000010	<0.000010	0.000015	
	Chromium (Cr)-Total (mg/L)	0.00019	0.00050	0.00031	0.00044	
	Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Copper (Cu)-Total (mg/L)	0.00405	0.0129	0.00177	0.00215	
	Iron (Fe)-Total (mg/L)	0.019	0.085	0.059	0.086	
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	0.000056	
	Lithium (Li)-Total (mg/L)	0.0030	0.0031	0.0016	0.0014	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2163084-1 Water 11-SEP-18 14:10 UMC	L2163084-2 Water 11-SEP-18 14:10 UMCX	L2163084-3 Water 11-SEP-18 09:15 LMC	L2163084-4 Water 12-SEP-18 09:30 LBC	
Grouping	Analyte						
WATER							
Total Metals	Magnesium (Mg)-Total (mg/L)	30.5	29.0	16.6	9.04		
	Manganese (Mn)-Total (mg/L)	0.0402	0.0427	0.00221	0.00931		
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Total (mg/L)	0.00459	0.00474	0.00163	0.00118		
	Nickel (Ni)-Total (mg/L)	0.00099	0.00103	0.00090	0.00111		
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050		
	Potassium (K)-Total (mg/L)	2.38	2.36	1.52	0.779		
	Rubidium (Rb)-Total (mg/L)	0.00032	0.00041	0.00052	0.00075		
	Selenium (Se)-Total (mg/L)	0.000169	0.000282	0.000152	0.000067		
	Silicon (Si)-Total (mg/L)	3.76	6.06	5.61	5.76		
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010		
	Sodium (Na)-Total (mg/L)	19.1	18.5	10.1	6.64		
	Strontium (Sr)-Total (mg/L)	0.707	0.716	0.431	0.230		
	Sulfur (S)-Total (mg/L)	11.1	19.5	6.82	4.23		
	Tellurium (Te)-Total (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020		
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010		
	Thorium (Th)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010		
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010		
	Titanium (Ti)-Total (mg/L)	0.00034	0.00253	<0.00060 ^{DLM}	0.00174		
	Tungsten (W)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010		
	Uranium (U)-Total (mg/L)	0.00278	0.00284	0.00198	0.00233		
	Vanadium (V)-Total (mg/L)	<0.00050	0.00056	0.00075	0.00084		
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030		
	Zirconium (Zr)-Total (mg/L)	0.000113	0.000101	0.000149	0.000241		
Dissolved Metals	Dissolved Mercury Filtration Location	LAB	LAB	LAB	LAB		
	Dissolved Metals Filtration Location	LAB	LAB	LAB	LAB		
	Aluminum (Al)-Dissolved (mg/L)	<0.0020 ^{DLB}	<0.0020 ^{DLB}	<0.0040 ^{DLB}	0.0156		
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00014		
	Arsenic (As)-Dissolved (mg/L)	0.00025	0.00025	0.00045	0.00074		
	Barium (Ba)-Dissolved (mg/L)	0.0675	0.0675	0.0585	0.0603		
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010		
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050		
	Boron (B)-Dissolved (mg/L)	0.022	0.024	<0.010	<0.010		
	Cadmium (Cd)-Dissolved (mg/L)	0.0000062	0.0000080	<0.0000050	0.0000064		
	Calcium (Ca)-Dissolved (mg/L)	55.4	59.8	44.1	22.1		
	Cesium (Cs)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010		
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	0.00019	0.00019		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2163084-1 Water 11-SEP-18 14:10 UMC	L2163084-2 Water 11-SEP-18 14:10 UMCX	L2163084-3 Water 11-SEP-18 09:15 LMC	L2163084-4 Water 12-SEP-18 09:30 LBC	
Grouping	Analyte					
WATER						
Dissolved Metals	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Copper (Cu)-Dissolved (mg/L)	0.00279	0.00286	0.00164	0.00190	
	Iron (Fe)-Dissolved (mg/L)	0.014	0.014	0.040	0.032	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.0029	0.0030	0.0015	0.0013	
	Magnesium (Mg)-Dissolved (mg/L)	28.6	29.3	16.8	9.67	
	Manganese (Mn)-Dissolved (mg/L)	0.0372	0.0381	0.00087	0.00669	
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Dissolved (mg/L)	0.00499	0.00485	0.00167	0.00123	
	Nickel (Ni)-Dissolved (mg/L)	0.00092	0.00093	0.00084	0.00088	
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Potassium (K)-Dissolved (mg/L)	2.25	2.31	1.49	0.776	
	Rubidium (Rb)-Dissolved (mg/L)	0.00028	0.00023	0.00050	0.00063	
	Selenium (Se)-Dissolved (mg/L)	0.000326 ^{DTC}	0.000316	0.000155	0.000071	
	Silicon (Si)-Dissolved (mg/L)	5.82 ^{DTC}	6.08	5.86	5.90	
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Sodium (Na)-Dissolved (mg/L)	17.5	18.0	9.81	6.70	
	Strontium (Sr)-Dissolved (mg/L)	0.770	0.778	0.457	0.250	
	Sulfur (S)-Dissolved (mg/L)	19.3 ^{DTC}	20.5	7.88	4.84	
	Tellurium (Te)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Thorium (Th)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	
	Tungsten (W)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Uranium (U)-Dissolved (mg/L)	0.00270	0.00265	0.00192	0.00221	
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	0.00059	0.00070	
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Zirconium (Zr)-Dissolved (mg/L)	0.000090	0.000090	0.000146	0.000241	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Nitrate (as N)	B	L2163084-1, -2, -4
Method Blank	Aluminum (Al)-Dissolved	MB-LOR	L2163084-1, -2, -3, -4
Method Blank	Barium (Ba)-Dissolved	MB-LOR	L2163084-1, -2, -3, -4
Matrix Spike	Dissolved Organic Carbon	MS-B	L2163084-1, -2, -3, -4
Matrix Spike	Dissolved Organic Carbon	MS-B	L2163084-1, -2, -3, -4
Matrix Spike	Total Inorganic Carbon	MS-B	L2163084-1, -2, -3, -4
Matrix Spike	Total Inorganic Carbon	MS-B	L2163084-1, -2, -3, -4
Matrix Spike	Total Inorganic Carbon	MS-B	L2163084-1, -2, -3, -4
Matrix Spike	Total Organic Carbon	MS-B	L2163084-1, -2, -3, -4
Matrix Spike	Total Organic Carbon	MS-B	L2163084-1, -2, -3, -4
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2163084-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2163084-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2163084-1, -2, -3, -4
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2163084-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2163084-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2163084-1, -2, -3, -4
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2163084-1, -2, -3, -4
Matrix Spike	Barium (Ba)-Total	MS-B	L2163084-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Total	MS-B	L2163084-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2163084-1, -2, -3, -4
Matrix Spike	Manganese (Mn)-Total	MS-B	L2163084-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Total	MS-B	L2163084-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Total	MS-B	L2163084-1, -2, -3, -4
Matrix Spike	Ammonia, Total (as N)	MS-B	L2163084-1, -2, -3, -4

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
DLB	Detection Limit Raised. Analyte detected at comparable level in Method Blank.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DTC	Dissolved concentration exceeds total. Results were confirmed by re-analysis.
HTD	Hold time exceeded for re-analysis or dilution, but initial testing was conducted within hold time.
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
BR-L-IC-N-WR	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CARBONS-TIC-VA	Water	Total inorganic carbon by CO2 purge	APHA 5310B TOTAL ORGANIC CARBON (TOC)
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".			
CARBONS-TOC-VA	Water	Total organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".			
CL-IC-N-WR	Water	Chloride in Water by IC	EPA 300.1 (mod)

Reference Information

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

CN-T-CFA-VA Water Total Cyanide in water by CFA ISO 14403:2002

This analysis is carried out using procedures adapted from ISO Method 14403:2002 "Determination of Total Cyanide using Flow Analysis (FIA and CFA)". Total or strong acid dissociable (SAD) cyanide is determined by in-line UV digestion along with sample distillation and final determination by colourimetric analysis. Method Limitation: This method is susceptible to interference from thiocyanate (SCN). If SCN is present in the sample, there could be a positive interference with this method, but it would be less than 1% and could be as low as zero.

EC-PCT-VA Water Conductivity (Automated) APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-SCREEN-VA Water Conductivity Screen (Internal Use Only) APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

F-IC-N-WR Water Fluoride in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 µm), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-WR Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

P-T-PRES-COL-VA Water Total P in Water by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.

Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

P-TD-COL-VA Water Total Dissolved P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorus is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

Reference Information

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-VA Water Total Dissolved Solids by Gravimetric APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

1 of 1

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

[illegible]



MINNOW ENVIRONMENTAL INC.
ATTN: Lisa Bowron
101 - 1025 Hillside Ave.
Victoria BC V8T 2A2

Date Received: 12-SEP-18
Report Date: 24-SEP-18 18:27 (MT)
Version: FINAL

Client Phone: 250-595-1627

Certificate of Analysis

Lab Work Order #: L2163103
Project P.O. #: NOT SUBMITTED
Job Reference: MINNOW PROJECT 18:48
C of C Numbers: 1 of 1
Legal Site Desc:

Can Dang
Senior Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

		Sample ID Description Sampled Date Sampled Time Client ID	L2163103-1 TISSUE 06-SEP-18 LMC-5	L2163103-2 TISSUE 06-SEP-18 LMC-4	L2163103-3 TISSUE 06-SEP-18 LMC-3	L2163103-4 TISSUE 06-SEP-18 LMC-2	L2163103-5 TISSUE 11-SEP-18 LMC-1
Grouping	Analyte						
BIOTA							
Field Tests	Area Sampled (cm2)	0	0	0	0	0	
Plant Pigments	Chlorophyll a (ug)	114	56.0	166	111	104	

		Sample ID Description Sampled Date Sampled Time Client ID	L2163103-6 TISSUE 08-SEP-18 LWC-5	L2163103-7 TISSUE 08-SEP-18 LWC-5X	L2163103-8 TISSUE 08-SEP-18 LWC-4	L2163103-9 TISSUE 08-SEP-18 LWC-3	L2163103-10 TISSUE 10-SEP-18 LWC-2
Grouping	Analyte						
BIOTA							
Field Tests	Area Sampled (cm2)	0	0	0	0	0	
Plant Pigments	Chlorophyll a (ug)	374	465	10.0	19.2	19.3	

	Sample ID Description Sampled Date Sampled Time Client ID	L2163103-11 TISSUE 10-SEP-18 LWC-1				
Grouping	Analyte					
BIOTA						
Field Tests	Area Sampled (cm2)	0				
Plant Pigments	Chlorophyll a (ug)	10.3				

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
AREA SAMPLED-VA	Biota	Area Sampled (cm2)	Not Applicable
CHLOROA-F-VA	Biota	Chlorophyll a in Biota by Fluorometer	EPA 445.0

This analysis is done using procedures adapted from EPA Method 445.0. Chlorophyll-a is determined by a routine acetone extraction followed with analysis by fluorometry using the non-acidification procedure. This method is not subject to interferences from chlorophyll b. Note: Biota samples are typically submitted as scrapings on a filter.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

1 of 1

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

APPENDIX C

**SEDIMENT, PERIPHYTON AND BENTHIC
INVERTEBRATE QUALITY DATA**

Tables

Laboratory Reports

APPENDIX C

**SEDIMENT, PERIPHYTON AND BENTHIC
INVERTEBRATE QUALITY DATA**

Tables

Table C.1: Sediment Chemistry Data Collected at Reference and Exposed Areas, Minto Mine WUL, 2018

Analyte		Units	CSQG ^a		Upper McGinty Creek (Reference)						Upper Minto Creek (Exposed)					
					URC-1	URC-2	URC-3	URC-4	URC-5	URC	UMC-1	UMC-2	UMC-3	UMC-4	UMC-5	UMC
			ISQG	PEL	9-Sep-18	9-Sep-18	9-Sep-18	9-Sep-18	9-Sep-18	9-Sep-18	10-Sep-18	10-Sep-18	10-Sep-18	10-Sep-18	10-Sep-18	10-Sep-18
Particle size, TKN, carbon analytes and pH	Loss on Ignition @ 550 °C	%	-	-	13	13	6.0	6.0	4.0	-	10	7.0	9.0	7.0	4.0	-
	pH (1:2 soil:water)	pH units	-	-	6.6	7.0	6.7	7.0	7.7	-	7.8	8.1	8.2	8.2	8.1	-
	Gravel (> 2 mm)	%	-	-	-	-	-	-	-	<1.0	-	-	-	-	-	<1.0
	Sand (2.0 mm - 0.063 mm)	%	-	-	-	-	-	-	-	68	-	-	-	-	-	57
	Silt (0.063 mm - 4 µm)	%	-	-	-	-	-	-	-	29	-	-	-	-	-	37
	Clay (< 4 µm)	%	-	-	-	-	-	-	-	2.9	-	-	-	-	-	6.1
	Total Kjeldahl Nitrogen (TKN)	%	-	-	0.29	0.37	0.15	0.12	0.098	-	0.20	0.20	0.21	0.18	0.090	-
	Inorganic Carbon	%	-	-	0.11	0.15	0.078	0.071	0.082	-	0.15	0.14	0.15	0.11	0.071	-
	Inorganic Carbon (as CaCO ₃ Equivalent)	%	-	-	0.92	1.3	0.65	0.59	0.68	-	1.3	1.2	1.2	0.90	0.59	-
	Total Carbon by Combustion	%	-	-	5.6	6.5	2.9	2.4	2.1	-	4.1	2.7	4.0	2.9	1.5	-
	Total Organic Carbon	%	-	-	5.5	6.3	2.9	2.4	2.0	-	4.0	2.5	3.9	2.8	1.4	-
Total Metals	Aluminum (Al)	mg/kg	-	-	12,400	13,100	10,500	8,730	6,770	-	15,400	12,400	12,200	10,600	10,800	-
	Antimony (Sb)	mg/kg	-	-	0.37	0.42	0.31	0.27	0.32	-	0.79	0.46	0.43	0.34	0.36	-
	Arsenic (As)	mg/kg	5.9	17	7.7	10	7.3	8.0	5.3	-	7.6	6.1	5.8	4.8	5.0	-
	Barium (Ba)	mg/kg	-	-	207	254	179	160	113	-	333	303	316	159	164	-
	Beryllium (Be)	mg/kg	-	-	0.36	0.39	0.30	0.25	0.21	-	0.57	0.47	0.42	0.37	0.38	-
	Bismuth (Bi)	mg/kg	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20	-
	Boron (B)	mg/kg	-	-	<5.0	<5.0	<5.0	<5.0	<5.0	-	<5.0	<5.0	<5.0	<5.0	<5.0	-
	Cadmium (Cd)	mg/kg	0.60	3.5	0.20	0.20	0.11	0.099	0.086	-	0.37	0.26	0.31	0.13	0.15	-
	Calcium (Ca)	mg/kg	-	-	8,760	10,700	6,370	5,820	5,250	-	11,500	8,290	8,790	7,590	7,920	-
	Chromium (Cr)	mg/kg	37	90	24	27	21	18	16	-	32	28	30	29	29	-
	Cobalt (Co)	mg/kg	-	-	8.9	11	7.7	7.4	6.2	-	14	12	12	8.9	9.4	-
	Copper (Cu)	mg/kg	36	197	24	24	17	14	11	-	403	243	245	72	87	-
	Iron (Fe)	mg/kg	-	-	24,600	29,500	23,600	22,700	17,800	-	29,900	26,100	26,100	21,600	22,000	-
	Lead (Pb)	mg/kg	35	91	4.6	4.9	3.9	3.4	2.9	-	7.0	5.8	5.9	4.8	5.0	-
	Lithium (Li)	mg/kg	-	-	6.9	7.7	6.2	5.0	4.1	-	10	8.3	8.0	6.9	7.3	-
	Magnesium (Mg)	mg/kg	-	-	4,580	5,070	4,240	3,610	3,030	-	8,620	6,930	6,890	5,980	6,560	-
	Manganese (Mn)	mg/kg	-	-	413	953	280	540	666	-	2,800	4,830	4,730	1,020	897	-
	Mercury (Hg)	mg/kg	0.17	0.49	0.046	0.047	0.14	0.022	0.023	-	0.039	0.026	0.027	0.018	0.018	-
	Molybdenum (Mo)	mg/kg	-	-	0.57	0.64	0.57	0.45	0.62	-	2.2	2.8	2.8	0.95	0.86	-
	Nickel (Ni)	mg/kg	-	-	18	20	15	14	12	-	35	30	29	25	27	-
	Phosphorus (P)	mg/kg	-	-	928	1,040	1,010	901	638	-	1,100	987	986	1,060	979	-
	Potassium (K)	mg/kg	-	-	730	820	700	580	490	-	1,840	1,510	1,380	1,020	1,080	-
	Selenium (Se)	mg/kg	-	-	0.61	0.87	0.35	0.41	0.47	-	0.99	0.63	0.74	0.33	0.33	-
	Silver (Ag)	mg/kg	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	-	0.19	0.12	0.12	<0.10	<0.10	-
	Sodium (Na)	mg/kg	-	-	222	240	219	181	149	-	426	336	355	312	323	-
	Strontium (Sr)	mg/kg	-	-	65	85	53	48	56	-	128	95	106	73	79	-
	Thallium (Tl)	mg/kg	-	-	0.063	0.075	0.060	<0.050	<0.050	-	0.11	0.091	0.088	0.072	0.075	-
	Tin (Sn)	mg/kg	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	-	<2.0	<2.0	<2.0	<2.0	<2.0	-
	Titanium (Ti)	mg/kg	-	-	694	750	681	561	507	-	824	696	722	647	636	-
	Uranium (U)	mg/kg	-	-	1.3	2.4	0.59	0.75	0.98	-	1.5	0.82	0.88	0.68	0.69	-
	Vanadium (V)	mg/kg	-	-	49	55	43	40	40	-	63	60	61	51	50	-
	Zinc (Zn)	mg/kg	123	315	47	51	42	36	30	-	85	70	70	51	53	-

Indicates sediment concentration exceeding CSQG ISQG.

Indicates sediment concentration exceeding CSQG PEL.

^a Canadian Sediment Quality Guidelines: ISQG = interim sediment quality guideline; PEL = probable effect level (CCME 1999).

Table C.1: Sediment Chemistry Data Collected at Reference and Exposed Areas, Minto Mine WUL, 2018

Analyte		Units	CSQG ^a		Lower Wolverine Creek (Reference)					Lower Minto Creek (Exposed)				
					LWC-1	LWC-2	LWC-3	LWC-4	LWC-5	LMC-1	LMC-2	LMC-3	LMC-4	LMC-5
			ISQG	PEL	9-Sep-18	9-Sep-18	9-Sep-18	9-Sep-18	9-Sep-18	11-Sep-18	11-Sep-18	10-Sep-18	5-Sep-18	5-Sep-18
Particle size, TKN, carbon analytes and pH	Loss on Ignition @ 550 °C	%	-	-	13	18	11	14	14	6.0	13	3.0	11	10
	pH (1:2 soil:water)	pH units	-	-	6.6	6.5	7.6	6.6	6.6	7.8	7.7	7.7	7.8	8.0
	Gravel (> 2 mm)	%	-	-	<1.0	<1.0	2.6	<1.0	<1.0	<1.0	4.3	<1.0	<1.0	<1.0
	Sand (2.0 mm - 0.063 mm)	%	-	-	21	22	21	18	31	43	23	68	24	42
	Silt (0.063 mm - 4 µm)	%	-	-	72	73	66	75	62	48	63	28	65	49
	Clay (< 4 µm)	%	-	-	7.0	5.7	11	7.2	6.8	8.9	9.7	3.8	10	8.8
	Total Kjeldahl Nitrogen (TKN)	%	-	-	0.38	0.47	0.29	0.41	0.41	0.15	0.30	0.086	0.27	0.21
	Inorganic Carbon	%	-	-	0.13	0.15	0.17	0.16	0.14	0.12	0.21	0.076	0.17	0.16
	Inorganic Carbon (as CaCO ₃ Equivalent)	%	-	-	1.1	1.2	1.4	1.3	1.2	1.0	1.7	0.63	1.4	1.3
	Total Carbon by Combustion	%	-	-	6.2	6.6	5.1	7.1	7.5	2.6	6.6	1.6	5.5	4.8
	Total Organic Carbon	%	-	-	6.1	6.5	5.0	6.9	7.3	2.5	6.4	1.5	5.3	4.7
Total Metals	Aluminum (Al)	mg/kg	-	-	14,100	16,500	18,800	18,700	20,000	14,400	15,800	12,600	15,300	11,000
	Antimony (Sb)	mg/kg	-	-	0.39	0.46	0.68	0.47	0.47	0.48	0.57	0.36	0.54	0.52
	Arsenic (As)	mg/kg	5.9	17	5.5	5.6	10	5.2	7.6	7.4	9.1	5.8	8.9	7.2
	Barium (Ba)	mg/kg	-	-	201	219	367	252	280	245	299	175	263	204
	Beryllium (Be)	mg/kg	-	-	0.63	0.73	0.63	0.79	0.87	0.44	0.53	0.58	0.48	0.39
	Bismuth (Bi)	mg/kg	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B)	mg/kg	-	-	<5.0	<5.0	5.1	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	Cadmium (Cd)	mg/kg	0.60	3.5	0.22	0.23	0.37	0.25	0.28	0.19	0.27	0.18	0.24	0.17
	Calcium (Ca)	mg/kg	-	-	7,850	9,190	15,900	10,300	10,800	9,910	11,900	7,770	10,500	8,190
	Chromium (Cr)	mg/kg	37	90	41	48	40	52	56	30	33	37	33	24
	Cobalt (Co)	mg/kg	-	-	13	14	14	14	16	11	12	12	12	9.9
	Copper (Cu)	mg/kg	36	197	25	28	74	32	33	50	60	20	54	41
	Iron (Fe)	mg/kg	-	-	25,700	27,600	31,500	30,600	33,800	25,700	28,200	25,100	29,100	23,500
	Lead (Pb)	mg/kg	35	91	5.7	6.2	7.7	6.7	7.3	5.7	6.3	5.2	6.1	4.9
	Lithium (Li)	mg/kg	-	-	9.0	10	12	11	12	9.7	10	8.5	9.8	7.9
	Magnesium (Mg)	mg/kg	-	-	9,430	9,530	8,670	10,400	10,700	7,230	7,870	8,610	7,560	5,910
	Manganese (Mn)	mg/kg	-	-	298	333	1,980	243	736	1,130	1,500	619	1,240	1,040
	Mercury (Hg)	mg/kg	0.17	0.49	0.043	0.048	0.058	0.047	0.059	0.071	0.045	0.032	0.040	0.033
	Molybdenum (Mo)	mg/kg	-	-	0.66	0.61	1.0	0.72	0.49	0.72	0.84	0.49	0.81	0.71
	Nickel (Ni)	mg/kg	-	-	36	39	37	41	43	28	31	32	30	23
	Phosphorus (P)	mg/kg	-	-	1,050	1,010	1,040	1,130	1,390	807	918	976	923	770
	Potassium (K)	mg/kg	-	-	850	1,060	1,500	1,200	1,200	1,240	1,410	760	1,310	1,050
	Selenium (Se)	mg/kg	-	-	0.28	0.37	1.0	0.40	0.50	0.49	0.80	0.28	0.62	0.48
	Silver (Ag)	mg/kg	-	-	<0.10	<0.10	0.15	0.11	0.12	<0.10	0.10	<0.10	<0.10	<0.10
	Sodium (Na)	mg/kg	-	-	355	427	339	455	450	317	342	306	316	261
	Strontium (Sr)	mg/kg	-	-	82	93	180	108	116	114	133	81	119	86
	Thallium (Tl)	mg/kg	-	-	0.066	0.10	0.12	0.094	0.11	0.094	0.10	0.057	0.097	0.075
	Tin (Sn)	mg/kg	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Titanium (Ti)	mg/kg	-	-	720	923	773	969	916	771	808	672	772	626
	Uranium (U)	mg/kg	-	-	2.3	2.5	1.9	2.7	3.0	0.97	1.3	1.6	1.3	0.86
	Vanadium (V)	mg/kg	-	-	62	70	65	72	75	54	60	59	62	52
	Zinc (Zn)	mg/kg	123	315	64	63	75	70	71	59	66	53	65	53

Indicates sediment concentration exceeding CSQG ISQG.

Indicates sediment concentration exceeding CSQG PEL.

^a Canadian Sediment Quality Guidelines: ISQG = interim sediment quality guideline; PEL = probable effect level (CCME 1999).

Table C.2: Periphyton Tissue Quality Results at Reference and Exposure Areas, Minto Mine WUL, 2018

Analyte		Units	Lower Wolverine Creek (Reference)							Lower Big Creek (Reference)							Lower Minto Creek (Exposed)						
			LWC-1	LWC-2	LWC-3	LWC-4	LWC-5	Mean	Standard Deviation	LBC-1	LBC-2	LBC-3	LBC-4	LBC-5	Mean	Standard Deviation	LMC-1	LMC-2	LMC-3	LMC-4	LMC-5	Mean	Standard Deviation
Physical Tests	Moisture	%	51	45	56	50	35	47.4	8.17	68	40	61	81	63	62.5	14.6	63	51	64	55	58	58.2	5.34
Total Metals	Total Aluminum (Al)	mg/kg dw	19,468	15,704	15,991	16,338	10,934	15,687	3,058	15,531	12,265	16,403	18,756	16,427	15,877	2,347	19,413	17,669	21,253	15,644	16,643	18,125	2,236
	Total Antimony (Sb)	mg/kg dw	0.067	0.031	0.050	0.034	0.029	0.0423	0.0164	0.16	0.069	0.19	0.41	0.15	0.196	0.127	0.053	0.051	0.089	0.056	0.065	0.0628	0.0156
	Total Arsenic (As)	mg/kg dw	6.6	4.6	4.4	4.8	4.3	4.94	0.946	20	14	24	33	22	22.6	7.08	10	8.9	13	8.0	8.8	9.79	1.98
	Total Barium (Ba)	mg/kg dw	278	215	223	219	143	216	48.2	260	206	281	317	266	266	39.9	371	344	451	300	324	358	58.3
	Total Beryllium (Be)	mg/kg dw	0.89	0.70	0.67	0.71	0.49	0.694	0.141	0.62	0.48	0.62	0.71	0.65	0.616	0.0834	0.63	0.60	0.73	0.54	0.58	0.616	0.0727
	Total Bismuth (Bi)	mg/kg dw	0.11	0.087	0.093	0.091	0.061	0.0893	0.0190	0.78	0.49	1.3	1.8	0.98	1.08	0.518	0.16	0.14	0.18	0.12	0.13	0.147	0.0224
	Total Boron (B)	mg/kg dw	< 4.1	2.3	2.5	2.4	1.7	2.24	0.375	< 3.1	1.8	< 2.6	< 5.2	< 2.7	1.85	-	4.0	4.1	6.7	4.9	6.0	5.13	1.18
	Total Cadmium (Cd)	mg/kg dw	0.28	0.19	0.19	0.20	0.12	0.195	0.0560	0.31	0.22	0.34	0.42	0.34	0.326	0.0705	0.29	0.27	0.36	0.25	0.29	0.292	0.0431
	Total Calcium (Ca)	mg/kg dw	11,513	9,278	9,112	9,316	6,233	9,090	1,879	8,719	7,164	8,316	8,705	8,773	8,336	679	13,893	12,843	15,265	12,000	12,470	13,294	1,304
	Total Cesium (Cs)	mg/kg dw	1.7	1.1	1.2	1.2	0.88	1.21	0.284	2.6	1.6	2.5	3.7	2.6	2.60	0.751	1.0	0.90	1.4	0.92	0.97	1.04	0.211
	Total Chromium (Cr)	mg/kg dw	55	45	44	46	32	44.3	8.38	33	27	35	39	36	34.2	4.30	43	40	49	37	39	41.5	4.73
	Total Cobalt (Co)	mg/kg dw	16	13	13	14	11	13.6	1.75	12	9.4	12	13	12	11.4	1.26	15	14	17	12	13	14.2	1.85
	Total Copper (Cu)	mg/kg dw	34	23	24	23	14	23.6	6.77	33	23	41	53	38	37.4	11.2	58	54	67	49	53	56.3	6.95
	Total Iron (Fe)	mg/kg dw	31,697	25,090	25,285	26,358	21,286	25,943	3,746	25,844	21,141	27,296	30,725	26,933	26,388	3,456	34,400	31,697	38,719	27,556	28,537	32,182	4,543
	Total Lead (Pb)	mg/kg dw	7.8	6.4	6.6	6.8	4.8	6.46	1.08	12	8.8	13	15	13	12.1	2.14	8.7	8.1	9.4	6.7	7.4	8.05	1.04
	Total Lithium (Li)	mg/kg dw	14	13	12	13	8.5	12.0	2.16	12	9.6	12	14	13	12.1	1.56	16	15	18	13	14	15.1	1.76
	Total Magnesium (Mg)	mg/kg dw	11,166	9,621	9,681	10,040	8,331	9,768	1,015	8,281	6,913	8,061	8,912	8,400	8,113	740	9,653	9,080	10,390	8,111	8,273	9,102	953
	Total Manganese (Mn)	mg/kg dw	1,108	720	715	726	531	760	211	797	599	821	964	832	803	131	2,411	2,209	3,760	1,802	2,237	2,484	748
	Total Mercury (Hg)	mg/kg dw	0.057	0.040	0.036	0.039	0.018	0.0379	0.0140	0.049	0.034	0.055	0.079	0.061	0.0556	0.0164	0.046	0.041	0.052	0.039	0.042	0.0442	0.00503
	Total Molybdenum (Mo)	mg/kg dw	0.53	0.36	0.38	0.39	0.43	0.417	0.0698	1.2	0.66	1.4	2.0	1.2	1.28	0.473	0.80	0.72	1.1	0.72	0.83	0.825	0.137
	Total Nickel (Ni)	mg/kg dw	44	37	36	39	31	37.5	4.79	29	24	30	35	30	29.4	3.89	38	37	43	33	34	37.1	4.00
	Total Phosphorus (P)	mg/kg dw	1,342	1,161	1,246	1,213	1,110	1,214	87.9	1,244	1,122	1,500	1,896	1,408	1,434	297	1,339	1,309	1,649	1,209	1,324	1,366	166
	Total Potassium (K)	mg/kg dw	1,497	1,076	1,182	1,159	1,069	1,197	175	1,656	1,131	2,023	3,166	1,864	1,968	749	1,949	1,726	2,604	1,582	1,755	1,923	403
	Total Rubidium (Rb)	mg/kg dw	16	12	13	13	8.7	12.8	2.78	16	11	15	20	16	15.7	3.17	16	14	19	13	14	15.1	2.27
	Total Selenium (Se)	mg/kg dw	0.53	0.36	0.27	0.32	0.21	0.340	0.120	< 0.31	0.17	0.33	< 0.52	0.32	0.247	0.0969	0.99	0.90	1.5	0.96	1.2	1.11	0.256
	Total Sodium (Na)	mg/kg dw	423	368	392	416	375	395	24.4	497	398	505	585	533	504	68.7	331	368	443	347	355	369	43.7
	Total Strontium (Sr)	mg/kg dw	125	94	93	96	65	94.6	21.0	94	73	95	101	93	90.9	10.5	154	142	173	128	129	145	18.8
	Total Tellurium (Te)	mg/kg dw	< 0.082	< 0.036	< 0.046	< 0.040	< 0.031	< 0.0310	-	< 0.063	< 0.034	0.071	0.12	0.064	0.0645	0.0264	< 0.053	< 0.041	< 0.11	< 0.044	< 0.048	< 0.0410	-
	Total Thallium (Tl)	mg/kg dw	0.12	0.090	0.10	0.097	0.063	0.0939	0.0205	0.16	0.11	0.17	0.21	0.16	0.160	0.0339	0.14	0.13	0.17	0.11	0.13	0.137	0.0206
	Total Tin (Sn)	mg/kg dw	< 0.41	0.27	< 0.23	0.24	0.20	0.228	0.0372	< 0.31	0.23	< 0.26	< 0.52	< 0.27	0.235	-	< 0.27	0.25	< 0.56	0.29	0.26	0.263	0.0218
	Total Uranium (U)	mg/kg dw	2.1	1.6	1.5	1.7	1.0	1.58	0.401	1.8	1.6	1.8	1.9	1.9	1.80	0.126	1.1	1.2	1.3	1.1	1.3	1.20	0.0953
	Total Vanadium (V)	mg/kg dw	71	57	56	59	50	58.7	7.73	56	48	58	64	58	56.9	5.98	66	62	76	54	59	63.6	8.05
	Total Zinc (Zn)	mg/kg dw	78	66	68	68	49	66.0	10.5	80	63	82	96	85	81.3	11.9	83	78	92	70	74	79.5	8.54
	Total Zirconium (Zr)	mg/kg dw	19	14	15	15	10	14.5	3.16	11	8.5	12	14	12	11.7	2.06	17	15	18	13	14	15.4	2.24

 Indicates periphyton tissue concentration exceeding the higher reference mean by more than two times.

Table C.3: Benthic Tissue Quality Results at Reference and Exposure Areas, Minto Mine WUL, 2018

Analyte		Units	Lower Wolverine Creek (Reference)							Lower Big Creek (Reference)							Lower Minto Creek (Exposed)						
			LWC-1	LWC-2	LWC-3	LWC-4	LWC-5	Mean	Standard Deviation	LBC-1	LBC-2	LBC-3	LBC-4	LBC-5	Mean	Standard Deviation	LMC-1	LMC-2	LMC-3	LMC-4	LMC-5	Mean	Standard Deviation
Physical Tests	Moisture	%	65	63	73	72	66	67.72	4.37	69	68	67	72	60	67.20	4.24	64	65	76	75	79	71.78	6.87
Total Metals	Total Aluminum (Al)	mg/kg dw	1,072	4,865	1,456	1,350	1,091	1,967	1,629	1,561	751	1,506	695	2,889	1,480	886	1,806	1,952	1,461	1,028	1,557	1,561	356
	Total Antimony (Sb)	mg/kg dw	0.052	0.054	0.083	0.048	0.045	0.0562	0.0154	0.16	0.15	0.14	0.10	0.13	0.135	0.0214	0.067	0.081	0.061	0.059	0.079	0.0692	0.0103
	Total Arsenic (As)	mg/kg dw	1.6	1.9	3.1	1.4	1.6	1.92	0.682	4.7	2.6	3.6	2.8	6.7	4.10	1.70	1.8	2.2	2.4	1.9	2.7	2.19	0.353
	Total Barium (Ba)	mg/kg dw	143	292	54	55	33	115	107	60	58	53	27	112	62.1	31.1	48	66	56	37	66	54.5	12.4
	Total Beryllium (Be)	mg/kg dw	0.089	0.34	0.18	0.089	0.088	0.157	0.110	0.10	0.091	0.089	0.037	0.17	0.0978	0.0476	0.065	0.087	0.062	0.049	0.069	0.0666	0.0138
	Total Bismuth (Bi)	mg/kg dw	0.014	< 0.016	< 0.022	0.018	< 0.012	0.0143	0.00244	0.16	0.073	0.11	0.11	0.15	0.124	0.0368	0.021	0.026	0.022	0.017	0.032	0.0235	0.00572
	Total Boron (B)	mg/kg dw	5.6	4.3	6.0	1.8	< 1.2	3.79	2.07	< 0.65	1.4	0.70	< 0.70	2.5	1.18	0.858	< 1.7	1.1	1.2	1.0	3.5	1.58	1.10
	Total Cadmium (Cd)	mg/kg dw	0.75	1.2	1.6	1.6	1.0	1.24	0.366	2.2	2.6	2.7	2.6	1.0	2.22	0.696	0.35	0.32	0.38	0.34	0.41	0.360	0.0354
	Total Calcium (Ca)	mg/kg dw	1,851	3,649	1,874	1,926	1,763	2,213	805	2,229	2,703	2,464	1,425	2,259	2,216	481	2,360	2,462	2,423	1,988	3,278	2,502	473
	Total Cesium (Cs)	mg/kg dw	0.21	0.40	0.35	0.25	0.19	0.280	0.0898	0.61	0.25	0.41	0.28	0.76	0.461	0.219	0.25	0.29	0.21	0.15	0.21	0.220	0.0540
	Total Chromium (Cr)	mg/kg dw	6.2	24	8.6	11	8.8	11.7	7.26	7.2	4.6	5.2	3.2	8.6	5.77	2.17	13	7.7	5.5	5.1	14	9.15	4.32
	Total Cobalt (Co)	mg/kg dw	2.2	6.1	3.4	3.1	2.4	3.43	1.56	2.9	2.0	2.8	1.8	4.0	2.71	0.860	1.6	1.8	1.4	1.2	1.8	1.57	0.285
	Total Copper (Cu)	mg/kg dw	17	25	34	39	24	27.7	8.64	33	32	31	31	22	29.7	4.35	26	20	22	18	25	22.2	3.24
	Total Iron (Fe)	mg/kg dw	3,066	8,946	4,963	2,721	2,904	4,520	2,634	3,152	2,050	3,303	1,435	6,457	3,279	1,938	3,961	4,074	3,129	2,398	3,618	3,436	687
	Total Lead (Pb)	mg/kg dw	0.84	1.3	1.7	0.98	0.80	1.13	0.381	2.3	1.1	1.7	0.87	3.1	1.80	0.915	1.1	1.5	1.1	0.88	1.4	1.18	0.231
	Total Lithium (Li)	mg/kg dw	0.97	2.9	1.2	1.2	0.82	1.41	0.855	1.4	0.57	1.6	0.53	4.0	1.62	1.42	1.1	2.0	1.5	0.93	1.3	1.36	0.410
	Total Magnesium (Mg)	mg/kg dw	1,834	4,703	2,063	1,943	2,038	2,516	1,226	1,919	1,438	2,033	1,368	2,495	1,851	463	2,094	1,749	1,697	1,382	2,269	1,838	349
	Total Manganese (Mn)	mg/kg dw	1,324	2,005	290	357	178	831	801	477	274	269	207	425	330	115	319	362	378	264	445	353	67.6
	Total Mercury (Hg)	mg/kg dw	0.023	0.025	0.035	0.046	0.044	0.0345	0.0106	0.046	0.035	0.048	0.038	0.086	0.0506	0.0205	0.12	0.020	0.022	0.021	0.052	0.0467	0.0427
	Total Molybdenum (Mo)	mg/kg dw	0.71	1.1	1.0	0.85	0.90	0.906	0.141	1.1	1.2	1.1	1.2	0.71	1.05	0.195	0.95	0.82	1.0	1.1	1.4	1.06	0.218
	Total Nickel (Ni)	mg/kg dw	5.3	20	6.2	6.7	6.7	8.88	5.99	5.3	3.3	5.4	2.2	8.1	4.85	2.25	8.0	10	4.6	3.6	8.9	7.07	2.83
	Total Phosphorus (P)	mg/kg dw	7,822	9,216	7,370	7,456	7,924	7,958	742	7,516	7,192	7,303	7,158	4,497	6,733	1,258	9,224	6,809	7,386	7,398	7,877	7,739	913
	Total Potassium (K)	mg/kg dw	7,536	8,405	6,481	6,926	6,550	7,180	803	6,000	5,741	5,939	6,000	5,754	5,887	130	8,698	6,325	6,307	6,260	7,123	6,943	1,045
	Total Rubidium (Rb)	mg/kg dw	3.8	10	7.0	8.3	6.1	7.08	2.41	10	8.2	8.4	8.8	5.9	8.29	1.58	3.7	4.0	3.8	3.0	3.9	3.69	0.390
	Total Selenium (Se)	mg/kg dw	1.4	1.5	1.8	1.9	2.2	1.75	0.324	1.6	1.7	1.6	1.6	0.71	1.45	0.413	3.2	2.1	2.3	1.9	2.4	2.40	0.509
	Total Sodium (Na)	mg/kg dw	2,450	3,514	3,415	2,813	2,325	2,903	544	2,365	2,101	2,064	2,235	1,701	2,093	249	3,269	2,370	2,564	2,553	3,151	2,781	401
	Total Strontium (Sr)	mg/kg dw	28	101	23	21	15	37.4	35.6	25	38	29	14	23	25.8	8.43	22	32	28	21	35	27.4	6.05
	Total Tellurium (Te)	mg/kg dw	< 0.023	< 0.032	< 0.044	< 0.014	< 0.023	< 0.0140	-	< 0.013	< 0.013	< 0.012	< 0.014	0.010	0.0101	-	< 0.033	< 0.011	< 0.017	< 0.016	< 0.019	< 0.0110	-
	Total Thallium (Tl)	mg/kg dw	0.017	0.035	0.026	0.028	0.018	0.0248	0.00760	0.049	0.030	0.038	0.031	0.038	0.0372	0.00751	0.020	0.025	0.018	0.013	0.019	0.0190	0.00439
	Total Tin (Sn)	mg/kg dw	0.83	0.56	0.43	0.14	< 0.12	0.418	0.304	0.094	0.12	0.12	< 0.070	0.15	0.110	0.0236	< 0.17	0.12	0.091	0.093	0.33	0.146	0.105
	Total Uranium (U)	mg/kg dw	0.32	0.49	0.54	0.51	0.42	0.456	0.0893	0.78	1.0	1.4	0.30	1.3	0.973	0.454	0.18	0.33	0.24	0.27	0.36	0.276	0.0726
	Total Vanadium (V)	mg/kg dw	6.6	27	10	7.1	7.1	11.7	8.85	7.4	4.4	7.9	3.5	18	8.13	5.58	7.4	8.8	6.6	5.5	7.8	7.23	1.24
	Total Zinc (Zn)	mg/kg dw	62	90	101	119	95	93.5	20.9	110	98	121	108	117	111	9.04	76	82	98	96	114	93.1	14.9
	Total Zirconium (Zr)	mg/kg dw	2.6	13	2.5	1.9	2.5	4.48	4.68	1.6	1.6	2.2	0.89	3.3	1.92	0.893	2.0	2.6	1.7	1.4	2.2	1.97	0.463

 Indicates periphyton tissue concentration exceeding the higher reference mean by more than two times.

APPENDIX C

**SEDIMENT, PERIPHYTON AND BENTHIC
INVERTEBRATE QUALITY DATA**

Laboratory Reports



MINNOW ENVIRONMENTAL INC.
ATTN: Lisa Bowron
101 - 1025 Hillside Ave.
Victoria BC V8T 2A2

Date Received: 12-SEP-18
Report Date: 22-SEP-18 17:04 (MT)
Version: FINAL

Client Phone: 250-595-1627

Certificate of Analysis

Lab Work Order #: L2163149
Project P.O. #: NOT SUBMITTED
Job Reference: MINNOW PROJECT 18-48
C of C Numbers:
Legal Site Desc:

Can Dang
Senior Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2163149-1 Sediment 09-SEP-18 URC-4	L2163149-2 Sediment 09-SEP-18 URC-3	L2163149-3 Sediment 09-SEP-18 URC-2	L2163149-4 Sediment 09-SEP-18 URC-1	L2163149-5 Sediment 10-SEP-18 LMC-3X
Grouping	Analyte					
SOIL						
Physical Tests	Loss On Ignition @ 420 C (%)	6	6	13	13	19
	pH (1:2 soil:water) (pH)	7.04	6.71	6.99	6.59	7.87
Particle Size	% Gravel (>2mm) (%)					1.8
	% Sand (2.0mm - 0.063mm) (%)					13.0
	% Silt (0.063mm - 4um) (%)					73.0
	% Clay (<4um) (%)					12.2
	Texture					Silt loam
Leachable Anions & Nutrients	Total Kjeldahl Nitrogen (%)	0.120	0.148	0.368 ^{DLHC}	0.288 ^{DLHC}	0.52 ^{DLHC}
Organic / Inorganic Carbon	Inorganic Carbon (%)	0.071	0.078	0.154	0.110	0.247
	Inorganic Carbon (as CaCO3 Equivalent) (%)	0.59	0.65	1.28	0.92	2.06
	Total Carbon by Combustion (%)	2.43	2.94	6.45	5.58	8.63
	Total Organic Carbon (%)	2.36	2.86	6.30	5.47	8.38
Metals	Aluminum (Al) (mg/kg)	8730	10500	13100	12400	14700
	Antimony (Sb) (mg/kg)	0.27	0.31	0.42	0.37	0.48
	Arsenic (As) (mg/kg)	8.01	7.30	10.1	7.74	7.93
	Barium (Ba) (mg/kg)	160	179	254	207	252
	Beryllium (Be) (mg/kg)	0.25	0.30	0.39	0.36	0.49
	Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B) (mg/kg)	<5.0	<5.0	<5.0	<5.0	<5.0
	Cadmium (Cd) (mg/kg)	0.099	0.109	0.197	0.196	0.235
	Calcium (Ca) (mg/kg)	5820	6370	10700	8760	10800
	Chromium (Cr) (mg/kg)	17.7	20.5	26.8	24.1	33.6
	Cobalt (Co) (mg/kg)	7.41	7.71	11.2	8.93	11.5
	Copper (Cu) (mg/kg)	13.9	17.1	23.8	23.8	56.3
	Iron (Fe) (mg/kg)	22700	23600	29500	24600	26800
	Lead (Pb) (mg/kg)	3.40	3.87	4.94	4.58	6.22
	Lithium (Li) (mg/kg)	5.0	6.2	7.7	6.9	10.4
	Magnesium (Mg) (mg/kg)	3610	4240	5070	4580	7410
	Manganese (Mn) (mg/kg)	540	280	953	413	1240
	Mercury (Hg) (mg/kg)	0.0223	0.142	0.0467	0.0461	0.0382
	Molybdenum (Mo) (mg/kg)	0.45	0.57	0.64	0.57	0.73
	Nickel (Ni) (mg/kg)	14.3	15.3	19.9	17.6	30.2
	Phosphorus (P) (mg/kg)	901	1010	1040	928	928
	Potassium (K) (mg/kg)	580	700	820	730	1230
	Selenium (Se) (mg/kg)	0.41	0.35	0.87	0.61	0.61
	Silver (Ag) (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2163149-6 Sediment 10-SEP-18 UMC	L2163149-7 Sediment 10-SEP-18 UMC-5	L2163149-8 Sediment 10-SEP-18 UMC-4	L2163149-9 Sediment 10-SEP-18 UMC-3	L2163149-10 Sediment 10-SEP-18 UMC-2
Grouping	Analyte					
SOIL						
Physical Tests	Loss On Ignition @ 420 C (%)		4	7	9	7
	pH (1:2 soil:water) (pH)		8.12	8.23	8.17	8.14
Particle Size	% Gravel (>2mm) (%)	<1.0				
	% Sand (2.0mm - 0.063mm) (%)	56.6				
	% Silt (0.063mm - 4um) (%)	37.0				
	% Clay (<4um) (%)	6.1				
	Texture	Sandy loam				
Leachable Anions & Nutrients	Total Kjeldahl Nitrogen (%)		0.090	0.178	0.209	0.203
Organic / Inorganic Carbon	Inorganic Carbon (%)		0.071	0.109	0.146	0.141
	Inorganic Carbon (as CaCO3 Equivalent) (%)		0.59	0.90	1.21	1.17
	Total Carbon by Combustion (%)		1.45	2.92	4.00	2.65
	Total Organic Carbon (%)		1.38	2.81	3.85	2.51
Metals	Aluminum (Al) (mg/kg)		10800	10600	12200	12400
	Antimony (Sb) (mg/kg)		0.36	0.34	0.43	0.46
	Arsenic (As) (mg/kg)		5.01	4.82	5.79	6.08
	Barium (Ba) (mg/kg)		164	159	316	303
	Beryllium (Be) (mg/kg)		0.38	0.37	0.42	0.47
	Bismuth (Bi) (mg/kg)		<0.20	<0.20	<0.20	<0.20
	Boron (B) (mg/kg)		<5.0	<5.0	<5.0	<5.0
	Cadmium (Cd) (mg/kg)		0.148	0.134	0.313	0.264
	Calcium (Ca) (mg/kg)		7920	7590	8790	8290
	Chromium (Cr) (mg/kg)		28.5	28.7	29.9	28.3
	Cobalt (Co) (mg/kg)		9.44	8.88	11.6	11.5
	Copper (Cu) (mg/kg)		87.4	71.5	245	243
	Iron (Fe) (mg/kg)		22000	21600	26100	26100
	Lead (Pb) (mg/kg)		5.01	4.78	5.86	5.77
	Lithium (Li) (mg/kg)		7.3	6.9	8.0	8.3
	Magnesium (Mg) (mg/kg)		6560	5980	6890	6930
	Manganese (Mn) (mg/kg)		897	1020	4730	4830
	Mercury (Hg) (mg/kg)		0.0184	0.0175	0.0267	0.0258
	Molybdenum (Mo) (mg/kg)		0.86	0.95	2.80	2.80
	Nickel (Ni) (mg/kg)		27.4	25.2	28.8	29.5
	Phosphorus (P) (mg/kg)		979	1060	986	987
	Potassium (K) (mg/kg)		1080	1020	1380	1510
	Selenium (Se) (mg/kg)		0.33	0.33	0.74	0.63
	Silver (Ag) (mg/kg)		<0.10	<0.10	0.12	0.12

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2163149-11 Sediment 10-SEP-18 UMC-1				
Grouping	Analyte					
SOIL						
Physical Tests	Loss On Ignition @ 420 C (%)	10				
	pH (1:2 soil:water) (pH)	7.83				
Particle Size	% Gravel (>2mm) (%)					
	% Sand (2.0mm - 0.063mm) (%)					
	% Silt (0.063mm - 4um) (%)					
	% Clay (<4um) (%)					
	Texture					
Leachable Anions & Nutrients	Total Kjeldahl Nitrogen (%)	0.197				
Organic / Inorganic Carbon	Inorganic Carbon (%)	0.150				
	Inorganic Carbon (as CaCO3 Equivalent) (%)	1.25				
	Total Carbon by Combustion (%)	4.11				
	Total Organic Carbon (%)	3.96				
Metals	Aluminum (Al) (mg/kg)	15400				
	Antimony (Sb) (mg/kg)	0.79				
	Arsenic (As) (mg/kg)	7.62				
	Barium (Ba) (mg/kg)	333				
	Beryllium (Be) (mg/kg)	0.57				
	Bismuth (Bi) (mg/kg)	<0.20				
	Boron (B) (mg/kg)	<5.0				
	Cadmium (Cd) (mg/kg)	0.368				
	Calcium (Ca) (mg/kg)	11500				
	Chromium (Cr) (mg/kg)	32.2				
	Cobalt (Co) (mg/kg)	14.4				
	Copper (Cu) (mg/kg)	403				
	Iron (Fe) (mg/kg)	29900				
	Lead (Pb) (mg/kg)	6.98				
	Lithium (Li) (mg/kg)	10.4				
	Magnesium (Mg) (mg/kg)	8620				
	Manganese (Mn) (mg/kg)	2800				
	Mercury (Hg) (mg/kg)	0.0390				
	Molybdenum (Mo) (mg/kg)	2.18				
	Nickel (Ni) (mg/kg)	35.3				
	Phosphorus (P) (mg/kg)	1100				
	Potassium (K) (mg/kg)	1840				
	Selenium (Se) (mg/kg)	0.99				
	Silver (Ag) (mg/kg)	0.19				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2163149-1 Sediment 09-SEP-18 URC-4	L2163149-2 Sediment 09-SEP-18 URC-3	L2163149-3 Sediment 09-SEP-18 URC-2	L2163149-4 Sediment 09-SEP-18 URC-1	L2163149-5 Sediment 10-SEP-18 LMC-3X
Grouping	Analyte						
SOIL							
Metals	Sodium (Na) (mg/kg)	181	219	240	222	306	
	Strontium (Sr) (mg/kg)	48.4	53.3	84.9	65.3	105	
	Thallium (Tl) (mg/kg)	<0.050	0.060	0.075	0.063	0.093	
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0	
	Titanium (Ti) (mg/kg)	561	681	750	694	704	
	Uranium (U) (mg/kg)	0.745	0.594	2.39	1.25	1.14	
	Vanadium (V) (mg/kg)	40.3	43.4	54.9	49.3	57.4	
	Zinc (Zn) (mg/kg)	36.1	42.4	50.9	46.7	63.7	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2163149-6 Sediment 10-SEP-18 UMC	L2163149-7 Sediment 10-SEP-18 UMC-5	L2163149-8 Sediment 10-SEP-18 UMC-4	L2163149-9 Sediment 10-SEP-18 UMC-3	L2163149-10 Sediment 10-SEP-18 UMC-2
Grouping	Analyte					
SOIL						
Metals	Sodium (Na) (mg/kg)		323	312	355	336
	Strontium (Sr) (mg/kg)		79.2	72.8	106	94.7
	Thallium (Tl) (mg/kg)		0.075	0.072	0.088	0.091
	Tin (Sn) (mg/kg)		<2.0	<2.0	<2.0	<2.0
	Titanium (Ti) (mg/kg)		636	647	722	696
	Uranium (U) (mg/kg)		0.689	0.677	0.879	0.817
	Vanadium (V) (mg/kg)		50.3	50.6	61.3	60.1
	Zinc (Zn) (mg/kg)		53.0	50.6	69.7	70.2

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2163149-11 Sediment 10-SEP-18 UMC-1				
Grouping	Analyte					
SOIL						
Metals	Sodium (Na) (mg/kg)	426				
	Strontium (Sr) (mg/kg)	128				
	Thallium (Tl) (mg/kg)	0.114				
	Tin (Sn) (mg/kg)	<2.0				
	Titanium (Ti) (mg/kg)	824				
	Uranium (U) (mg/kg)	1.54				
	Vanadium (V) (mg/kg)	63.2				
	Zinc (Zn) (mg/kg)	85.1				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Arsenic (As)	DUP-H	L2163149-1, -10, -11, -2, -3, -4, -5, -7, -8, -9
Duplicate	Cobalt (Co)	DUP-H	L2163149-1, -10, -11, -2, -3, -4, -5, -7, -8, -9
Duplicate	Copper (Cu)	DUP-H	L2163149-1, -10, -11, -2, -3, -4, -5, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
DUP-H	Duplicate results outside ALS DQO, due to sample heterogeneity.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
C-TIC-PCT-SK	Soil	Total Inorganic Carbon in Soil A known quantity of acetic acid is consumed by reaction with carbonates in the soil. The pH of the resulting solution is measured and compared against a standard curve relating pH to weight of carbonate.	CSSS (2008) P216-217
C-TOC-CALC-SK	Soil	Total Organic Carbon Calculation Total Organic Carbon (TOC) is calculated by the difference between total carbon (TC) and total inorganic carbon. (TIC)	CSSS (2008) 21.2
C-TOT-LECO-SK	Soil	Total Carbon by combustion method The sample is ignited in a combustion analyzer where carbon in the reduced CO2 gas is determined using a thermal conductivity detector.	CSSS (2008) 21.2
HG-200.2-CVAF-VA	Soil	Mercury in Soil by CVAAS Soil samples are digested with hot nitric and hydrochloric acids, followed by CVAAS analysis. This method is fully compliant with the BC SALM strong acid leachable metals digestion method.	EPA 200.2/1631E (mod)
IC-CACO3-CALC-SK	Soil	Inorganic Carbon as CaCO3 Equivalent	Calculation
LOI-420-SK	Soil	Loss on Ignition @ 420 C The dry-ash method involves the removal of organic matter by combustion at 420OC for 2 hours. Samples are dried prior to combustion. Reference: McKeague, J.A. Soil Sampling and Methods of Analysis. Can. Soc. Soil Sci.(1978) method 3.81	CSSS (1978) METHOD 3.81
MET-200.2-CCMS-VA	Soil	Metals in Soil by CRC ICPMS This method uses a heated strong acid digestion with HNO3 and HCl and is intended to liberate metals that may be environmentally available. Silicate minerals are not solubilized. Dependent on sample matrix, some metals may be only partially recovered, including Al, Ba, Be, Cr, Sr, Ti, Tl, V, W, and Zr. Volatile forms of sulfur (including sulfide) may not be captured, as they may be lost during sampling, storage, or digestion. Analysis is by Collision/Reaction Cell ICPMS.	EPA 200.2/6020A (mod)
N-TOTKJ-COL-SK	Soil	Total Kjeldahl Nitrogen The soil is digested with sulfuric acid in the presence of CuSO4 and K2SO4 catalysts. Ammonia in the soil extract is determined colorimetrically at 660 nm.	CSSS (2008) 22.2.3
PH-1:2-VA	Soil	pH in Soil (1:2 Soil:Water Extraction) This analysis is carried out in accordance with procedures described in the pH, Electrometric in Soil and Sediment method - Section B Physical/Inorganic and Misc. Constituents, BC Environmental Laboratory Manual 2007. The procedure involves mixing the dried (at <60°C) and sieved (No. 10 / 2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water. The pH of the solution is then measured using a standard pH probe.	BC WLAP METHOD: PH, ELECTROMETRIC, SOIL
PSA-PIPET+GRAVEL-SK	Soil	Particle size - Sieve and Pipette Particle size distribution is determined by a combination of techniques. Dry sieving is performed for coarse particles, wet sieving for sand particles and the pipette sedimentation method for clay particles. Reference: Burt, R. (2009). Soil Survey Field and Laboratory Methods Manual. Soil Survey Investigations Report No. 5. Method 3.2.1.2.2. United States Department of Agriculture Natural Resources Conservation Service.	SSIR-51 METHOD 3.2.1

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
----------------------------	---------------------

Reference Information

SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Report To				Report Format / Distribution				Service Requested (Rush for routine analysis subject to availability)											
Company: Minnow Environmental Inc.				☒ Standard ☐ Other				☒ Regular (Standard Turnaround Times - Business Days)											
Contact: Lisa Bowron				☒ PDF ☒ Excel ☐ Digital ☐ Fax				☐ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT											
Address: 101 - 1025 Hillside Ave. Victoria, BC				Email 1: lbowron@minnow.ca				☐ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT											
Phone: (250)595-1627 x21 Fax: (250) 595-1625				Email 2: psteco@minnow.ca				☐ Same Day or Weekend Emergency - Contact ALS to Confirm TAT											
Invoice To Same as Report? ☐ Yes ☒ No				Client / Project Information				Analysis Request											
Hardcopy of Invoice with Report? ☒ Yes ☐ No				Job #: Minnow Project 18-48				Please indicate below Filtered, Preserved or both (F, P, F/P)											
Company: Minto Explorations Ltd				PO / AFE:				Rescan Low Level Sediments	Inorganic Carbon	Total Carbon by combustion	Mercury by CVAFS	Loss on Ignition	pH in soil	Particle Size	Total Organic Carbon	Total Kjeldahl Nitrogen	**See Complete Quote #Q51327	Number of Containers	
Contact: Cindy Keehn				LSD:															
Address: Suite 2100-510 West Georgia Street, Vancouver, BC				Quote #: Q51327 Q69230															
Phone: 604-684-8894 Fax: 604-688-2180				ALS Contact: <i>Jerry Con Day</i> <i>Folz</i>															
Lab Work Order # (lab use only)				Sampler: Lisa Bowron															
Sample #	Sample Identification (This description will appear on the report)			Date (dd-mm-yy)	Time (hh:mm)	Sample Type													
	URC-4			9-Sep-18		Sediment	X	X	X	X	X	X		X	X	X		1	
	URC-3			9-Sep-18		Sediment	X	X	X	X	X	X		X	X	X		1	
	URC-2			9-Sep-18		Sediment	X	X	X	X	X	X		X	X	X		1	
	URC-1			9-Sep-18		Sediment	X	X	X	X	X	X		X	X	X		1	
	LMC-3K			10-Sep-18		Sediment	X	X	X	X	X	X	X	X	X	X		2	
	UMC			10-Sep-18		Sediment							X					1	
	UMC-5			10-Sep-18		Sediment	X	X	X	X	X	X		X	X	X		1	
	UMC-4			10-Sep-18		Sediment	X	X	X	X	X	X		X	X	X		1	
	UMC-3			10-Sep-18		Sediment	X	X	X	X	X	X		X	X	X		1	
	UMC-2			10-Sep-18		Sediment	X	X	X	X	X	X		X	X	X		1	
	UMC-1			10-Sep-18		Sediment	X	X	X	X	X	X		X	X	X		1	
Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details																			
Small samples. The critical analyte of interest is selenium; please ensure best possible MDLs.																			
Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.																			
By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.																			
Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.																			
SHIPMENT RELEASE (client use)						SHIPMENT RECEPTION (lab use only)						SHIPMENT VERIFICATION (lab use only)							
Released by:	Date (dd-mm-yy)	Time (hh:mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations:									
Lisa Bowron	12-Sep-18	13:30	E/HF	2018 12 Sep	2018 12 Sep	6.0 °C	HA	9/13	12:30P	Yes / No ? If Yes add SIF									



MINNOW ENVIRONMENTAL INC.
ATTN: Lisa Bowron
101 - 1025 Hillside Ave.
Victoria BC V8T 2A2

Date Received: 12-SEP-18
Report Date: 24-SEP-18 18:44 (MT)
Version: FINAL

Client Phone: 250-595-1627

Certificate of Analysis

Lab Work Order #: L2163150
Project P.O. #: NOT SUBMITTED
Job Reference: MINNOW PROJECT 18-48
C of C Numbers:
Legal Site Desc:

Can Dang
Senior Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

24-SEP-18 18:44 (MT)

Version: FINAL

Sample ID Description Sampled Date Sampled Time Client ID		L2163150-1 Sediment 05-SEP-18 LMC-5	L2163150-2 Sediment 05-SEP-18 LMC-4	L2163150-3 Sediment 10-SEP-18 LMC-3	L2163150-4 Sediment 11-SEP-18 LMC-2	L2163150-5 Sediment 11-SEP-18 LMC-1
Grouping	Analyte					
SOIL						
Physical Tests	Loss On Ignition @ 420 C (%)	10	11	3	13	6
	pH (1:2 soil:water) (pH)	7.95	7.78	7.68	7.66	7.82
Particle Size	% Gravel (>2mm) (%)	<1.0	<1.0	<1.0	4.3	<1.0
	% Sand (2.0mm - 0.063mm) (%)	41.9	24.4	68.2	23.3	42.9
	% Silt (0.063mm - 4um) (%)	49.1	65.4	28.0	62.7	48.1
	% Clay (<4um) (%)	8.8	10.2	3.8	9.7	8.9
	Texture	Silt loam	Silt loam	Sandy loam	Silt loam	Silt loam / Sandy loam
Leachable Anions & Nutrients						
Organic / Inorganic Carbon	Total Kjeldahl Nitrogen (%)	0.214 ^{DLHC}	0.269 ^{DLHC}	0.086	0.298 ^{DLHC}	0.154
	Inorganic Carbon (%)	0.157	0.165	0.076	0.206	0.121
	Inorganic Carbon (as CaCO3 Equivalent) (%)	1.30	1.37	0.63	1.72	1.01
	Total Carbon by Combustion (%)	4.83	5.46	1.60	6.57	2.62
		4.67	5.30	1.52	6.36	2.50
Metals	Aluminum (Al) (mg/kg)	11000	15300	12600	15800	14400
	Antimony (Sb) (mg/kg)	0.52	0.54	0.36	0.57	0.48
	Arsenic (As) (mg/kg)	7.15	8.93	5.83	9.07	7.35
	Barium (Ba) (mg/kg)	204	263	175	299	245
	Beryllium (Be) (mg/kg)	0.39	0.48	0.58	0.53	0.44
	Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B) (mg/kg)	<5.0	<5.0	<5.0	<5.0	<5.0
	Cadmium (Cd) (mg/kg)	0.174	0.237	0.179	0.266	0.189
	Calcium (Ca) (mg/kg)	8190	10500	7770	11900	9910
	Chromium (Cr) (mg/kg)	24.2	33.3	36.8	33.3	29.9
	Cobalt (Co) (mg/kg)	9.94	11.7	11.7	12.0	10.6
	Copper (Cu) (mg/kg)	40.6	54.3	19.7	60.0	50.3
	Iron (Fe) (mg/kg)	23500	29100	25100	28200	25700
	Lead (Pb) (mg/kg)	4.87	6.05	5.16	6.26	5.72
	Lithium (Li) (mg/kg)	7.9	9.8	8.5	10.2	9.7
	Magnesium (Mg) (mg/kg)	5910	7560	8610	7870	7230
	Manganese (Mn) (mg/kg)	1040	1240	619	1500	1130
	Mercury (Hg) (mg/kg)	0.0333	0.0403	0.0319	0.0446	0.0711
	Molybdenum (Mo) (mg/kg)	0.71	0.81	0.49	0.84	0.72
	Nickel (Ni) (mg/kg)	22.9	29.6	31.9	31.4	27.5
	Phosphorus (P) (mg/kg)	770	923	976	918	807
	Potassium (K) (mg/kg)	1050	1310	760	1410	1240
	Selenium (Se) (mg/kg)	0.48	0.62	0.28	0.80	0.49

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2163150-6 Sediment 09-SEP-18 LWC-5	L2163150-7 Sediment 09-SEP-18 LWC-4	L2163150-8 Sediment 09-SEP-18 LWC-3	L2163150-9 Sediment 09-SEP-18 LWC-2	L2163150-10 Sediment 09-SEP-18 LWC-1
Grouping	Analyte					
SOIL						
Physical Tests	Loss On Ignition @ 420 C (%)	14	14	11	18	13
	pH (1:2 soil:water) (pH)	6.57	6.57	7.57	6.50	6.60
Particle Size	% Gravel (>2mm) (%)	<1.0	<1.0	2.6	<1.0	<1.0
	% Sand (2.0mm - 0.063mm) (%)	31.1	17.5	20.6	21.5	20.7
	% Silt (0.063mm - 4um) (%)	62.0	75.4	66.4	72.9	72.1
	% Clay (<4um) (%)	6.8	7.2	10.5	5.7	7.0
	Texture	Silt loam	Silt loam	Silt loam	Silt loam	Silt loam
Leachable Anions & Nutrients	Total Kjeldahl Nitrogen (%)	0.41 ^{DLHC}	0.41 ^{DLHC}	0.291 ^{DLHC}	0.47 ^{DLHC}	0.38 ^{DLHC}
Organic / Inorganic Carbon	Inorganic Carbon (%)	0.144	0.156	0.169	0.146	0.134
	Inorganic Carbon (as CaCO3 Equivalent) (%)	1.20	1.30	1.41	1.21	1.11
	Total Carbon by Combustion (%)	7.48	7.06	5.14	6.64	6.22
	Total Organic Carbon (%)	7.34	6.90	4.97	6.49	6.09
Metals	Aluminum (Al) (mg/kg)	20000	18700	18800	16500	14100
	Antimony (Sb) (mg/kg)	0.47	0.47	0.68	0.46	0.39
	Arsenic (As) (mg/kg)	7.61	5.19	10.3	5.64	5.48
	Barium (Ba) (mg/kg)	280	252	367	219	201
	Beryllium (Be) (mg/kg)	0.87	0.79	0.63	0.73	0.63
	Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B) (mg/kg)	<5.0	<5.0	5.1	<5.0	<5.0
	Cadmium (Cd) (mg/kg)	0.279	0.250	0.374	0.232	0.216
	Calcium (Ca) (mg/kg)	10800	10300	15900	9190	7850
	Chromium (Cr) (mg/kg)	55.9	52.1	40.3	47.5	41.3
	Cobalt (Co) (mg/kg)	15.5	13.5	13.5	13.6	12.5
	Copper (Cu) (mg/kg)	33.1	32.0	73.6	27.5	24.9
	Iron (Fe) (mg/kg)	33800	30600	31500	27600	25700
	Lead (Pb) (mg/kg)	7.29	6.70	7.72	6.18	5.68
	Lithium (Li) (mg/kg)	12.0	11.4	12.1	10.1	9.0
	Magnesium (Mg) (mg/kg)	10700	10400	8670	9530	9430
	Manganese (Mn) (mg/kg)	736	243	1980	333	298
	Mercury (Hg) (mg/kg)	0.0588	0.0473	0.0577	0.0481	0.0431
	Molybdenum (Mo) (mg/kg)	0.49	0.72	1.03	0.61	0.66
	Nickel (Ni) (mg/kg)	42.7	40.6	37.2	38.5	36.0
	Phosphorus (P) (mg/kg)	1390	1130	1040	1010	1050
	Potassium (K) (mg/kg)	1200	1200	1500	1060	850
	Selenium (Se) (mg/kg)	0.50	0.40	1.01	0.37	0.28

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2163150-11 Sediment 09-SEP-18 URC	L2163150-12 Sediment 09-SEP-18 URC-5			
Grouping	Analyte					
SOIL						
Physical Tests	Loss On Ignition @ 420 C (%)		4			
	pH (1:2 soil:water) (pH)		7.66			
Particle Size	% Gravel (>2mm) (%)	<1.0				
	% Sand (2.0mm - 0.063mm) (%)	67.7				
	% Silt (0.063mm - 4um) (%)	28.7				
	% Clay (<4um) (%)	2.9				
	Texture	Sandy loam				
Leachable Anions & Nutrients	Total Kjeldahl Nitrogen (%)		0.098			
Organic / Inorganic Carbon	Inorganic Carbon (%)		0.082			
	Inorganic Carbon (as CaCO3 Equivalent) (%)		0.68			
	Total Carbon by Combustion (%)		2.10			
	Total Organic Carbon (%)		2.02			
Metals	Aluminum (Al) (mg/kg)		6770			
	Antimony (Sb) (mg/kg)		0.32			
	Arsenic (As) (mg/kg)		5.34			
	Barium (Ba) (mg/kg)		113			
	Beryllium (Be) (mg/kg)		0.21			
	Bismuth (Bi) (mg/kg)		<0.20			
	Boron (B) (mg/kg)		<5.0			
	Cadmium (Cd) (mg/kg)		0.086			
	Calcium (Ca) (mg/kg)		5250			
	Chromium (Cr) (mg/kg)		15.5			
	Cobalt (Co) (mg/kg)		6.17			
	Copper (Cu) (mg/kg)		11.2			
	Iron (Fe) (mg/kg)		17800			
	Lead (Pb) (mg/kg)		2.91			
	Lithium (Li) (mg/kg)		4.1			
	Magnesium (Mg) (mg/kg)		3030			
	Manganese (Mn) (mg/kg)		666			
	Mercury (Hg) (mg/kg)		0.0228			
	Molybdenum (Mo) (mg/kg)		0.62			
	Nickel (Ni) (mg/kg)		11.7			
	Phosphorus (P) (mg/kg)		638			
	Potassium (K) (mg/kg)		490			
	Selenium (Se) (mg/kg)		0.47			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2163150-1 Sediment 05-SEP-18 LMC-5	L2163150-2 Sediment 05-SEP-18 LMC-4	L2163150-3 Sediment 10-SEP-18 LMC-3	L2163150-4 Sediment 11-SEP-18 LMC-2	L2163150-5 Sediment 11-SEP-18 LMC-1
Grouping	Analyte						
SOIL							
Metals	Silver (Ag) (mg/kg)	<0.10	<0.10	<0.10	0.10	<0.10	
	Sodium (Na) (mg/kg)	261	316	306	342	317	
	Strontium (Sr) (mg/kg)	85.5	119	81.2	133	114	
	Thallium (Tl) (mg/kg)	0.075	0.097	0.057	0.103	0.094	
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0	
	Titanium (Ti) (mg/kg)	626	772	672	808	771	
	Uranium (U) (mg/kg)	0.860	1.27	1.59	1.32	0.970	
	Vanadium (V) (mg/kg)	51.5	62.2	59.4	60.3	53.6	
	Zinc (Zn) (mg/kg)	53.2	65.4	52.9	66.4	59.4	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2163150-6 Sediment 09-SEP-18 LWC-5	L2163150-7 Sediment 09-SEP-18 LWC-4	L2163150-8 Sediment 09-SEP-18 LWC-3	L2163150-9 Sediment 09-SEP-18 LWC-2	L2163150-10 Sediment 09-SEP-18 LWC-1
Grouping	Analyte						
SOIL							
Metals	Silver (Ag) (mg/kg)	0.12	0.11	0.15	<0.10	<0.10	
	Sodium (Na) (mg/kg)	450	455	339	427	355	
	Strontium (Sr) (mg/kg)	116	108	180	92.7	82.2	
	Thallium (Tl) (mg/kg)	0.105	0.094	0.124	0.101	0.066	
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0	
	Titanium (Ti) (mg/kg)	916	969	773	923	720	
	Uranium (U) (mg/kg)	3.00	2.68	1.88	2.53	2.27	
	Vanadium (V) (mg/kg)	75.1	72.1	65.4	70.1	61.6	
	Zinc (Zn) (mg/kg)	71.4	70.1	74.9	62.8	64.3	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2163150-11 Sediment 09-SEP-18 URC	L2163150-12 Sediment 09-SEP-18 URC-5			
Grouping	Analyte						
SOIL							
Metals	Silver (Ag) (mg/kg)			<0.10			
	Sodium (Na) (mg/kg)			149			
	Strontium (Sr) (mg/kg)			55.6			
	Thallium (Tl) (mg/kg)			<0.050			
	Tin (Sn) (mg/kg)			<2.0			
	Titanium (Ti) (mg/kg)			507			
	Uranium (U) (mg/kg)			0.976			
	Vanadium (V) (mg/kg)			39.6			
	Zinc (Zn) (mg/kg)			30.2			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
C-TIC-PCT-SK	Soil	Total Inorganic Carbon in Soil A known quantity of acetic acid is consumed by reaction with carbonates in the soil. The pH of the resulting solution is measured and compared against a standard curve relating pH to weight of carbonate.	CSSS (2008) P216-217
C-TOC-CALC-SK	Soil	Total Organic Carbon Calculation Total Organic Carbon (TOC) is calculated by the difference between total carbon (TC) and total inorganic carbon. (TIC)	CSSS (2008) 21.2
C-TOT-LECO-SK	Soil	Total Carbon by combustion method The sample is ignited in a combustion analyzer where carbon in the reduced CO ₂ gas is determined using a thermal conductivity detector.	CSSS (2008) 21.2
HG-200.2-CVAF-VA	Soil	Mercury in Soil by CVAAS Soil samples are digested with hot nitric and hydrochloric acids, followed by CVAAS analysis. This method is fully compliant with the BC SALM strong acid leachable metals digestion method.	EPA 200.2/1631E (mod)
IC-CACO3-CALC-SK	Soil	Inorganic Carbon as CaCO ₃ Equivalent	Calculation
LOI-420-SK	Soil	Loss on Ignition @ 420 C The dry-ash method involves the removal of organic matter by combustion at 420OC for 2 hours. Samples are dried prior to combustion. Reference: McKeague, J.A. Soil Sampling and Methods of Analysis. Can. Soc. Soil Sci.(1978) method 3.81	CSSS (1978) METHOD 3.81
MET-200.2-CCMS-VA	Soil	Metals in Soil by CRC ICPMS This method uses a heated strong acid digestion with HNO ₃ and HCl and is intended to liberate metals that may be environmentally available. Silicate minerals are not solubilized. Dependent on sample matrix, some metals may be only partially recovered, including Al, Ba, Be, Cr, Sr, Ti, Tl, V, W, and Zr. Volatile forms of sulfur (including sulfide) may not be captured, as they may be lost during sampling, storage, or digestion. Analysis is by Collision/Reaction Cell ICPMS.	EPA 200.2/6020A (mod)
N-TOTKJ-COL-SK	Soil	Total Kjeldahl Nitrogen The soil is digested with sulfuric acid in the presence of CuSO ₄ and K ₂ SO ₄ catalysts. Ammonia in the soil extract is determined colorimetrically at 660 nm.	CSSS (2008) 22.2.3
PH-1:2-VA	Soil	pH in Soil (1:2 Soil:Water Extraction) This analysis is carried out in accordance with procedures described in the pH, Electrometric in Soil and Sediment method - Section B Physical/Inorganic and Misc. Constituents, BC Environmental Laboratory Manual 2007. The procedure involves mixing the dried (at <60°C) and sieved (No. 10 / 2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water. The pH of the solution is then measured using a standard pH probe.	BC WLAP METHOD: PH, ELECTROMETRIC, SOIL
PSA-PIPET+GRAVEL-SK	Soil	Particle size - Sieve and Pipette Particle size distribution is determined by a combination of techniques. Dry sieving is performed for coarse particles, wet sieving for sand particles and the pipette sedimentation method for clay particles. Reference: Burt, R. (2009). Soil Survey Field and Laboratory Methods Manual. Soil Survey Investigations Report No. 5. Method 3.2.1.2.2. United States Department of Agriculture Natural Resources Conservation Service.	SSIR-51 METHOD 3.2.1

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Report To			Report Format / Distribution			Service Requested (Rush for routine analysis subject to availability)										
Company: Minnow Environmental Inc.			☒ Standard ☐ Other			☒ Regular (Standard Turnaround Times - Business Days)										
Contact: Lisa Bowron			☒ PDF ☒ Excel ☐ Digital ☐ Fax			☐ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT										
Address: 101 - 1025 Hillside Ave.			Email 1: lbowron@minnow.ca			☐ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT										
Victoria, BC			Email 2: pstecko@minnow.ca			☐ Same Day or Weekend Emergency - Contact ALS to Confirm TAT										
Phone: (250)595-1627 x21 Fax: (250) 595-1625			Email 3:													
Invoice To Same as Report? ☐ Yes ☒ No			Client / Project Information			Analysis Request										
Hardcopy of Invoice with Report? ☒ Yes ☐ No			Job #: Minnow Project 12-48			Please indicate below Filtered, Preserved or both (F, P, F/P)										
Company: Minto Explorations Ltd			PO / AFE:													
Contact: Cindy Keehn			LSD:													
Address: Suite 2100-510 West Georgia Street, Vancouver, BC																
Phone: 604-684-8894 Fax: 604-688-2180			Quote #: Q51327 Q69230													
Lab Work Order # (lab use only)			ALS Contact: Jerry Can Dong H. Becker		Sampler: Lisa Bowron											
Sample #	Sample Identification (This description will appear on the report)	Date (dd-mm-yy)	Time (hh:mm)	Sample Type	Rescan Low Level Sediments	Inorganic Carbon	Total Carbon by combustion	Mercury by CVAFS	Loss on Ignition	pH in soil	Particle Size	Total Organic Carbon	Total Kjeldahl Nitrogen	**See Complete Quote #Q51327	Number of Containers	
	LMC-5	5-Sep-18		Sediment	X	X	X	X	X	X	X	X	X	X	2	
	LMC-4	5-Sep-18		Sediment	X	X	X	X	X	X	X	X	X	X	2	
	LMC-3	10-Sep-18		Sediment	X	X	X	X	X	X	X	X	X	X	2	
	LMC-2	11-Sep-18		Sediment	X	X	X	X	X	X	X	X	X	X	2	
	LMC-1	11-Sep-18		Sediment	X	X	X	X	X	X	X	X	X	X	2	
	LWC-5	9-Sep-18		Sediment	X	X	X	X	X	X	X	X	X	X	2	
	LWC-4	9-Sep-18		Sediment	X	X	X	X	X	X	X	X	X	X	2	
	LWC-3	9-Sep-18		Sediment	X	X	X	X	X	X	X	X	X	X	2	
	LWC-2	9-Sep-18		Sediment	X	X	X	X	X	X	X	X	X	X	2	
	LWC-1	9-Sep-18		Sediment	X	X	X	X	X	X	X	X	X	X	2	
	WRC	9-Sep-18		Sediment						X					1	
	WRC-5	9-Sep-18		Sediment	X	X	X	X	X	X	X	X	X	X	1	
Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details																
Small samples. The critical analyte of interest is selenium; please ensure best possible MDLs.																
Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.																
By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.																
Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.																
SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)									
Released by:	Date (dd-mm-yy)	Time (hh:mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations:						
Lisa Bowron	12-Sep-18	13:30	EHF	2018 12 Sep	13:30	6.0 °C	HA	9/13	12:30pm	Yes / No? If Yes add SIF						



Toxicity testing for Minnow Environmental Inc.

September 2018 Sediment Samples

Final Report

November 20, 2018

Submitted to: **Minnow Environmental Inc.**
Victoria, BC

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SIGNATURE PAGE

Report By:
Karen Lee, B. Sc.
Biologist – Project Manager



Reviewed By:
Armando Tang, R.P.Bio.
Senior Reviewer

This report has been prepared by Nautilus Environmental Company Inc. based on data and/or samples provided by our client and the results of this study are for their sole benefit. Any reliance on the data by a third party is at the sole and exclusive risk of that party. The results presented here relate only to the samples tested.

SUMMARY

Sample and Test Type Information

Sample ID	LMC and LWC
Sample collection date	September 5 to 11, 2018
Sample receipt date	September 13, 2018
Sample receipt temperature	6.8°C
Test types	14-d <i>Hyaella azteca</i> survival and growth 10-d <i>Chironomus dilutus</i> survival and growth

Results

Endpoint (mean + SD)	Sample ID		
	Control Sediment	LWC	LMC
<i>H. azteca</i> survival	96.0 ± 5.5	100 ± 0.0	94.0 ± 5.5
<i>H. azteca</i> growth	0.21 ± 0.02	0.26 ± 0.06	0.27 ± 0.02
<i>C. dilutus</i> survival	92.0 ± 4.5	88.0 ± 8.4	70.0 ± 12.2*, α
<i>C. dilutus</i> growth	2.20 ± 0.09	2.64 ± 0.51	2.98 ± 0.31

SD = Standard Deviation

(*) Indicates a statistically significant effect relative to the control sediment

(α) Indicates a statistically significant effect relative to reference sediment LWC

1.0 INTRODUCTION

Nautilus Environmental Company Inc. conducted freshwater sediment toxicity tests for Minnow Environmental Inc. on samples identified as LMC and LWC. The samples were collected on September 5, 9, 10 and 11, 2018; each sample was transported in five 500-mL glass container and delivered to laboratory in Burnaby, BC on September 13, 2018. The samples had a temperature of 6.8°C on receipt and were stored in the dark at $4 \pm 2^\circ\text{C}$ prior to testing. A 14-d *Hyalella azteca* and a 10-d *Chironomus dilutus* survival and growth sediment toxicity test was conducted on the samples and the test results are provided in this report. Copies of laboratory data sheets and printouts of statistical analyses for the tests are provided in Appendices A and B, analytical chemistry is provided in Appendix C and the chain-of-custody form is provided in Appendix D.

2.0 METHODS

Methods for the toxicity tests are summarized in Tables 1 and 2. Testing was conducted according to procedures described by Environment Canada (1997 and 2017). Statistical analyses for all tests were performed using CETIS (Tidepool Scientific Software, 2013).

Ammonia concentrations were measured in-house three times per week on reference sediment sample LWC to ensure that un-ionized ammonia was below 0.2 mg/L (Environment Canada, 2017). Samples of overlying water were also collected at test initiation and termination, and sent to ALS Environmental, Burnaby, BC for measurements of total ammonia concentration. Analytical results are provided in Appendix C.

Table 1. Summary of test conditions: *Hyalella azteca* survival and growth test.

Test species	<i>Hyalella azteca</i>
Organism source	Aquatic BioSystems, Fort Collins, CO
Organism age	2- to 9-days old
Test type	Static
Test duration	14 days
Test vessel	375-mL glass container
Test volume	100 mL sediment; 175 mL overlying water
Test replicates	5 per sample
Number of organisms	10 per replicate
Control/dilution water	Reconstituted water
Test solution renewal	None
Test temperature	23 ± 1°C
Feeding	0.75 mL of YCT and 1.35 mg of Tetramin per replicate daily
Light intensity	500 to 1000 lux at water surface
Photoperiod	16 hours light/8 hours dark
Aeration	Continuous gentle aeration
Test measurements	Temperature, dissolved oxygen, pH and conductivity of overlying water measured daily; hardness, alkalinity and total ammonia of overlying water measured at test initiation and termination; unionized ammonia measured three times weekly in overlying water of reference sample
Test protocol	Environment Canada (2017), EPS 1/RM/33
Statistical software	CETIS Version 1.9.4
Test endpoints	Survival and dry weight
Test acceptability criteria for controls	≥80% survival and ≥0.1 mg/amphipod dry weight
Reference toxicant	Sodium chloride (NaCl)

Table 2. Summary of test conditions: *Chironomus dilutus* survival and growth test.

Test species	<i>Chironomus dilutus</i>
Organism source	Aquatic BioSystems, Fort Collins, CO
Organism age	Third instar
Test type	Static
Test duration	10 days
Test vessel	375-mL glass container
Test volume	100 mL sediment; 175 mL overlying water
Test replicates	5 per sample
Number of organisms	10 per replicate
Control/dilution water	Reconstituted water
Test solution renewal	None
Test temperature	23 ± 1°C
Feeding	6 mg of Tetramin per replicate daily
Light intensity	500 to 1000 lux at water surface
Photoperiod	16 hours light/8 hours dark
Aeration	Continuous gentle aeration
Test measurements	Temperature, dissolved oxygen, pH and conductivity of overlying water measured daily; hardness, alkalinity and total ammonia of overlying water measured at test initiation and termination
Test protocol	Environment Canada (1997), EPS 1/RM/32
Statistical software	CETIS Version 1.9.4
Test endpoints	Survival and dry weight
Test acceptability criteria for controls	≥70% survival and ≥0.6 mg/worm dry weight
Reference toxicant	Potassium chloride (KCl)

3.0 RESULTS

No adverse effects was observed on either the survival or growth of *H. azteca* compared to the control sediment or the reference sediment LWC (Table 3). Sample LMC was significantly different on the survival of *C. dilutus* compared to both the control and reference sediment (Table 4); there were no significant effects observed on dry weight.

Measured total ammonia concentrations in the *H. azteca* and *C. dilutus* tests are summarized in Table 5. These concentrations were at levels that are not expected to cause adverse effects to

either species. Un-ionized ammonia measurements on the reference sediment sample were below 0.2 mg/L throughout the *H. azteca* test; therefore, renewal of the overlying water was not required (Environment Canada, 2017).

Table 3. Results: *Hyaella azteca* survival and growth test.

Sample ID	Mean $\pm$ SD	
	Survival (%)	Average Dry Weight (mg/org)
Control Sediment	96.0 $\pm$ 5.5	0.21 $\pm$ 0.02
LWC	100 $\pm$ 0.0	0.26 $\pm$ 0.06
LMC	94.0 $\pm$ 5.5	0.27 $\pm$ 0.02

SD = Standard Deviation

Table 4. Results: *Chironomus dilutus* survival and growth test.

Sample ID	Mean $\pm$ SD	
	Survival (%)	Average Dry Weight (mg/org)
Control Sediment	92.0 $\pm$ 4.5	2.20 $\pm$ 0.09
LWC	88.0 $\pm$ 8.4	2.64 $\pm$ 0.51
LMC	70.0 $\pm$ 12.2*, α	2.98 $\pm$ 0.31

SD = Standard Deviation

(*) Indicates a statistically significant effect relative to the control sediment

(α) Indicates a statistically significant effect relative to reference sediment LWC

Table 5. Summary of total overlying ammonia concentrations (mg/L N) measured in the toxicity tests.

Sample ID	<i>Hyaella azteca</i>		<i>Chironomus dilutus</i>	
	Day 0	Day 14	Day 0	Day 10
Control Sediment	0.0096	1.66	0.0096	0.223
LWC	0.0708	0.0869	0.0708	1.01
LMC	0.390	0.0625	0.390	0.068

4.0 QA/QC

The health histories of the test organisms used in the exposures were acceptable and met the requirements of the Environment Canada protocols. The tests met all control acceptability criteria and water quality parameters remained within ranges specified in the protocols throughout the tests. There were no deviations from the test methodologies. Uncertainty associated with these tests is best described by the standard deviations around the means.

Results of the reference toxicant tests conducted during the testing program are summarized in Table 7. Results for these tests fell within the acceptable range for organism performance of mean and two standard deviations, based on historical results obtained by the laboratory with these tests. Thus, the sensitivity of the organisms used in these tests was appropriate.

Table 6. Reference toxicant test results.

Test Species	Endpoint	Historical Mean (2 SD Range)	CV (%)	Test Date
<i>H. azteca</i>	Survival (LC50): 6.6 g/L NaCl	5.8 (5.0–6.8)	8	September 28, 2018
<i>C. dilutus</i>	Survival (LC50): 7.1 g/L KCl	5.0 (2.9 – 8.6)	28	September 28, 2018

SD = Standard Deviation, CV = Coefficient of Variation, LC = Lethal Concentration

5.0 REFERENCES

Environment Canada. 2017. Biological test method: test for survival and growth in sediment and water using the freshwater amphipod, *Hyalella azteca*. EPS 1/RM/33, Second Edition, September 2017.

Environment Canada. 1997. Biological test method: test for survival and growth in sediment using the larvae of freshwater midges (*Chironomus tentans* and *Chironomus riparius*). Environmental Protection Series EPS 1/RM/32. December 1997. Environment Canada, Method Development and Application Section, Environmental Technology Centre, Ottawa, ON. 131 pp.

Tidepool Scientific Software. 2013. CETIS comprehensive environmental toxicity information system, version 1.9.4 Tidepool Scientific Software, McKinleyville, CA. 275 pp.

APPENDIX A – *Hyaella azteca* Toxicity Test Data

Hyalella azteca Sediment Test Summary Sheet

Client: Minnow Environmental Inc.
Work Order No.: 181545

Start Date: Sept 28/18
Set up by: WV

Sample Information:

Sample ID: LMC and LWC
Sample Date: Sept 5, 9-11, 2018
Date Received: Sept 13, 2018
Sample Volume: 57500 mL per sample.

Test Organism Information:

Species: Hyalella azteca
Supplier: Aquatic Biosystems, CO
Date received: Sept 27/18
Age or size (Day 0): 7-9 d

NaCl Reference Toxicant Results:

Reference Toxicant ID: HA154
Stock Solution ID: n/a
Date Initiated: Sept 28/18

96-h LC50 (95% CL): 6.6 (5.4 - 8.1) g/L NaCl

96-h LC50 Reference Toxicant Mean and Range: 5.8 (5.0 - 6.8) g/L NaCl CV (%): 8

Test Results:

Sample ID	Survival $\pm$ SD (%)	Average Dry Wt. $\pm$ SD (mg)
Control sediment	96.0 $\pm$ 5.5	0.21 $\pm$ 0.02
LWC	100 $\pm$ 0.0	0.26 $\pm$ 0.06
LMC	94.0 $\pm$ 5.5	0.27 $\pm$ 0.02
	$\pm$	$\pm$
	$\pm$	$\pm$
	$\pm$	$\pm$
	$\pm$	$\pm$
	$\pm$	$\pm$

Reviewed by: 

Date reviewed: Nov 14, 2018

Chronic *H. azteca* Sediment Toxicity Test Data Sheet
Freshwater Sediment Water Quality

Client: Minnow Environmental
Work Order No.: 18154J

Start Date: Sept 28/18
Termination Date: Oct 12/18
CER #: 9
Test Organism: *Hyalella azteca*

Temperature (°C)

Sample ID	Day														
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Control Sediment	23.0	22.5	23.0	23.0	23.0	23.0	22.0	22.0	22.0	22.0	22.0	22.0	23.0	23.0	23.0
LWC	22.9	22.5	23.0	23.0	23.0	22.5	22.0	22.0	22.0	22.0	22.0	22.0	23.0	23.0	23.0
LMC	23.0	22.5	23.0	23.0	23.0	22.5	22.0	22.0	22.0	22.0	22.0	22.0	23.0	23.0	23.0
Technician Initials	AM	MM	MM	MM	MM	MM	MM	MM	MM	MM	MM	MM	MM	MM	MM

Thermometer: 9

Conductivity (µS)

Sample ID	Day														
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Control Sediment	416	420	438	446	455	463	472	478	484	498	503	492	485	495	504
LWC	415	427	428	433	453	475	497	510	516	525	509	494	491	512	502
LMC	513	570	617	623	702	736	769	796	819	850	873	880	903	914	931
Technician Initials	AM	MM	MM	MM	MM	MM	MM	MM	MM	MM	MM	MM	MM	MM	MM

Conductivity meter/probe: 4 / 4

Comments: (2) 654
(3) 446

Reviewed by: MM

Date Reviewed: Nov 14, 2018

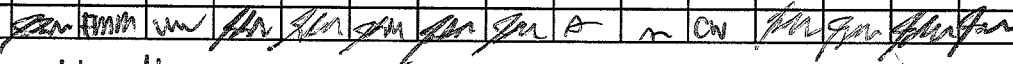
Chronic *H. azteca* Sediment Toxicity Test Data Sheet
Freshwater Sediment Water Quality

Client:
Work Order No.:

Minnow Environmental
181545

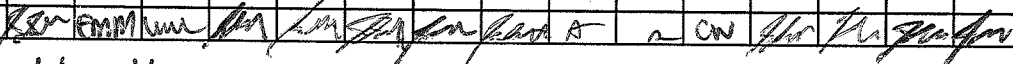
Start Date: Sep 28/18
Termination Date: Oct 12/18
CER #: 9
Test Organism: *Hyalella azteca*

Dissolved oxygen (mg/L)

Sample ID	Day														
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Control Sediment	7.7	7.8	7.9	7.8	7.6	8.1	8.2	7.8	8.0	8.0	7.9	7.8	7.9	7.8	7.3
LWC	7.6	7.9	7.9	7.6	7.7	7.9	8.0	7.8	8.0	7.9	7.5	7.6	7.4	7.8	7.5
LMC	7.6	7.9	7.8	7.6	7.6	8.0	8.0	7.9	8.1	8.0	7.7	7.7	7.8	7.6	7.6
Technician Initials															

DO meter/probe: 4, 4

pH

Sample ID	Day														
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Control Sediment	7.1	7.3	7.7	7.3	7.4	7.2	7.3	7.3	7.4	7.5	7.5	7.6	7.4	7.8	7.8
LWC	7.3	7.4	7.7	7.4	7.6	7.4	7.6	7.5	7.7	7.7	7.7	7.7	7.7	7.5	8.1
LMC	7.6	7.4	7.8	7.9	7.9	7.8	8.0	7.9	8.0	8.1	8.3	8.4	8.4	8.5	8.5
Technician Initials															

pH meter/probe: 4, 4

Light meter: Li-1

Light intensity (Lux): 710 - 940

Comments:

Reviewed by: JOU

Date Reviewed: Oct-25/18

H. azteca Sediment Toxicity Test Data Sheet
Freshwater Sediment 14-d Survival and Weight

Client: Minnow Environmental
Work Order No: 181945
Sample ID: See below

Start Date: Sept 28/18
Termination Date: Oct 12/18
Test Organism: Hyalella azteca
Balance: 1

Sample ID	928 Pan No. Black	Rep	No. alive	No. dead	No. missing	Initials	Pan weight (mg)	Pan + organism (mg)	No. weighed	Initials
Control Sediment	1	A	10	0	0	KJL	1013.47	1015.87	10	KJL
	2	B	10	0	0		1019.07	1021.25	10	
	3	C	10	0	0		1026.79	1028.48	9	
	4	D	10	0	0		1011.04	1013.01	10	
	5	E	9	0	1	↓	1015.32	1017.33	9	
LWL	6	A	10	0	0	KJL	1020.07	1023.38	10	
	7	B	10	0	0		1002.51	1005.15	10	
	8	C	10	0	0		1049.15	1050.94	10	
	9	D	10	0	0		1003.75	1006.89	10	
	10	E	10	0	0	↓	1005.77	1008.09	10	
LML	11	A	90	0	1	JAM	1044.14	1046.62	9	
	12	B	90	0	1		1032.01	1034.31	9	
	13	C	10	0	0		1029.71	1032.23	10	
	14	D	10	0	0		1007.29	1010.26	10	
	15	E	90	0	1	↓	1022.41	1024.93	9	
		A								
		B								
		C								
		D								
		E								

Comments:

Checked by KJL
Reweighed Pan #6 (1023.48 mg) and Pan #13 (1032.21 mg)

Reviewed by:

Joh

Date Reviewed:

Oct. 25/18

CETIS Summary Report

Report Date: 14 Nov-18 11:37 (p 1 of 2)
Test Code/ID: 181545 / 18-7001-6261

Hyalella 14-d Survival and Growth Sediment Test

Nautilus Environmental

Batch ID: 15-3278-8190 Test Type: Growth-Survival (10d) Analyst: Karen Lee
Start Date: 28 Sep-18 Protocol: EC/EPS 1/RM/33 Diluent: Reconstituted Water
Ending Date: 12 Oct-18 Species: Hyalella azteca Brine:
Test Length: 14d 0h Taxon: Malacostraca Source: Aquatic Biosystems, CO Age: 7-9d

Sample Code	Sample ID	Sample Date	Receipt Date	Sample Age	Client Name	Project
Control Sedimen	16-3819-8140	28 Sep-18	28 Sep-18	n/a	Minnow Environmental	
LWC	07-7104-5524	09 Sep-18	13 Sep-18	19d 0h (6.8 °C)		
LMC	11-7089-1311	05 Sep-18	13 Sep-18	23d 0h (6.8 °C)		

Sample Code	Material Type	Sample Source	Station Location	Lat/Long
Control Sedimen	Sediment Sample	Minnow Environmental	Control Sediment	
LWC	Sediment Sample	Minnow Environmental	LWC	
LMC	Sediment Sample	Minnow Environmental	LMC	

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
14-1431-7226	10d Survival Rate	Fisher Exact/Bonferroni-Holm Test	1.0000	LWC passed 10d survival rate	1
14-1431-7226	10d Survival Rate	Fisher Exact/Bonferroni-Holm Test	1.0000	Control Sedimen passed 10d survival rate	1
14-1431-7226	10d Survival Rate	Fisher Exact/Bonferroni-Holm Test	1.0000	LMC passed 10d survival rate	1
13-9148-4844	10d Survival Rate	Fisher Exact/Bonferroni-Holm Test	0.1212	Control Sedimen passed 10d survival rate	1
13-9148-4844	10d Survival Rate	Fisher Exact/Bonferroni-Holm Test	0.1212	LMC passed 10d survival rate	1
13-9148-4844	10d Survival Rate	Fisher Exact/Bonferroni-Holm Test	0.1212	LWC passed 10d survival rate	1
14-1431-7226	10d Survival Rate	Fisher Exact/Bonferroni-Holm Test	0.5000	Control Sedimen passed 10d survival rate	1
14-1431-7226	10d Survival Rate	Fisher Exact/Bonferroni-Holm Test	0.5000	LWC passed 10d survival rate	1
14-1431-7226	10d Survival Rate	Fisher Exact/Bonferroni-Holm Test	0.5000	LMC passed 10d survival rate	1
04-1884-5197	Mean Dry Weight-mg	Equal Variance t Two-Sample Test	0.9402	LMC passed mean dry weight-mg	1
04-1884-5197	Mean Dry Weight-mg	Equal Variance t Two-Sample Test	0.9402	LWC passed mean dry weight-mg	1
04-1884-5197	Mean Dry Weight-mg	Equal Variance t Two-Sample Test	0.9402	Control Sedimen passed mean dry weight-	1
04-1884-5197	Mean Dry Weight-mg	Equal Variance t Two-Sample Test	0.9992	Control Sedimen passed mean dry weight-	1
04-1884-5197	Mean Dry Weight-mg	Equal Variance t Two-Sample Test	0.9992	LMC passed mean dry weight-mg	1
04-1884-5197	Mean Dry Weight-mg	Equal Variance t Two-Sample Test	0.9992	LWC passed mean dry weight-mg	1
05-9392-8266	Mean Dry Weight-mg	Equal Variance t Two-Sample Test	0.6062	Control Sedimen passed mean dry weight-	1
05-9392-8266	Mean Dry Weight-mg	Equal Variance t Two-Sample Test	0.6062	LWC passed mean dry weight-mg	1
05-9392-8266	Mean Dry Weight-mg	Equal Variance t Two-Sample Test	0.6062	LMC passed mean dry weight-mg	1

10d Survival Rate Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
Control Sedimen	N	5	0.9600	0.8920	1.0000	0.9000	1.0000	0.0245	0.0548	5.71%	0.00%
LWC		5	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.00%	-4.17%
LMC		5	0.9400	0.8720	1.0000	0.9000	1.0000	0.0245	0.0548	5.83%	2.08%

Mean Dry Weight-mg Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
Control Sedimen	N	5	0.2132	0.1872	0.2392	0.1878	0.24	0.009362	0.02093	9.82%	0.00%
LWC		5	0.264	0.1874	0.3406	0.179	0.331	0.0276	0.06172	23.38%	-23.81%
LMC		5	0.272	0.249	0.295	0.252	0.297	0.008283	0.01852	6.81%	-27.58%


11/14/18

CETIS Summary Report

Report Date: 14 Nov-18 11:37 (p 2 of 2)
Test Code/ID: 181545 / 18-7001-6261

Hyalella 14-d Survival and Growth Sediment Test

Nautilus Environmental

10d Survival Rate Detail

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sedimen	N	1.0000	1.0000	0.9000	1.0000	0.9000
LWC		1.0000	1.0000	1.0000	1.0000	1.0000
LMC		0.9000	0.9000	1.0000	1.0000	0.9000

Mean Dry Weight-mg Detail

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sedimen	N	0.24	0.218	0.1878	0.197	0.2233
LWC		0.331	0.264	0.179	0.314	0.232
LMC		0.2756	0.2556	0.252	0.297	0.28

10d Survival Rate Binomials

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sedimen	N	10/10	10/10	9/10	10/10	9/10
LWC		10/10	10/10	10/10	10/10	10/10
LMC		9/10	9/10	10/10	10/10	9/10

CETIS Analytical Report

Report Date: 14 Nov-18 11:35 (p 1 of 2)
Test Code/ID: 181545 / 18-7001-6261

Hyalella 14-d Survival and Growth Sediment Test

Nautilus Environmental

Analysis ID: 04-1884-5197	Endpoint: Mean Dry Weight-mg	CETIS Version: CETISv1.9.4
Analyzed: 14 Nov-18 11:35	Analysis: Parametric-Two Sample	Status Level: 1
Batch ID: 15-3278-8190	Test Type: Growth-Survival (19d)	Analyst: Karen Lee
Start Date: 28 Sep-18	Protocol: EC/EPS 1/RM/33	Diluent: Reconstituted Water
Ending Date: 12 Oct-18	Species: Hyalella azteca	Brine:
Test Length: 14d 0h	Taxon: Malacostraca	Source: Aquatic Biosystems, CO Age: 7-9d

Sample Code	Sample ID	Sample Date	Receipt Date	Sample Age	Client Name	Project
Control Sedimen	16-3819-8140	28 Sep-18	28 Sep-18	n/a	Minnow Environmental	
LWC	07-7104-5524	09 Sep-18	13 Sep-18	19d 0h (6.8 °C)		
LMC	11-7089-1311	05 Sep-18	13 Sep-18	23d 0h (6.8 °C)		

Sample Code	Material Type	Sample Source	Station Location	Lat/Long
Control Sedimen	Sediment Sample	Minnow Environmental	Control Sediment	
LWC	Sediment Sample	Minnow Environmental	LWC	
LMC	Sediment Sample	Minnow Environmental	LMC	

Data Transform	Alt Hyp	Comparison Result	PMSD
Untransformed	C > T	LWC passed mean dry weight-mg	10.90%
		LMC passed mean dry weight-mg	10.90%

Equal Variance t Two-Sample Test

Sample I	vs	Sample II	Test Stat	Critical	MSD	DF	P-Type	P-Value	Decision(α:5%)
Negative Control		LWC	-1.742	1.86	0.054	8	CDF	0.9402	Non-Significant Effect
		LMC	-4.704	1.86	0.023	8	CDF	0.9992	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.0101676	0.0050838	2	3.322	0.0711	Non-Significant Effect
Error	0.0183646	0.0015304	12			
Total	0.0285323		14			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance Test	6.602	9.21	0.0368	Equal Variances
Distribution	Shapiro-Wilk W Normality Test	0.9605	0.8328	0.7017	Normal Distribution

Mean Dry Weight-mg Summary

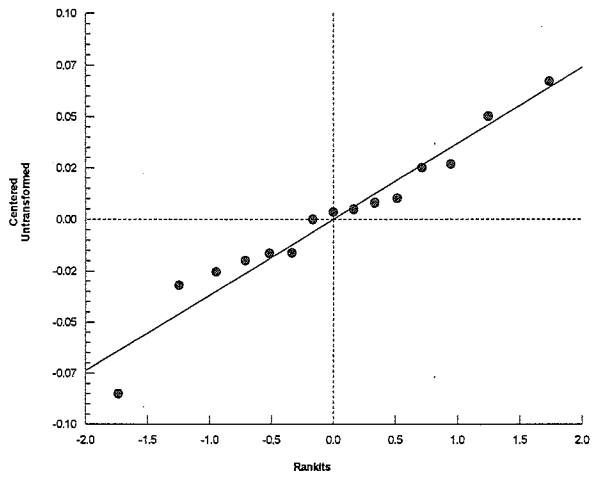
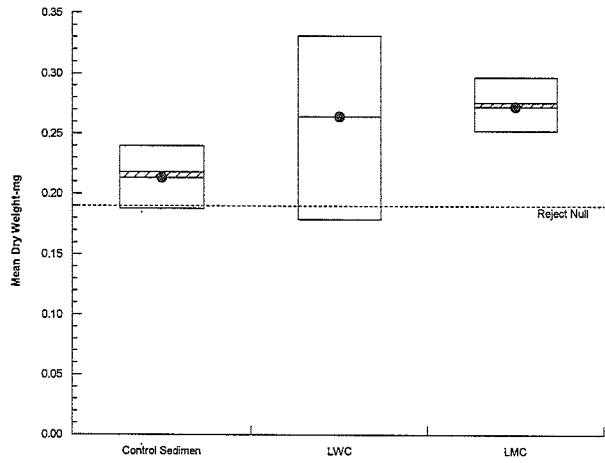
Sample	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control Sedimen	N	5	0.2132	0.1872	0.2392	0.218	0.1878	0.24	0.009362	9.82%	0.00%
LWC		5	0.264	0.1874	0.3406	0.264	0.179	0.331	0.0276	23.38%	-23.81%
LMC		5	0.272	0.249	0.295	0.2756	0.252	0.297	0.008283	6.81%	-27.58%

Mean Dry Weight-mg Detail

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sedimen	N	0.24	0.218	0.1878	0.197	0.2233
LWC		0.331	0.264	0.179	0.314	0.232
LMC		0.2756	0.2556	0.252	0.297	0.28

Hyalella 14-d Survival and Growth Sediment Test		Nautilus Environmental	
Analysis ID: 04-1884-5197	Endpoint: Mean Dry Weight-mg	CETIS Version: CETISv1.9.4	
Analyzed: 14 Nov-18 11:35	Analysis: Parametric-Two Sample	Status Level: 1	

Graphics



CETIS Analytical Report

Report Date: 14 Nov-18 11:35 (p 1 of 2)
Test Code/ID: 181545 / 18-7001-6261

Hyalella 14-d Survival and Growth Sediment Test

Nautilus Environmental

Analysis ID: 05-9392-8266	Endpoint: Mean Dry Weight-mg	CETIS Version: CETISv1.9.4
Analyzed: 14 Nov-18 11:35	Analysis: Parametric-Two Sample	Status Level: 1
Batch ID: 15-3278-8190	Test Type: Growth-Survival (14d)	Analyst: Karen Lee
Start Date: 28 Sep-18	Protocol: EC/EPS 1/RM/33	Diluent: Reconstituted Water
Ending Date: 12 Oct-18	Species: Hyalella azteca	Brine:
Test Length: 14d 0h	Taxon: Malacostraca	Source: Aquatic Biosystems, CO Age: 7-9d

Sample Code	Sample ID	Sample Date	Receipt Date	Sample Age	Client Name	Project
LWC	07-7104-5524	09 Sep-18	13 Sep-18	19d 0h (6.8 °C)	Minnow Environmental	
LMC	11-7089-1311	05 Sep-18	13 Sep-18	23d 0h (6.8 °C)		

Sample Code	Material Type	Sample Source	Station Location	Lat/Long
LWC	Sediment Sample	Minnow Environmental	LWC	
LMC	Sediment Sample	Minnow Environmental	LMC	

Data Transform	Alt Hyp	Comparison Result	PMSD
Untransformed	C > T	LMC passed mean dry weight-mg	20.30%

Equal Variance t Two-Sample Test

Sample I	vs	Sample II	Test Stat	Critical	MSD	DF	P-Type	P-Value	Decision(α:5%)
Reference Sed		LMC	-0.2785	1.86	0.054	8	CDF	0.6062	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.0001611	0.0001611	1	0.07757	0.7877	Non-Significant Effect
Error	0.0166116	0.0020765	8			
Total	0.0167726		9			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Variance Ratio F Test	11.11	23.15	0.0387	Equal Variances
Distribution	Shapiro-Wilk W Normality Test	0.9706	0.7411	0.8960	Normal Distribution

Mean Dry Weight-mg Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
LWC	RS	5	0.264	0.1874	0.3406	0.264	0.179	0.331	0.0276	23.38%	0.00%
LMC		5	0.272	0.249	0.295	0.2756	0.252	0.297	0.008283	6.81%	-3.04%

Mean Dry Weight-mg Detail

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
LWC	RS	0.331	0.264	0.179	0.314	0.232
LMC		0.2756	0.2556	0.252	0.297	0.28

LWC = reference sediment

CETIS Analytical Report

Report Date: 14 Nov-18 11:35 (p 2 of 2)
Test Code/ID: 181545 / 18-7001-6261

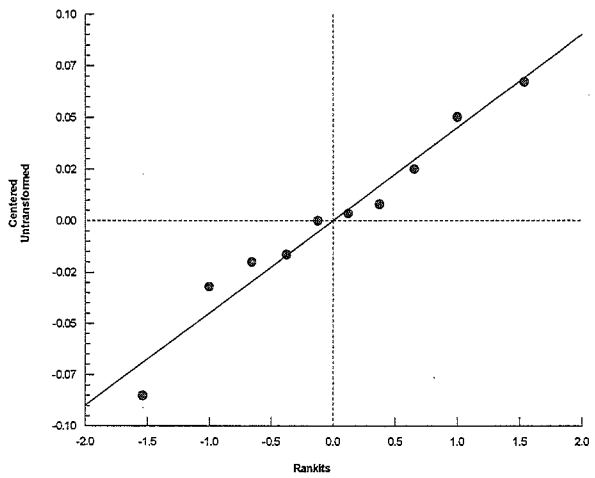
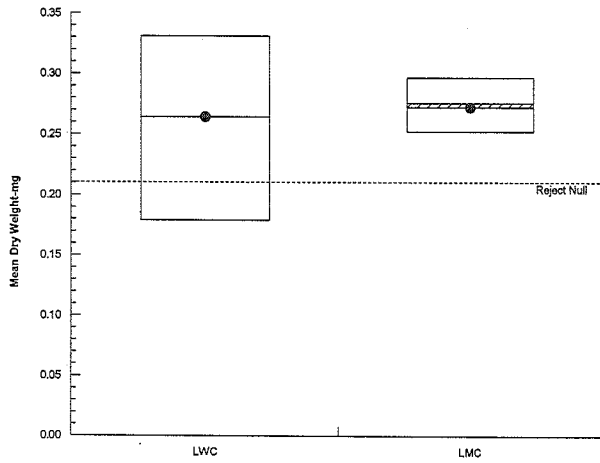
Hyaella 14-d Survival and Growth Sediment Test

Nautilus Environmental

Analysis ID: 05-9392-8266 Endpoint: Mean Dry Weight-mg
Analyzed: 14 Nov-18 11:35 Analysis: Parametric-Two Sample

CETIS Version: CETISv1.9.4
Status Level: 1

Graphics



Nautilus Environmental Company Inc.

Client : Minnow Environmental

W.O.: 181545

Date see below

Table of PKa values

Temperature (°C)	TDS (mg/L)			Salinity (g/kg)		
	0	250	2000	10	20	30
12	9.662	9.699	9.754	9.788	9.819	9.837
15	9.564	9.601	9.655	9.688	9.719	9.737
18	9.465	9.502	9.557	9.588	9.619	9.636
20	9.401	9.438	9.492	9.523	9.554	9.571
22		9.391				
23	9.307	9.344	9.398	9.426	9.459	9.476
25	9.246	9.283	9.337	9.366	9.397	9.414

Sample ID	Temperature (C)	pH	Salinity (ppt)	Total Ammonia as N (mg/L)	pKa	Unionized Ammonia (mg/L N)
Sep 27 LWC	23.0	7.3		0.0300	9.344	0.000269
Oct 1 LWC	23.0	7.4		1.1000	9.344	0.012373
3 LWC	22.5	7.4		1.6000	9.391	0.016170
5 LWC	22.0	7.5		1.7000	9.391	0.021573
8 LWC	22.0	7.7		0.1000	9.391	0.001996
10 LWC	23.0	7.7		0.2000	9.344	0.004439

for
Oct-25/18

W.O.#: 181544-545

[illegible]

Notes:

Reviewed by:

Date Reviewed:

Sediment Description Data Sheet

Client:
Work Order No.:

Minnow Environmental Inc.
181544-545

Date: _____
Test Organism: _____

Sept 27/18.
Hyalella azteca Kiddius

[illegible]

Reviewed by:



Date Reviewed:

Oct-28/10

APPENDIX B – *Chironomus dilutus* Toxicity Test Data

Chironomus dilutus Sediment Test Summary Sheet

Client: Milnow Environmental Inc.
 Work Order No.: 181544

Start Date: Sept 28/18
 Set up by: KOL

Sample Information:

Sample ID: LMC and LWC
 Sample Date: Sept 5, 9-11, 2018
 Date Received: Sept 13, 2018
 Sample Volume: 5x 500 mL per sample

Test Organism Information:

Species: C. dilutus
 Supplier: Aquatic Biosystems, CO
 Date received: Sept 27/18
 Age or size (Day 0): 3rd in-star

KCI Reference Toxicant Results:

Reference Toxicant ID: ca #A154 CT 70
 Stock Solution ID: n/a
 Date Initiated: Sept 28/18

96-h LC50 (95% CL): ca 6.7-1 (5.0-10.6)

96-h LC50 Reference Toxicant Mean and Range: ca 5.8 (5.0-6.8) CV (%): ca 8 28
2-98 5.0 (2.9-8.6)

Test Results:

Sample ID	Survival $\pm$ SD (%)	Average Dry Wt. $\pm$ SD (mg)
Control Sediment	92.0 $\pm$ 4.5	2.20 $\pm$ 0.09
LWC	88.0 $\pm$ 8.4	2.64 $\pm$ 0.51
LMC	70.0 $\pm$ 12.2*, α	2.98 $\pm$ 0.31
	$\pm$	$\pm$
	$\pm$	$\pm$
	$\pm$	$\pm$
	$\pm$	$\pm$

*Significantly different compared to control sediment
 α Significantly different compared to reference site LWC

Reviewed by: JOH

Date reviewed: Oct. 25/18

10-d Chironomid Sediment Toxicity Test Data Sheet
Freshwater Sediment 10-d Water Quality

Client:
W.O #:

Minus Environmental
181544

Start Date: Sept 28/18
Termination Date: Oct 8/18
CER #: 9
Test Organism: Chironomus dilutus

Temperature (°C)

Sample ID	Day										
	0	1	2	3	4	5	6	7	8	9	10
Control Sediment	22.9	22.5	23.0	23.0	23.0	22.5	22.0	22.0	22.0	22.0	22.5
LWC	22.9	22.5	23.0	23.0	23.0	22.5	22.0	22.0	22.0	22.0	22.0
LMC	23.6	22.5	23.0	23.0	23.0	22.5	22.0	22.0	22.0	22.0	22.5
Technician Initials	AM		MM	AM	AM	AM	AM	AM	P	A	CW

Thermometer:

9

① 23.0
② 23.0
Conductivity (µS)

Sample ID	Day										
	0	1	2	3	4	5	6	7	8	9	10
Control Sediment	418	420	432	444	459	471	484	493	505	513	518
LWC	415	430	410	413	435	455	473	495	515	535	535
LMC	529	583	633	674	725	760	794	816	838	862	887
Technician Initials	AM	MM	MM	AM	AM	AM	AM	AM	P	A	CW

Conductivity meter/probe:

4, 4

Comments:

Reviewed by:

JG

Date Reviewed:

Oct. 25/18

10-d Chironomid Sediment Toxicity Test Data Sheet
Freshwater Sediment 10-d Water Quality

Client:
W.O. #:

Minnow Environmental
181544

Start Date: Sept 28/18
Termination Date: Oct 8/18
CER #: 9
Test Organism: Chironomus dilutus

Dissolved oxygen (mg/L)

Sample ID	Day										
	0	1	2	3	4	5	6	7	8	9	10
Control Sediment	7.7	7.9	7.8	7.7	7.6	7.9	8.1	7.9	8.1	8.0	7.4
LWC	7.4	7.6	7.9	7.1	7.2	7.5	7.7	7.6	8.0	8.1	8.1
LMC	7.4	7.6	7.8	7.5	7.5	7.8	7.8	7.8	8.1	8.0	7.4
Technician Initials	JEM	MM	MM	JEM	JEM	JEM	JEM	JEM	P	P	CW

DO meter/probe:

4 / 4

pH

Sample ID	Day										
	0	1	2	3	4	5	6	7	8	9	10
Control Sediment	7.4	7.5	7.7	7.7	7.4	7.4	7.5	7.4	7.6	7.7	7.5
LWC	7.4	7.6	7.6	7.3	7.3	7.3	7.5	7.4	7.6	7.7	8.1
LMC	7.8	7.9	8.0	7.9	7.9	7.9	8.0	8.0	8.0	8.1	8.2
Technician Initials	JEM	MM	MM	JEM	JEM	JEM	JEM	JEM	P	P	CW

pH meter/probe:

4 / 4 0.72

Light meter:

64-1

Light intensity (Lux):

710-940

Comments:

Reviewed by:

JEM

Date Reviewed:

Oct. 25/18

10-d Chironomid Sediment Toxicity Test Data Sheet
Freshwater Sediment 10-d Survival and Weight

Client: Minnow Environmental -
W.O. #: 181544
Sample ID: See below

Start Date: Sept 28/18
Termination Date: Oct 8/18
Test Organism: Chironomus dilutus
Balance: 1

Sample ID	928 Pan No. green	Rep	No. alive	No. dead	No. missing	Initials	Pan weight (mg)	Pan + organism (mg)	No. weighed	Initials
Control Sediment	1	A	9 ^①	0	1	CW	1011.49	1025.24	6	
	2	B	9 ^②	0	1		1024.01	1034.50	5	
	3	C	CW 9 ^③ 10 ^③	0	0		1023.15	1042.49	9	
	4	D	9 ^④	0	1		1004.48	1022.90	8	
	5	E	9 ^⑤ 8 ^⑤ 10 ^⑤	0	1		983.91	998.93	7	
LWC	6	A	9	0	1	CW	1011.54	1040.22	9	
	7	B	8	0	2		1025.80	1049.73	8	
	8	C	10	0	0		1055.32	1077.29	10	
	9	D	8 ^⑥	1	1 ^⑦ 1 ^⑧		1031.92	1051.63	7	
	10	E	9	0	1		1018.70	1036.97	9	
LMC	11	A	5 ^⑨	0	5	MLT	1019.42	1035.91	5	
	12	B	7 ^⑩ 6 ^⑩	0	3	MLT	1040.70	1056.50	5	
	13	C	8 ^⑪	0	2	CW	1032.82	1054.88	7	
	14	D	8 ^⑫	0	2	MLT	1003.86	1021.85	7	
	15	E	7 ^⑬	0	3	MLT	1003.54	1022.66	7	
		A								
		B								
		C								
		D								
		E								

Comments:

① 3 midges pupae on ② 4 midges pupae on ③ 1 midge pupae on ④ 2 midge ⑤ 2 pupae
⑥ checked by MLT ⑦ checked by CW

Reviewed by:

JGB

Reweighed pans #8 (1077.27 mg) and #6 (1039.92 mg)

Date Reviewed:

Oct. 25/18

CETIS Summary Report

Report Date: 22 Oct-18 11:51 (p 1 of 2)
Test Code/ID: 181544 / 15-2938-7020

Chironomus 10-d Survival and Growth Sediment Test

Nautilus Environmental

Batch ID: 03-5398-6355 Test Type: Growth-Survival (10d) Analyst: Karen Lee
Start Date: 28 Sep-18 Protocol: EC/EPS 1/RM/32 Diluent: Reconstituted Water
Ending Date: 08 Oct-18 Species: Chironomus dilutus Brine:
Test Length: 10d 0h Taxon: Source: Aquatic Biosystems, CO Age: 3rd

Sample Code	Sample ID	Sample Date	Receipt Date	Sample Age	Client Name	Project
Control Sedimen	16-3819-8140	28 Sep-18	28 Sep-18	n/a	Minnow Environmental	
LWC	07-7104-5524	09 Sep-18	13 Sep-18	19d 0h (6.8 °C)		
LMC	11-7089-1311	05 Sep-18	13 Sep-18	23d 0h (6.8 °C)		

Sample Code	Material Type	Sample Source	Station Location	Lat/Long
Control Sedimen	Sediment Sample	Minnow Environmental	Control Sediment	
LWC	Sediment Sample	Minnow Environmental	LWC	
LMC	Sediment Sample	Minnow Environmental	LMC	

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
14-9091-9903	10d Survival Rate	Fisher Exact/Bonferroni-Holm Test	0.7407	Control Sedimen passed 10d survival rate	1
14-9091-9903	10d Survival Rate	Fisher Exact/Bonferroni-Holm Test	0.7407	LWC passed 10d survival rate	1
14-9091-9903	10d Survival Rate	Fisher Exact/Bonferroni-Holm Test	0.7407	LMC passed 10d survival rate	1
14-9091-9903	10d Survival Rate	Fisher Exact/Bonferroni-Holm Test	0.0047	Control Sedimen failed 10d survival rate	1
14-9091-9903	10d Survival Rate	Fisher Exact/Bonferroni-Holm Test	0.0047	LWC failed 10d survival rate	1
14-9091-9903	10d Survival Rate	Fisher Exact/Bonferroni-Holm Test	0.0047	LMC failed 10d survival rate	1
18-5684-2667	Mean Dry Weight-mg	Dunnett Multiple Comparison Test	0.9920	Control Sedimen passed mean dry weight-	1
18-5684-2667	Mean Dry Weight-mg	Dunnett Multiple Comparison Test	0.9920	LWC passed mean dry weight-mg	1
18-5684-2667	Mean Dry Weight-mg	Dunnett Multiple Comparison Test	0.9920	LMC passed mean dry weight-mg	1
18-5684-2667	Mean Dry Weight-mg	Dunnett Multiple Comparison Test	0.9997	Control Sedimen passed mean dry weight-	1
18-5684-2667	Mean Dry Weight-mg	Dunnett Multiple Comparison Test	0.9997	LWC passed mean dry weight-mg	1
18-5684-2667	Mean Dry Weight-mg	Dunnett Multiple Comparison Test	0.9997	LMC passed mean dry weight-mg	1

10d Survival Rate Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
Control Sedimen	N	5	0.9200	0.8645	0.9755	0.9000	1.0000	0.0200	0.0447	4.86%	0.00%
LWC		5	0.8800	0.7761	0.9839	0.8000	1.0000	0.0374	0.0837	9.51%	4.35%
LMC		5	0.7000	0.5479	0.8521	0.5000	0.8000	0.0548	0.1225	17.50%	23.91%

Mean Dry Weight-mg Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
Control Sedimen	N	5	2.197	2.081	2.313	2.098	2.303	0.04174	0.09333	4.25%	0.00%
LWC		5	2.644	2.017	3.272	2.03	3.187	0.226	0.5053	19.11%	-20.33%
LMC		5	2.982	2.593	3.371	2.57	3.298	0.1401	0.3134	10.51%	-35.72%

10d Survival Rate Detail

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sedimen	N	0.9000	0.9000	1.0000	0.9000	0.9000
LWC		0.9000	0.8000	1.0000	0.8000	0.9000
LMC		0.5000	0.7000	0.8000	0.8000	0.7000

Mean Dry Weight-mg Detail

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sedimen	N	2.292	2.098	2.149	2.303	2.146
LWC		3.187	2.991	2.197	2.816	2.03
LMC		3.298	3.16	3.151	2.57	2.731

KL
Oct-25/18

CETIS Summary Report

Report Date: 22 Oct-18 11:51 (p 2 of 2)
Test Code/ID: 181544 / 15-2938-7020

Chironomus 10-d Survival and Growth Sediment Test

Nautilus Environmental

10d Survival Rate Binomials

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sedimen	N	9/10	9/10	10/10	9/10	9/10
LWC		9/10	8/10	10/10	8/10	9/10
LMC		5/10	7/10	8/10	8/10	7/10

CETIS Analytical Report

Report Date: 22 Oct-18 11:51 (p 1 of 1)
Test Code/ID: 181544 / 15-2938-7020

Chironomus 10-d Survival and Growth Sediment Test

Nautilus Environmental

Analysis ID: 14-9091-9903	Endpoint: 10d Survival Rate	CETIS Version: CETISv1.9.4
Analyzed: 22 Oct-18 11:51	Analysis: STP 2xK Contingency Tables	Status Level: 1
Batch ID: 03-5398-6355	Test Type: Growth-Survival (10d)	Analyst: Karen Lee
Start Date: 28 Sep-18	Protocol: EC/EPS 1/RM/32	Diluent: Reconstituted Water
Ending Date: 08 Oct-18	Species: Chironomus dilutus	Brine:
Test Length: 10d 0h	Taxon:	Source: Aquatic Biosystems, CO Age: 3rd

Sample Code	Sample ID	Sample Date	Receipt Date	Sample Age	Client Name	Project
Control Sedimen	16-3819-8140	28 Sep-18	28 Sep-18	n/a	Minnow Environmental	
LWC	07-7104-5524	09 Sep-18	13 Sep-18	19d 0h (6.8 °C)		
LMC	11-7089-1311	05 Sep-18	13 Sep-18	23d 0h (6.8 °C)		

Sample Code	Material Type	Sample Source	Station Location	Lat/Long
Control Sedimen	Sediment Sample	Minnow Environmental	Control Sediment	
LWC	Sediment Sample	Minnow Environmental	LWC	
LMC	Sediment Sample	Minnow Environmental	LMC	

Fisher Exact/Bonferroni-Holm Test

Sample I	vs	Sample II	Test Stat	P-Type	P-Value	Decision(α:5%)
Negative Control		LWC	0.3703	Exact	0.7407	Non-Significant Effect
		LMC*	0.0047	Exact	0.0047	Significant Effect

Data Summary

Sample	Code	NR	R	NR + R	Prop NR	Prop R	%Effect
Control Sedimen	N	46	4	50	0.92	0.08	-4.55%
LWC		44	6	50	0.88	0.12	0.0%
LMC		35	15	50	0.7	0.3	20.45%

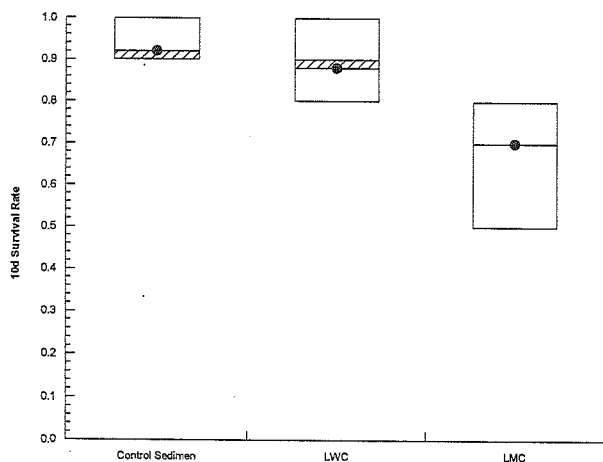
10d Survival Rate Detail

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sedimen	N	0.9000	0.9000	1.0000	0.9000	0.9000
LWC		0.9000	0.8000	1.0000	0.8000	0.9000
LMC		0.5000	0.7000	0.8000	0.8000	0.7000

10d Survival Rate Binomials

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sedimen	N	9/10	9/10	10/10	9/10	9/10
LWC		9/10	8/10	10/10	8/10	9/10
LMC		5/10	7/10	8/10	8/10	7/10

Graphics



CETIS Analytical Report

Report Date: 22 Oct-18 11:51 (p 1 of 2)
 Test Code/ID: 181544 / 15-2938-7020

Chironomus 10-d Survival and Growth Sediment Test

Nautilus Environmental

Analysis ID: 18-5684-2667	Endpoint: Mean Dry Weight-mg	CETIS Version: CETISv1.9.4
Analyzed: 22 Oct-18 11:51	Analysis: Parametric-Control vs Treatments	Status Level: 1
Batch ID: 03-5398-6355	Test Type: Growth-Survival (10d)	Analyst: Karen Lee
Start Date: 28 Sep-18	Protocol: EC/EPS 1/RM/32	Diluent: Reconstituted Water
Ending Date: 08 Oct-18	Species: Chironomus dilutus	Brine:
Test Length: 10d 0h	Taxon:	Source: Aquatic Biosystems, CO Age: 3rd

Sample Code	Sample ID	Sample Date	Receipt Date	Sample Age	Client Name	Project
Control Sedimen	16-3819-8140	28 Sep-18	28 Sep-18	n/a	Minnow Environmental	
LWC	07-7104-5524	09 Sep-18	13 Sep-18	19d 0h (6.8 °C)		
LMC	11-7089-1311	05 Sep-18	13 Sep-18	23d 0h (6.8 °C)		

Sample Code	Material Type	Sample Source	Station Location	Lat/Long
Control Sedimen	Sediment Sample	Minnow Environmental	Control Sediment	
LWC	Sediment Sample	Minnow Environmental	LWC	
LMC	Sediment Sample	Minnow Environmental	LMC	

Data Transform	Alt Hyp	Comparison Result	PMSD
Untransformed	C > T	LWC passed mean dry weight-mg	21.08%
		LMC passed mean dry weight-mg	21.08%

Dunnett Multiple Comparison Test

Sample I	vs	Sample II	Test Stat	Critical	MSD	DF	P-Type	P-Value	Decision(α:5%)
Negative Control		LWC	-2.033	2.108	0.463	8	CDF	0.9920	Non-Significant Effect
		LMC	-3.571	2.108	0.463	8	CDF	0.9997	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	1.54971	0.774857	2	6.417	0.0127	Significant Effect
Error	1.44898	0.120748	12			
Total	2.99869		14			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance Test	7.514	9.21	0.0234	Equal Variances
Distribution	Shapiro-Wilk W Normality Test	0.966	0.8328	0.7952	Normal Distribution

Mean Dry Weight-mg Summary

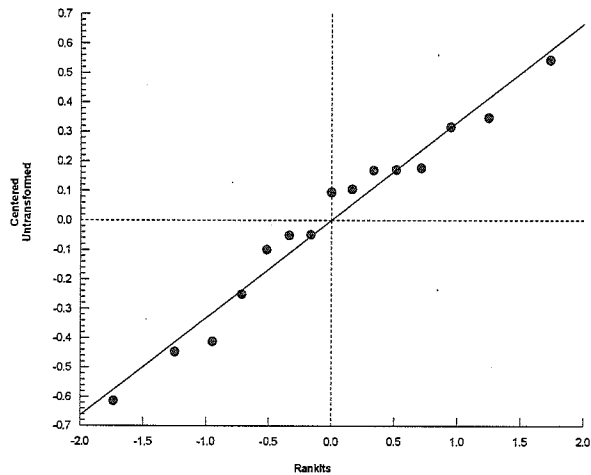
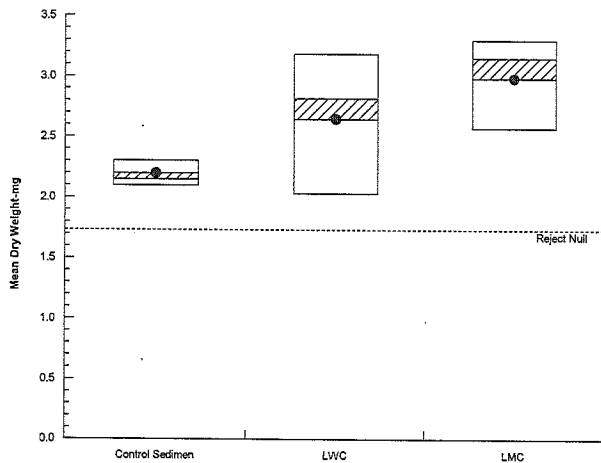
Sample	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control Sedimen	N	5	2.197	2.081	2.313	2.149	2.098	2.303	0.04174	4.25%	0.00%
LWC		5	2.644	2.017	3.272	2.816	2.03	3.187	0.226	19.11%	-20.33%
LMC		5	2.982	2.593	3.371	3.151	2.57	3.298	0.1401	10.51%	-35.72%

Mean Dry Weight-mg Detail

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sedimen	N	2.292	2.098	2.149	2.303	2.146
LWC		3.187	2.991	2.197	2.816	2.03
LMC		3.298	3.16	3.151	2.57	2.731

Chironomus 10-d Survival and Growth Sediment Test		Nautilus Environmental	
Analysis ID: 18-5684-2667	Endpoint: Mean Dry Weight-mg	CETIS Version: CETISv1.9.4	
Analyzed: 22 Oct-18 11:51	Analysis: Parametric-Control vs Treatments	Status Level: 1	

Graphics



CETIS Analytical Report

Report Date: 22 Oct-18 11:52 (p 1 of 1)
Test Code/ID: 181544 / 15-2938-7020

Chironomus 10-d Survival and Growth Sediment Test

Nautilus Environmental

Analysis ID: 17-2145-9544	Endpoint: 10d Survival Rate	CETIS Version: CETISv1.9.4
Analyzed: 22 Oct-18 11:52	Analysis: STP 2xK Contingency Tables	Status Level: 1
Batch ID: 03-5398-6355	Test Type: Growth-Survival (10d)	Analyst: Karen Lee
Start Date: 28 Sep-18	Protocol: EC/EPS 1/RM/32	Diluent: Reconstituted Water
Ending Date: 08 Oct-18	Species: Chironomus dilutus	Brine:
Test Length: 10d 0h	Taxon:	Source: Aquatic Biosystems, CO Age: 3rd

Sample Code	Sample ID	Sample Date	Receipt Date	Sample Age	Client Name	Project
LWC	07-7104-5524	09 Sep-18	13 Sep-18	19d 0h (6.8 °C)	Minnow Environmental	
LMC	11-7089-1311	05 Sep-18	13 Sep-18	23d 0h (6.8 °C)		

Sample Code	Material Type	Sample Source	Station Location	Lat/Long
LWC	Sediment Sample	Minnow Environmental	LWC	
LMC	Sediment Sample	Minnow Environmental	LMC	

Fisher Exact/Bonferroni-Holm Test

Sample I	vs	Sample II	Test Stat	P-Type	P-Value	Decision(α:5%)
Reference Sed		LMC*	0.0239	Exact	0.0239	Significant Effect

Data Summary

Sample	Code	NR	R	NR + R	Prop NR	Prop R	%Effect
LWC	RS	44	6	50	0.88	0.12	0.0%
LMC		35	15	50	0.7	0.3	20.45%

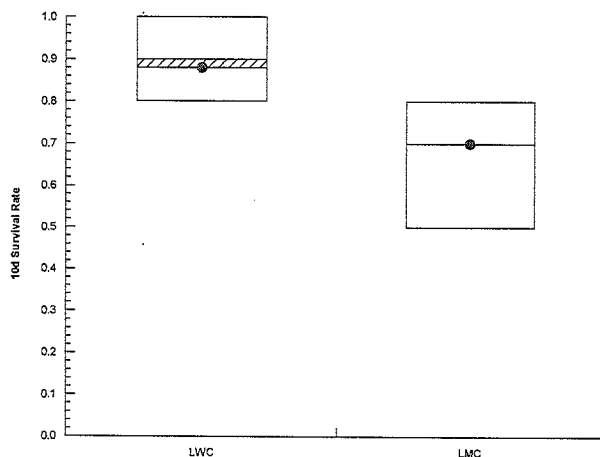
10d Survival Rate Detail

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
LWC	RS	0.9000	0.8000	1.0000	0.8000	0.9000
LMC		0.5000	0.7000	0.8000	0.8000	0.7000

10d Survival Rate Binomials

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
LWC	RS	9/10	8/10	10/10	8/10	9/10
LMC		5/10	7/10	8/10	8/10	7/10

Graphics



CETIS Analytical Report

Report Date: 22 Oct-18 11:52 (p 1 of 2)
 Test Code/ID: 181544 / 15-2938-7020

Chironomus 10-d Survival and Growth Sediment Test

Nautilus Environmental

Analysis ID: 07-3281-2567	Endpoint: Mean Dry Weight-mg	CETIS Version: CETISv1.9.4
Analyzed: 22 Oct-18 11:52	Analysis: Parametric-Control vs Treatments	Status Level: 1
Batch ID: 03-5398-6355	Test Type: Growth-Survival (10d)	Analyst: Karen Lee
Start Date: 28 Sep-18	Protocol: EC/EPS 1/RM/32	Diluent: Reconstituted Water
Ending Date: 08 Oct-18	Species: Chironomus dilutus	Brine:
Test Length: 10d 0h	Taxon:	Source: Aquatic Biosystems, CO Age: 3rd

Sample Code	Sample ID	Sample Date	Receipt Date	Sample Age	Client Name	Project
LWC	07-7104-5524	09 Sep-18	13 Sep-18	19d 0h (6.8 °C)	Minnow Environmental	
LMC	11-7089-1311	05 Sep-18	13 Sep-18	23d 0h (6.8 °C)		

Sample Code	Material Type	Sample Source	Station Location	Lat/Long
LWC	Sediment Sample	Minnow Environmental	LWC	
LMC	Sediment Sample	Minnow Environmental	LMC	

Data Transform	Alt Hyp	Comparison Result	PMSD
Untransformed	C > T	LMC passed mean dry weight-mg	18.70%

Dunnett Multiple Comparison Test

Sample I	vs	Sample II	Test Stat	Critical	MSD	DF	P-Type	P-Value	Decision(α:5%)
Reference Sed		LMC	-1.271	1.86	0.495	8	CDF	0.8803	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.285699	0.285699	1	1.616	0.2393	Non-Significant Effect
Error	1.41414	0.176767	8			
Total	1.69984		9			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Variance Ratio F Test	2.6	23.15	0.3772	Equal Variances
Distribution	Shapiro-Wilk W Normality Test	0.9088	0.7411	0.2728	Normal Distribution

Mean Dry Weight-mg Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
LWC	RS	5	2.644	2.017	3.272	2.816	2.03	3.187	0.226	19.11%	0.00%
LMC		5	2.982	2.593	3.371	3.151	2.57	3.298	0.1401	10.51%	-12.79%

Mean Dry Weight-mg Detail

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
LWC	RS	3.187	2.991	2.197	2.816	2.03
LMC		3.298	3.16	3.151	2.57	2.731

CETIS Analytical Report

Report Date: 22 Oct-18 11:52 (p 2 of 2)
Test Code/ID: 181544 / 15-2938-7020

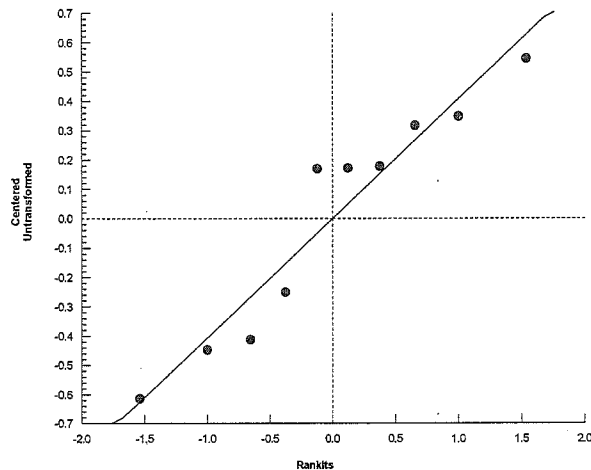
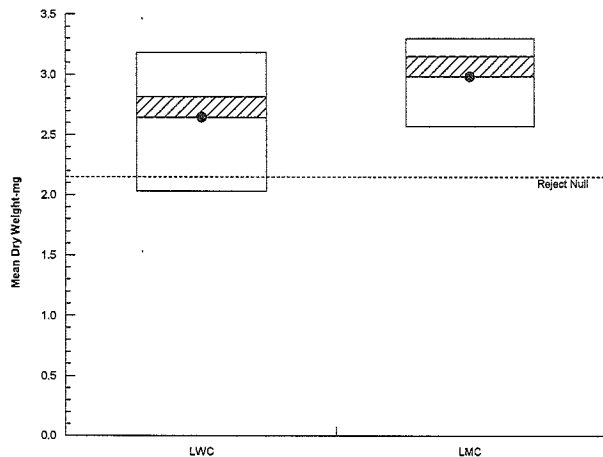
Chironomus 10-d Survival and Growth Sediment Test

Nautilus Environmental

Analysis ID: 07-3281-2567
Analyzed: 22 Oct-18 11:52
Endpoint: Mean Dry Weight-mg
Analysis: Parametric-Control vs Treatments

CETIS Version: CETISv1.9.4
Status Level: 1

Graphics



APPENDIX C – Analytical Chemistry



NAUTILUS ENVIRONMENTAL
ATTN: Karen Lee
8664 Commerce Court
Imperial Square Lake City
Burnaby BC V5A 4N7

Date Received: 16-OCT-18
Report Date: 23-OCT-18 17:04 (MT)
Version: FINAL

Client Phone: 604-420-8773

Certificate of Analysis

Lab Work Order #: L2181737
Project P.O. #: NOT SUBMITTED
Job Reference:
C of C Numbers:
Legal Site Desc:

Heather McKenzie
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

		Sample ID Description Sampled Date Sampled Time Client ID	L2181737-1 Water 28-SEP-18 CONTROL SEDIMENT	L2181737-2 Water 28-SEP-18 LWC	L2181737-3 Water 28-SEP-18 LMC		
Grouping	Analyte						
WATER							
Anions and Nutrients	Ammonia, Total (as N) (mg/L)		0.0096	0.0708	0.390		

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



L2181737-COFC

IS
AL

TESTING LOCATION (Please Circle)

Burnaby ☒
 8664 Commerce Court
 Burnaby, British Columbia, Canada
 V5A 4N7
 Phone 604.420.8773

Calgary ☐
 #4, 6125 12 Street SE
 Calgary, Alberta, Canada
 T2H 2K1
 Phone 403.253.7121

Chain of Custody

Date _____ Page 1 of 1

Report to:

Company Nautilus Environmental
 Address _____
 City/Prov/PC _____
 Contact Karen
 Phone _____
 Email karen@nautilusenvironmental.ca

Invoice To:

Company Same
 Address _____
 City/Prov/PC _____
 Contact _____
 Phone _____
 Email _____
 PO No. _____

ANALYSES REQUIRED

Overlying ammonia

Receipt Temperature (°C)

Sample Collection By:

Sample Type: Grab ☐ OR Composite ☐

	SAMPLE ID	DATE (DD/MM/YY)	TIME	MATRIX	# OF CONTAINERS AND VOLUME (e.g. 1 x 20 L)	COMMENTS														
1	Control Sediment	28/09/18		Water	1x 125mL	Day 0	✓													16
2	LWC	28/09/18		Water	1x 125mL	Day 0	✓													
3	LMC	28/09/18		Water	1x 125mL	Day 0	✓													
4																				
5																				
6																				
7																				
8																				
9																				
10																				

SPECIAL INSTRUCTIONS/COMMENTS (CLIENT)

Samples are preserved.
 Hyal/Chiron Day 0

SAMPLE RECEIPT DETAILS (LABORATORY)

1. Total No. of Containers		4. Ice Present in Cooler?	Y/N
2. Courier		5. Seal Present?	Y/N
3. Good Condition?	Y/N	6. Initials Present on Seal?	Y/N

SAMPLE DESCRIPTION AND COMMENTS (LABORATORY)

RELINQUISHED BY (CLIENT)

Karen Lee (Printed Name)  (Signature)

Nautilus Environmental (Company) Sept 29/18 1800h (Date DD/MM/YY and Time)

RECEIVED BY (LABORATORY)

HA (Printed Name)  (Signature)

(Company) 10/16 - 1800h (Date DD/MM/YY and Time)

Our liability is limited to the cost of the test requested. The test results only relate to the sample as received. No liability in whole or in part is assumed for the collection, handling, or transport of the sample, application or interpretation of the test data or results in part or in whole.

Additional costs may be required for sample disposal or storage. Payment net 30 unless otherwise contracted.

Form 020; Version 1.2; Revised by CC 2016/10/06



NAUTILUS ENVIRONMENTAL
ATTN: Karen Lee
8664 Commerce Court
Imperial Square Lake City
Burnaby BC V5A 4N7

Date Received: 16-OCT-18
Report Date: 23-OCT-18 17:19 (MT)
Version: FINAL

Client Phone: 604-420-8773

Certificate of Analysis

Lab Work Order #: L2181908
Project P.O. #: NOT SUBMITTED
Job Reference:
C of C Numbers:
Legal Site Desc:

Heather McKenzie
Account Manager

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		Sample ID Description Sampled Date Sampled Time Client ID	L2181908-1 Water 08-OCT-18 CONTROL SEDIMENT	L2181908-2 Water 08-OCT-18 LWC	L2181908-3 Water 08-OCT-18 LMC		
Grouping	Analyte						
WATER							
Anions and Nutrients	Ammonia, Total (as N) (mg/L)		0.223	1.01	0.0680		

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

TESTING LOCATION (Please Circle)

Burnaby 
8664 Commerce Court
Burnaby, British Columbia,
V5A 4N7
Phone 604.420.8773



L2181908-COFC

Chain of Custody

Date _____ Page 1 of 1

Report to:				Invoice To:				ANALYSES REQUIRED												Receipt Temperature (°C)					
Company: Nautilus Environmental Address: _____ City/Prov/PC: _____ Contact: Karen Phone: _____ Email: karen@nautilusenvironmental.ca				Company: Same Address: _____ City/Prov/PC: _____ Contact: _____ Phone: _____ Email: _____ PO No.: _____				Overlying ammonia																	
Sample Collection By:				Sample Type: ☒ Grab OR ☐ Composite																					
SAMPLE ID	DATE (DD/MM/YY)	TIME	MATRIX	# OF CONTAINERS AND VOLUME (e.g. 1 x 20 L)	COMMENTS																				
Control Sediment	8/10/18		Water	1x 125mL	Day 10		☒																		
LWC	8/10/18		Water	1x 125mL	Day 10		☒																		
LMC	8/10/18		Water	1x 125mL	Day 10		☒																		
SPECIAL INSTRUCTIONS/COMMENTS (CLIENT)				SAMPLE RECEIPT DETAILS (LABORATORY)				SAMPLE DESCRIPTION AND COMMENTS (LABORATORY)																	
Samples are preserved. Chiron Day 10				1. Total No. of Containers			4. Ice Present in Cooler?		Y / N																
				2. Courier			5. Seal Present?		Y / N																
				3. Good Condition?		Y / N	6. Initials Present on Seal?		Y / N																
RELINQUISHED BY (CLIENT)				RECEIVED BY (LABORATORY)								Our liability is limited to the cost of the test requested. The test results only relate to the sample as received. No liability in whole or in part is assumed for the collection, handling, or transport of the sample, application or interpretation of the test data or results in part or in whole.													
Karen Lee (Printed Name)				HA (Printed Name)																					
Nautilus Environmental (Company)				0ct 8/18/2018 (Date DD/MM/YY and Time)				10/1/18 - 1pm (Date DD/MM/YY and Time)																	
Additional costs may be required for sample disposal or storage. Payment net 30 unless otherwise contracted.																Form 020; Version 1.2; Revised by CC 2016/10/0									



NAUTILUS ENVIRONMENTAL
ATTN: Karen Lee
8664 Commerce Court
Imperial Square Lake City
Burnaby BC V5A 4N7

Date Received: 16-OCT-18
Report Date: 23-OCT-18 17:01 (MT)
Version: FINAL

Client Phone: 604-420-8773

Certificate of Analysis

Lab Work Order #: L2181736
Project P.O. #: NOT SUBMITTED
Job Reference:
C of C Numbers:
Legal Site Desc:

Heather McKenzie
Account Manager

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		Sample ID Description Sampled Date Sampled Time Client ID	L2181736-1 Water 12-OCT-18 CONTROL SEDIMENT	L2181736-2 Water 12-OCT-18 LWC	L2181736-3 Water 12-OCT-18 LMC		
Grouping	Analyte						
WATER							
Anions and Nutrients	Ammonia, Total (as N) (mg/L)		1.66	0.0869	0.0625		

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

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mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

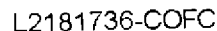
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Burnaby
8664 Commerce Court
Burnaby, British Columbia, Canada
V5A 4N7
Phone 604.420.8773

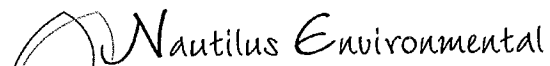
Calgary 
#4, 6125 12 Street SE
Calgary, Alberta, Canada
T2H 2K1
Phone 403.253.7121

Chain of Custody

Date _____ Page 1 of 1

[illegible]

APPENDIX D – Chain-of-Custody Forms



Chain of Custody

Date_____ Page__ of __

DISTRIBUTION: WHITE - Nautilus Environmental, COLOR - Originator

END OF REPORT



MINNOW ENVIRONMENTAL INC.
ATTN: Lisa Bowron
101 - 1025 Hillside Ave.
Victoria BC V8T 2A2

Date Received: 12-SEP-18
Report Date: 21-NOV-18 18:01 (MT)
Version: FINAL

Client Phone: 250-595-1627

Certificate of Analysis

Lab Work Order #: L2163146
Project P.O. #: NOT SUBMITTED
Job Reference: MINNOW PROJECT 18-48
C of C Numbers: 1 of 2, 2 of 2
Legal Site Desc:

Can Dang
Senior Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

21-NOV-18 18:01 (MT)

Version: FINAL

Sample ID Description Sampled Date Sampled Time Client ID		L2163146-1 TISSUE - Peri 06-SEP-18 LMC-5	L2163146-2 TISSUE - Peri 06-SEP-18 LMC-4	L2163146-3 TISSUE - Peri 06-SEP-18 LMC-3	L2163146-4 TISSUE - Peri 06-SEP-18 LMC-2	L2163146-5 TISSUE - Peri 11-SEP-18 LMC-1
Grouping	Analyte					
TISSUE						
Physical Tests	% Moisture (%)	58.3	55.0	64.1	51.1	62.5
Metals	Aluminum (Al)-Total (mg/kg ww)	6940	7040	7630	8640	7280
	Antimony (Sb)-Total (mg/kg ww)	0.027	0.025	0.032	0.025	0.020
	Arsenic (As)-Total (mg/kg ww)	3.67	3.60	4.67	4.34	3.85
	Barium (Ba)-Total (mg/kg ww)	135	135	162	168	139
	Beryllium (Be)-Total (mg/kg ww)	0.241	0.242	0.262	0.293	0.238
	Bismuth (Bi)-Total (mg/kg ww)	0.055	0.055	0.064	0.070	0.060
	Boron (B)-Total (mg/kg ww)	2.5	2.2	2.4	2.0	1.5
	Cadmium (Cd)-Total (mg/kg ww)	0.120	0.114	0.131	0.131	0.108
	Calcium (Ca)-Total (mg/kg ww)	5200	5400	5480	6280	5210
	Cesium (Cs)-Total (mg/kg ww)	0.404	0.413	0.507	0.442	0.382
	Chromium (Cr)-Total (mg/kg ww)	16.2	16.5	17.6	19.8	16.0
	Cobalt (Co)-Total (mg/kg ww)	5.50	5.52	6.16	6.82	5.46
	Copper (Cu)-Total (mg/kg ww)	22.2	22.1	24.2	26.3	21.7
	Iron (Fe)-Total (mg/kg ww)	11900	12400	13900	15500	12900
	Lead (Pb)-Total (mg/kg ww)	3.08	3.03	3.36	3.94	3.27
	Lithium (Li)-Total (mg/kg ww)	5.89	5.93	6.4	7.23	5.86
	Magnesium (Mg)-Total (mg/kg ww)	3450	3650	3730	4440	3620
	Manganese (Mn)-Total (mg/kg ww)	933	811	1350	1080	904
	Mercury (Hg)-Total (mg/kg ww)	0.0177	0.0177	0.0187	0.0201	0.0172
	Molybdenum (Mo)-Total (mg/kg ww)	0.345	0.324	0.379	0.354	0.300
	Nickel (Ni)-Total (mg/kg ww)	14.2	14.9	15.5	18.0	14.4
	Phosphorus (P)-Total (mg/kg ww)	552	544	592	640	502
	Potassium (K)-Total (mg/kg ww)	732	712	935	844	731
	Rubidium (Rb)-Total (mg/kg ww)	5.78	5.87	6.74	6.93	5.92
	Selenium (Se)-Total (mg/kg ww)	0.48	0.43	0.55	0.44	0.37
	Sodium (Na)-Total (mg/kg ww)	148	156	159	180	124
	Strontium (Sr)-Total (mg/kg ww)	53.8	57.5	62.1	69.5	57.6
	Tellurium (Te)-Total (mg/kg ww)	<0.020 ^{DLA}	<0.020 ^{DLA}	<0.040 ^{DLA}	<0.020 ^{DLA}	<0.020 ^{DLA}
	Thallium (Tl)-Total (mg/kg ww)	0.0535	0.0517	0.0608 ^{DLA}	0.0633	0.0535 ^{DLA}
	Tin (Sn)-Total (mg/kg ww)	0.11	0.13	<0.20	0.12	<0.10
	Uranium (U)-Total (mg/kg ww)	0.537	0.491	0.471	0.581	0.426
	Vanadium (V)-Total (mg/kg ww)	24.8	24.5	27.2	30.3	24.9
	Zinc (Zn)-Total (mg/kg ww)	31.0	31.5	33.1	38.2	31.1
	Zirconium (Zr)-Total (mg/kg ww)	5.89	5.75	6.64	7.34	6.28

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

21-NOV-18 18:01 (MT)

Version: FINAL

Sample ID Description Sampled Date Sampled Time Client ID		L2163146-6 TISSUE - Peri 07-SEP-18 LBC-5	L2163146-7 TISSUE - Peri 07-SEP-18 LBC-4	L2163146-8 TISSUE - Peri 07-SEP-18 LBC-3	L2163146-9 TISSUE - Peri 07-SEP-18 LBC-2	L2163146-10 TISSUE - Peri 07-SEP-18 LBC-1
Grouping	Analyte					
TISSUE						
Physical Tests	% Moisture (%)	62.5	80.7	60.8	40.4	68.0
Metals	Aluminum (Al)-Total (mg/kg ww)	6160	3620	6430	7310	4970
	Antimony (Sb)-Total (mg/kg ww)	0.057	0.079	0.074	0.041	0.051
	Arsenic (As)-Total (mg/kg ww)	8.35	6.38	9.48	8.10	6.36
	Barium (Ba)-Total (mg/kg ww)	99.7	61.1	110	123	83.3
	Beryllium (Be)-Total (mg/kg ww)	0.245	0.137	0.243	0.288	0.197
	Bismuth (Bi)-Total (mg/kg ww)	0.369	0.357	0.499	0.294	0.250
	Boron (B)-Total (mg/kg ww)	<1.0 ^{DLA}	<1.0 ^{DLA}	<1.0 ^{DLA}	1.1	<1.0 ^{DLA}
	Cadmium (Cd)-Total (mg/kg ww)	0.127	0.081	0.132	0.133	0.099
	Calcium (Ca)-Total (mg/kg ww)	3290	1680	3260	4270	2790
	Cesium (Cs)-Total (mg/kg ww)	0.962	0.717	0.968	0.955	0.840
	Chromium (Cr)-Total (mg/kg ww)	13.5	7.51	13.8	16.3	10.7
	Cobalt (Co)-Total (mg/kg ww)	4.43	2.48	4.54	5.59	3.68
	Copper (Cu)-Total (mg/kg ww)	14.1	10.3	15.9	13.6	10.5
	Iron (Fe)-Total (mg/kg ww)	10100	5930	10700	12600	8270
	Lead (Pb)-Total (mg/kg ww)	4.76	2.84	4.94	5.25	3.76
	Lithium (Li)-Total (mg/kg ww)	4.90	2.63	4.81	5.70	3.81
	Magnesium (Mg)-Total (mg/kg ww)	3150	1720	3160	4120	2650
	Manganese (Mn)-Total (mg/kg ww)	312	186	322	357	255
	Mercury (Hg)-Total (mg/kg ww)	0.0229	0.0152	0.0217	0.0203	0.0156
	Molybdenum (Mo)-Total (mg/kg ww)	0.454	0.379	0.558	0.391	0.372
	Nickel (Ni)-Total (mg/kg ww)	11.3	6.70	11.6	14.2	9.16
	Phosphorus (P)-Total (mg/kg ww)	528	366	588	669	398
	Potassium (K)-Total (mg/kg ww)	699	611	793	674	530
	Rubidium (Rb)-Total (mg/kg ww)	5.84	3.89	6.04	6.68	5.09
	Selenium (Se)-Total (mg/kg ww)	0.12	<0.10 ^{DLA}	0.13	0.10	<0.10 ^{DLA}
	Sodium (Na)-Total (mg/kg ww)	200	113	198	237	159
	Strontium (Sr)-Total (mg/kg ww)	34.7	19.4	37.1	43.5	30.0
	Tellurium (Te)-Total (mg/kg ww)	0.024	0.023	0.028	<0.020 ^{DLA}	<0.020 ^{DLA}
	Thallium (Tl)-Total (mg/kg ww)	0.0608	0.0397	0.0652	0.0659	0.0499
	Tin (Sn)-Total (mg/kg ww)	<0.10 ^{DLA}	<0.10 ^{DLA}	<0.10 ^{DLA}	0.14	<0.10 ^{DLA}
	Uranium (U)-Total (mg/kg ww)	0.728	0.363	0.697	0.959	0.575
	Vanadium (V)-Total (mg/kg ww)	21.8	12.4	22.8	28.4	18.0
	Zinc (Zn)-Total (mg/kg ww)	32.0	18.5	32.2	37.5	25.6
	Zirconium (Zr)-Total (mg/kg ww)	4.53	2.72	4.85	5.04	3.64

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

21-NOV-18 18:01 (MT)

Version: FINAL

Sample ID Description Sampled Date Sampled Time Client ID		L2163146-11 TISSUE - Peri 08-SEP-18 LWC-5	L2163146-12 TISSUE - Peri 08-SEP-18 LWC-5X	L2163146-13 TISSUE - Peri 08-SEP-18 LWC-4	L2163146-14 TISSUE - Peri 08-SEP-18 LWC-3	L2163146-15 TISSUE - Peri 10-SEP-18 LWC-2
Grouping	Analyte					
TISSUE						
Physical Tests	% Moisture (%)	34.7	33.2	50.3	56.1	44.6
Metals	Aluminum (Al)-Total (mg/kg ww)	7140	6530	8120	7020	8700
	Antimony (Sb)-Total (mg/kg ww)	0.019	0.021	0.017	0.022	0.017
	Arsenic (As)-Total (mg/kg ww)	2.78	2.77	2.41	1.94	2.54
	Barium (Ba)-Total (mg/kg ww)	93.2	80.2	109	97.9	119
	Beryllium (Be)-Total (mg/kg ww)	0.322	0.344	0.355	0.294	0.389
	Bismuth (Bi)-Total (mg/kg ww)	0.040	0.031	0.045	0.041	0.048
	Boron (B)-Total (mg/kg ww)	1.1	<1.0 ^{DLA}	1.2	1.1	1.3
	Cadmium (Cd)-Total (mg/kg ww)	0.077	0.071	0.097	0.085	0.106
	Calcium (Ca)-Total (mg/kg ww)	4070	3860	4630	4000	5140
	Cesium (Cs)-Total (mg/kg ww)	0.576	0.838	0.603	0.510	0.617
	Chromium (Cr)-Total (mg/kg ww)	20.6	18.6	22.9	19.3	24.9
	Cobalt (Co)-Total (mg/kg ww)	7.31	7.07	6.96	5.79	7.40
	Copper (Cu)-Total (mg/kg ww)	9.42	8.94	11.6	10.4	12.7
	Iron (Fe)-Total (mg/kg ww)	13900	13800	13100	11100	13900
	Lead (Pb)-Total (mg/kg ww)	3.13	2.84	3.36	2.89	3.53
	Lithium (Li)-Total (mg/kg ww)	5.52	5.12	6.26	5.40	6.95
	Magnesium (Mg)-Total (mg/kg ww)	5440	5310	4990	4250	5330
	Manganese (Mn)-Total (mg/kg ww)	347	326	361	314	399
	Mercury (Hg)-Total (mg/kg ww)	0.0116	0.0104	0.0195	0.0157	0.0219
	Molybdenum (Mo)-Total (mg/kg ww)	0.278	0.223	0.196	0.165	0.198
	Nickel (Ni)-Total (mg/kg ww)	20.3	21.6	19.3	15.9	20.6
	Phosphorus (P)-Total (mg/kg ww)	725	664	603	547	643
	Potassium (K)-Total (mg/kg ww)	698	622	576	519	596
	Rubidium (Rb)-Total (mg/kg ww)	5.68	5.26	6.60	5.76	6.79
	Selenium (Se)-Total (mg/kg ww)	0.14	<0.10 ^{DLA}	0.16	0.12	0.20
	Sodium (Na)-Total (mg/kg ww)	245	215	207	172	204
	Strontium (Sr)-Total (mg/kg ww)	42.7	36.3	47.9	40.7	51.9
	Tellurium (Te)-Total (mg/kg ww)	<0.020 ^{DLA}	<0.020 ^{DLA}	<0.020 ^{DLA}	<0.020 ^{DLA}	<0.020 ^{DLA}
	Thallium (Tl)-Total (mg/kg ww)	0.0409	0.0375	0.0484	0.0439	0.0501
	Tin (Sn)-Total (mg/kg ww)	0.13	0.10	0.12	<0.10 ^{DLA}	0.15
	Uranium (U)-Total (mg/kg ww)	0.656	0.589	0.835	0.665	0.863
	Vanadium (V)-Total (mg/kg ww)	32.8	30.7	29.5	24.6	31.4
	Zinc (Zn)-Total (mg/kg ww)	32.1	33.0	34.0	29.9	36.6
	Zirconium (Zr)-Total (mg/kg ww)	6.63	6.57	7.29	6.38	7.75

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2163146-16 TISSUE - Peri 10-SEP-18 LWC-1				
Grouping	Analyte					
TISSUE						
Physical Tests	% Moisture (%)	51.1				
Metals	Aluminum (Al)-Total (mg/kg ww)	9520				
	Antimony (Sb)-Total (mg/kg ww)	0.033				
	Arsenic (As)-Total (mg/kg ww)	3.22				
	Barium (Ba)-Total (mg/kg ww)	136				
	Beryllium (Be)-Total (mg/kg ww)	0.435				
	Bismuth (Bi)-Total (mg/kg ww)	0.056				
	Boron (B)-Total (mg/kg ww)	<2.0 ^{DLA}				
	Cadmium (Cd)-Total (mg/kg ww)	0.135				
	Calcium (Ca)-Total (mg/kg ww)	5630				
	Cesium (Cs)-Total (mg/kg ww)	0.812				
	Chromium (Cr)-Total (mg/kg ww)	26.9				
	Cobalt (Co)-Total (mg/kg ww)	7.85				
	Copper (Cu)-Total (mg/kg ww)	16.4				
	Iron (Fe)-Total (mg/kg ww)	15500				
	Lead (Pb)-Total (mg/kg ww)	3.81				
	Lithium (Li)-Total (mg/kg ww)	7.0				
	Magnesium (Mg)-Total (mg/kg ww)	5460				
	Manganese (Mn)-Total (mg/kg ww)	542				
	Mercury (Hg)-Total (mg/kg ww)	0.0280				
	Molybdenum (Mo)-Total (mg/kg ww)	0.261				
	Nickel (Ni)-Total (mg/kg ww)	21.7				
	Phosphorus (P)-Total (mg/kg ww)	656				
	Potassium (K)-Total (mg/kg ww)	732				
	Rubidium (Rb)-Total (mg/kg ww)	8.05				
	Selenium (Se)-Total (mg/kg ww)	0.26				
	Sodium (Na)-Total (mg/kg ww)	207				
	Strontium (Sr)-Total (mg/kg ww)	61.0				
	Tellurium (Te)-Total (mg/kg ww)	<0.040 ^{DLA}				
	Thallium (Tl)-Total (mg/kg ww)	0.0583				
	Tin (Sn)-Total (mg/kg ww)	<0.20 ^{DLA}				
	Uranium (U)-Total (mg/kg ww)	1.04				
	Vanadium (V)-Total (mg/kg ww)	34.8				
	Zinc (Zn)-Total (mg/kg ww)	38.2				
	Zirconium (Zr)-Total (mg/kg ww)	9.32				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
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HG-WET-MICR-CVAF-VA Tissue Mercury in Tissue by CVAFS Micro (WET) EPA 200.3, EPA 245.7

This method is adapted from US EPA Method 200.3 "Sample Procedures for Spectrochemical Determination of Total Recoverable Elements in Biological Tissues" (1996). Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis is by atomic fluorescence spectrophotometry or atomic absorption spectrophotometry, adapted from US EPA Method 245.7.

MET-WET-CCMS-MID-VA Tissue Metals in Tissue by CRC ICPMS (WET) EPA 200.3/6020A

This method is conducted following British Columbia Lab Manual method "Metals in Animal Tissue and Vegetation (Biota) - Prescriptive". Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with addition of hydrogen peroxide. Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.

MOISTURE-MICR-VA Tissue Moisture in Tissue Puget Sound WQ Authority, Apr 1997

This analysis is carried out gravimetrically by drying the sample at <60 deg. C.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

1 of 2

2 of 2

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

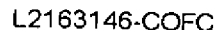
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

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COC #

Page 2 of 2

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MINNOW ENVIRONMENTAL INC.
ATTN: Lisa Bowron
101 - 1025 Hillside Ave.
Victoria BC V8T 2A2

Date Received: 12-SEP-18
Report Date: 07-NOV-18 18:23 (MT)
Version: FINAL

Client Phone: 250-595-1627

Certificate of Analysis

Lab Work Order #: L2163138
Project P.O. #: NOT SUBMITTED
Job Reference: MINNOW PROJECT 18:48
C of C Numbers:
Legal Site Desc:

Can Dang
Senior Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2163138-1 TISSUE 08-SEP-18 LWC-3	L2163138-2 TISSUE 10-SEP-18 LWC-2	L2163138-3 TISSUE 10-SEP-18 LWC-1	L2163138-4 TISSUE 10-SEP-18 LWC-1X	
Grouping	Analyte					
TISSUE						
Physical Tests	% Moisture (%)	73.0	63.0	65.1	79.0	
Metals	Aluminum (Al)-Total (mg/kg wwt)	393	1800	374	648	
	Antimony (Sb)-Total (mg/kg wwt)	0.0224	0.0198	0.0181	0.0178	
	Arsenic (As)-Total (mg/kg wwt)	0.836	0.708	0.553	0.662	
	Barium (Ba)-Total (mg/kg wwt)	14.5	108	49.8	62.6	
	Beryllium (Be)-Total (mg/kg wwt)	0.0474	0.126	0.0311	0.0422	
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0060 ^{DLIS}	<0.0060 ^{DLIS}	0.0049	<0.0060 ^{DLIS}	
	Boron (B)-Total (mg/kg wwt)	1.62	1.58	1.97	1.96	
	Cadmium (Cd)-Total (mg/kg wwt)	0.432	0.449	0.262	0.367	
	Calcium (Ca)-Total (mg/kg wwt)	506	1350	646	915	
	Cesium (Cs)-Total (mg/kg wwt)	0.0948	0.147	0.0731	0.0471	
	Chromium (Cr)-Total (mg/kg wwt)	2.31	9.01	2.15	2.46	
	Cobalt (Co)-Total (mg/kg wwt)	0.924	2.24	0.756	1.35	
	Copper (Cu)-Total (mg/kg wwt)	9.05	9.11	6.01	9.04	
	Iron (Fe)-Total (mg/kg wwt)	1340	3310	1070	1770	
	Lead (Pb)-Total (mg/kg wwt)	0.460	0.488	0.293	0.300	
	Lithium (Li)-Total (mg/kg wwt)	0.32	1.08	0.34	0.51	
	Magnesium (Mg)-Total (mg/kg wwt)	557	1740	640	1100	
	Manganese (Mn)-Total (mg/kg wwt)	78.2	742	462	570	
	Mercury (Hg)-Total (mg/kg wwt)	0.0095	0.0091	0.0080	0.0068	
	Molybdenum (Mo)-Total (mg/kg wwt)	0.269	0.398	0.247	0.288	
	Nickel (Ni)-Total (mg/kg wwt)	1.68	7.23	1.84	3.02	
	Phosphorus (P)-Total (mg/kg wwt)	1990	3410	2730	3160	
	Potassium (K)-Total (mg/kg wwt)	1750	3110	2630	3700	
	Rubidium (Rb)-Total (mg/kg wwt)	1.88	3.79	1.33	1.46	
	Selenium (Se)-Total (mg/kg wwt)	0.490	0.541	0.484	0.515	
	Sodium (Na)-Total (mg/kg wwt)	922	1300	855	1120	
	Strontium (Sr)-Total (mg/kg wwt)	6.17	37.2	9.67	10.8	
	Tellurium (Te)-Total (mg/kg wwt)	<0.012 ^{DLIS}	<0.012 ^{DLIS}	<0.0080 ^{DLIS}	<0.012 ^{DLIS}	
	Thallium (Tl)-Total (mg/kg wwt)	0.0069	0.0131	0.00595	0.0069	
	Tin (Sn)-Total (mg/kg wwt)	0.117	0.207	0.291	0.179	
	Uranium (U)-Total (mg/kg wwt)	0.146	0.183	0.111	0.124	
	Vanadium (V)-Total (mg/kg wwt)	2.79	10.1	2.31	4.04	
	Zinc (Zn)-Total (mg/kg wwt)	27.3	33.4	21.6	27.8	
	Zirconium (Zr)-Total (mg/kg wwt)	0.68	4.75	0.920	0.87	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Chromium (Cr)-Total	B	L2163138-1, -2, -3, -4

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
DLIS	Detection Limit Adjusted: Insufficient Sample

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
HG-WET-MICR-CVAF-VA	Tissue	Mercury in Tissue by CVAFS Micro (WET)	EPA 200.3, EPA 245.7
This method is adapted from US EPA Method 200.3 "Sample Procedures for Spectrochemical Determination of Total Recoverable Elements in Biological Tissues" (1996). Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis is by atomic fluorescence spectrophotometry or atomic absorption spectrophotometry, adapted from US EPA Method 245.7.			
MET-WET-MICR-HRMS-VA	Tissue	Metals in Tissue by HR-ICPMS Micro (WET)	EPA 200.3/200.8
Trace metals in tissue are analyzed by high resolution inductively coupled plasma mass spectrometry (HR-ICPMS) modified from US EPA Method 200.8, (Revision 5.5). The sample preparation procedure is modified from US EPA 200.3. Analytical results are reported on wet weight basis.			
Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.			
MOISTURE-BIOPSY-VA	Tissue	Moisture Content (low weight) in tissue	Puget Sound WQ Authority, Apr 1997
This analysis is carried out gravimetrically by drying the sample at <60 deg. C for a minimum of three days.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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Bathic Tissue

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L2163138-COFC

Best Form
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COC #

Page 2 of 10

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GENF 20.00 Front



MINNOW ENVIRONMENTAL INC.
ATTN: Lisa Bowron
101 - 1025 Hillside Ave.
Victoria BC V8T 2A2

Date Received: 12-SEP-18
Report Date: 07-NOV-18 18:27 (MT)
Version: FINAL

Client Phone: 250-595-1627

Certificate of Analysis

Lab Work Order #: L2163142
Project P.O. #: NOT SUBMITTED
Job Reference: MINNOW PROJECT 18-48
C of C Numbers: 1 of 2
Legal Site Desc:

Can Dang
Senior Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2163142-1 Tissue 06-SEP-18 LMC-5	L2163142-2 Tissue 06-SEP-18 LMC-4	L2163142-3 Tissue 06-SEP-18 LMC-3	L2163142-4 Tissue 06-SEP-18 LMC-2	L2163142-5 Tissue 11-SEP-18 LMC-1
Grouping	Analyte					
TISSUE						
Physical Tests	% Moisture (%)	78.8	75.4	75.9	64.9	63.9
Metals	Aluminum (Al)-Total (mg/kg ww)	330	253	352	685	652
	Antimony (Sb)-Total (mg/kg ww)	0.0168	0.0144	0.0146	0.0283	0.0242
	Arsenic (As)-Total (mg/kg ww)	0.568	0.466	0.573	0.760	0.657
	Barium (Ba)-Total (mg/kg ww)	14.0	9.07	13.4	23.1	17.4
	Beryllium (Be)-Total (mg/kg ww)	0.0147	0.0121	0.0149	0.0306	0.0236
	Bismuth (Bi)-Total (mg/kg ww)	0.0067	0.0041	0.0052	0.0093	0.0076
	Boron (B)-Total (mg/kg ww)	0.74	0.25	0.28	0.40	<0.60 ^{DLIS}
	Cadmium (Cd)-Total (mg/kg ww)	0.0875	0.0833	0.0906	0.113	0.127
	Calcium (Ca)-Total (mg/kg ww)	695	489	584	864	852
	Cesium (Cs)-Total (mg/kg ww)	0.0438	0.0357	0.0495	0.101	0.0913
	Chromium (Cr)-Total (mg/kg ww)	3.05	1.26	1.32	2.70	4.72
	Cobalt (Co)-Total (mg/kg ww)	0.392	0.289	0.344	0.644	0.573
	Copper (Cu)-Total (mg/kg ww)	5.32	4.52	5.19	7.08	9.38
	Iron (Fe)-Total (mg/kg ww)	767	590	754	1430	1430
	Lead (Pb)-Total (mg/kg ww)	0.290	0.216	0.265	0.510	0.399
	Lithium (Li)-Total (mg/kg ww)	0.27	0.23	0.36	0.70	0.40
	Magnesium (Mg)-Total (mg/kg ww)	481	340	409	614	756
	Manganese (Mn)-Total (mg/kg ww)	94.4	65.0	91.0	127	115
	Mercury (Hg)-Total (mg/kg ww)	0.0110	0.0052	0.0052	0.0069	0.043
	Molybdenum (Mo)-Total (mg/kg ww)	0.298	0.266	0.251	0.288	0.342
	Nickel (Ni)-Total (mg/kg ww)	1.88	0.889	1.12	3.60	2.87
	Phosphorus (P)-Total (mg/kg ww)	1670	1820	1780	2390	3330
	Potassium (K)-Total (mg/kg ww)	1510	1540	1520	2220	3140
	Rubidium (Rb)-Total (mg/kg ww)	0.832	0.742	0.909	1.40	1.35
	Selenium (Se)-Total (mg/kg ww)	0.513	0.470	0.549	0.747	1.17
	Sodium (Na)-Total (mg/kg ww)	668	628	618	832	1180
	Strontium (Sr)-Total (mg/kg ww)	7.38	5.05	6.74	11.1	8.05
	Tellurium (Te)-Total (mg/kg ww)	<0.0040	<0.0040	<0.0040	<0.0040	<0.012 ^{DLIS}
	Thallium (Tl)-Total (mg/kg ww)	0.00407	0.00310	0.00437	0.00869	0.0074 ^{DLIS}
	Tin (Sn)-Total (mg/kg ww)	0.069	0.023	0.022	0.042	<0.060 ^{DLIS}
	Uranium (U)-Total (mg/kg ww)	0.0764	0.0660	0.0569	0.117	0.0653
	Vanadium (V)-Total (mg/kg ww)	1.66	1.36	1.59	3.09	2.67
	Zinc (Zn)-Total (mg/kg ww)	24.2	23.5	23.6	28.8	27.4
	Zirconium (Zr)-Total (mg/kg ww)	0.465	0.336	0.414	0.908	0.71

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2163142-6 Tissue 07-SEP-18 LBC-5	L2163142-7 Tissue 07-SEP-18 LBC-4	L2163142-8 Tissue 07-SEP-18 LBC-3	L2163142-9 Tissue 07-SEP-18 LBC-2	L2163142-10 Tissue 07-SEP-18 LBC-1
Grouping	Analyte					
TISSUE						
Physical Tests	% Moisture (%)	60.2	71.5	67.0	68.3	69.0
Metals	Aluminum (Al)-Total (mg/kg ww)	1150	198	497	238	484
	Antimony (Sb)-Total (mg/kg ww)	0.0505	0.0297	0.0449	0.0465	0.0499
	Arsenic (As)-Total (mg/kg ww)	2.68	0.804	1.20	0.814	1.47
	Barium (Ba)-Total (mg/kg ww)	44.7	7.63	17.6	18.5	18.5
	Beryllium (Be)-Total (mg/kg ww)	0.0678	0.0106	0.0295	0.0287	0.0315
	Bismuth (Bi)-Total (mg/kg ww)	0.0614	0.0316	0.0379	0.0232	0.0511
	Boron (B)-Total (mg/kg ww)	0.99	<0.20	0.23	0.44	<0.20
	Cadmium (Cd)-Total (mg/kg ww)	0.411	0.733	0.890	0.836	0.673
	Calcium (Ca)-Total (mg/kg ww)	899	406	813	857	691
	Cesium (Cs)-Total (mg/kg ww)	0.303	0.0788	0.134	0.0803	0.189
	Chromium (Cr)-Total (mg/kg ww)	3.44	0.905	1.72	1.45	2.24
	Cobalt (Co)-Total (mg/kg ww)	1.59	0.514	0.936	0.649	0.896
	Copper (Cu)-Total (mg/kg ww)	8.77	8.85	10.2	10.0	10.2
	Iron (Fe)-Total (mg/kg ww)	2570	409	1090	650	977
	Lead (Pb)-Total (mg/kg ww)	1.24	0.249	0.564	0.337	0.699
	Lithium (Li)-Total (mg/kg ww)	1.60	0.15	0.53	0.18	0.43
	Magnesium (Mg)-Total (mg/kg ww)	993	390	671	456	595
	Manganese (Mn)-Total (mg/kg ww)	169	58.9	88.7	87.0	148
	Mercury (Hg)-Total (mg/kg ww)	0.0342	0.0108	0.0158	0.0111	0.0143
	Molybdenum (Mo)-Total (mg/kg ww)	0.281	0.330	0.374	0.368	0.340
	Nickel (Ni)-Total (mg/kg ww)	3.22	0.626	1.77	1.06	1.63
	Phosphorus (P)-Total (mg/kg ww)	1790	2040	2410	2280	2330
	Potassium (K)-Total (mg/kg ww)	2290	1710	1960	1820	1860
	Rubidium (Rb)-Total (mg/kg ww)	2.33	2.50	2.77	2.60	3.17
	Selenium (Se)-Total (mg/kg ww)	0.282	0.469	0.544	0.524	0.487
	Sodium (Na)-Total (mg/kg ww)	677	637	681	666	733
	Strontium (Sr)-Total (mg/kg ww)	9.26	4.08	9.43	11.9	7.88
	Tellurium (Te)-Total (mg/kg ww)	0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg ww)	0.0150	0.00880	0.0127	0.00952	0.0151
	Tin (Sn)-Total (mg/kg ww)	0.059	<0.020	0.038	0.039	0.029
	Uranium (U)-Total (mg/kg ww)	0.518	0.0855	0.477	0.328	0.243
	Vanadium (V)-Total (mg/kg ww)	6.97	0.987	2.62	1.38	2.29
	Zinc (Zn)-Total (mg/kg ww)	46.7	30.9	40.0	31.0	34.0
	Zirconium (Zr)-Total (mg/kg ww)	1.31	0.254	0.721	0.523	0.492

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2163142-11 Tissue 08-SEP-18 LWC-5	L2163142-12 Tissue 08-SEP-18 LWC-4		
Grouping	Analyte					
TISSUE						
Physical Tests	% Moisture (%)		65.8	71.7		
Metals	Aluminum (Al)-Total (mg/kg wwt)		373	382		
	Antimony (Sb)-Total (mg/kg wwt)		0.0153	0.0135		
	Arsenic (As)-Total (mg/kg wwt)		0.560	0.393		
	Barium (Ba)-Total (mg/kg wwt)		11.4	15.5		
	Beryllium (Be)-Total (mg/kg wwt)		0.0302	0.0252		
	Bismuth (Bi)-Total (mg/kg wwt)		<0.0040 ^{DLIS}	0.0051		
	Boron (B)-Total (mg/kg wwt)		<0.40 ^{DLIS}	0.52		
	Cadmium (Cd)-Total (mg/kg wwt)		0.356	0.452		
	Calcium (Ca)-Total (mg/kg wwt)		603	545		
	Cesium (Cs)-Total (mg/kg wwt)		0.0663	0.0702		
	Chromium (Cr)-Total (mg/kg wwt)		3.00	2.98		
	Cobalt (Co)-Total (mg/kg wwt)		0.804	0.889		
	Copper (Cu)-Total (mg/kg wwt)		8.25	11.1		
	Iron (Fe)-Total (mg/kg wwt)		993	770		
	Lead (Pb)-Total (mg/kg wwt)		0.274	0.277		
	Lithium (Li)-Total (mg/kg wwt)		0.28	0.33		
	Magnesium (Mg)-Total (mg/kg wwt)		697	550		
	Manganese (Mn)-Total (mg/kg wwt)		60.8	101		
	Mercury (Hg)-Total (mg/kg wwt)		0.0151	0.0129		
	Molybdenum (Mo)-Total (mg/kg wwt)		0.308	0.241		
	Nickel (Ni)-Total (mg/kg wwt)		2.28	1.90		
	Phosphorus (P)-Total (mg/kg wwt)		2710	2110		
	Potassium (K)-Total (mg/kg wwt)		2240	1960		
	Rubidium (Rb)-Total (mg/kg wwt)		2.08	2.35		
	Selenium (Se)-Total (mg/kg wwt)		0.741	0.541		
	Sodium (Na)-Total (mg/kg wwt)		795	796		
	Strontium (Sr)-Total (mg/kg wwt)		5.23	5.83		
	Tellurium (Te)-Total (mg/kg wwt)		<0.0080 ^{DLIS}	<0.0040		
	Thallium (Tl)-Total (mg/kg wwt)		0.00611 ^{DLIS}	0.00790		
	Tin (Sn)-Total (mg/kg wwt)		<0.040 ^{DLIS}	0.040		
	Uranium (U)-Total (mg/kg wwt)		0.143	0.144		
	Vanadium (V)-Total (mg/kg wwt)		2.42	2.01		
	Zinc (Zn)-Total (mg/kg wwt)		32.5	33.8		
	Zirconium (Zr)-Total (mg/kg wwt)		0.868	0.525		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	% Moisture	MB-LOR	L2163142-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLIS	Detection Limit Adjusted: Insufficient Sample
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
HG-WET-MICR-CVAF-VA	Tissue	Mercury in Tissue by CVAFS Micro (WET)	EPA 200.3, EPA 245.7
This method is adapted from US EPA Method 200.3 "Sample Procedures for Spectrochemical Determination of Total Recoverable Elements in Biological Tissues" (1996). Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis is by atomic fluorescence spectrophotometry or atomic absorption spectrophotometry, adapted from US EPA Method 245.7.			
MET-WET-MICR-HRMS-VA	Tissue	Metals in Tissue by HR-ICPMS Micro (WET)	EPA 200.3/200.8
Trace metals in tissue are analyzed by high resolution inductively coupled plasma mass spectrometry (HR-ICPMS) modified from US EPA Method 200.8, (Revision 5.5). The sample preparation procedure is modified from US EPA 200.3. Analytical results are reported on wet weight basis.			
Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.			
MOISTURE-BIOPSY-VA	Tissue	Moisture Content (low weight) in tissue	Puget Sound WQ Authority, Apr 1997
This analysis is carried out gravimetrically by drying the sample at <60 deg. C for a minimum of three days.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

1 of 2

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



L2163142-COFC

COC #

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Report To						Report Format / Distribution						Service Requested (Rush for routine analysis subject to availability)																							
Company: Minnow Environmental Inc.						☒ Standard ☐ Other						☒ Regular (Standard Turnaround Times - Business Days)																							
Contact: Lisa Bowron						☒ PDF ☒ Excel ☐ Digital ☐ Fax						☐ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT																							
Address: 101 - 1025 Hillside Ave. Victoria, BC						Email 1: lbowron@minnow.ca Email 2: pstecko@minnow.ca Email 3:						☐ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT ☐ Same Day or Weekend Emergency - Contact ALS to Confirm TAT																							
Phone: (250)595-1627 x21 Fax: (250) 595-1625												Analysis Request																							
Invoice To Same as Report ? ☐ Yes ☒ No						Client / Project Information						Please indicate below Filtered, Preserved or both (F, P, F/P)																							
Hardcopy of Invoice with Report? ☒ Yes ☐ No						Job #: Minnow Project 18-42																													
Company: Minto Exploration Ltd						PO / AFE:																													
Contact: Cindy Keehn						LSD:																													
Address: Suite 2100 - 510 West Georgia St., Vancouver, BC																																			
Phone: 604-684-8894 Fax: 604-688-2180						Quote #: Q54027 @ 69236																													
Lab Work Order # (lab use only)						ALS Contact: Can Dang						Sampler: Lisa Bowron																							
Sample #		Sample Identification (This description will appear on the report)				Date (dd-mmm-yy)		Time (hh:mm)		Sample Type		Moisture (%)		High Resolution ICP-MS scan		Mercury in Tissue by CVAFS		**See Complete Quote #Q51327										Number of Containers							
		LMC-5				6-Sep-18				Tissue		X	X	X		X									1										
		LMC-4				6-Sep-18				Tissue		X	X	X		X									1										
		LMC-3				6-Sep-18				Tissue		X	X	X		X									1										
		LMC-2				6-Sep-18				Tissue		X	X	X		X									1										
		LMC-1				11-Sep-18				Tissue		X	X	X		X									1										
		LBC-5				7-Sep-18				Tissue		X	X	X		X									1										
		LBC-4				7-Sep-18				Tissue		X	X	X		X									1										
		LBC-3				7-Sep-18				Tissue		X	X	X		X									1										
		LBC-2				7-Sep-18				Tissue		X	X	X		X									1										
		LBC-1				7-Sep-18				Tissue		X	X	X		X									1										
		LWC-5				8-Sep-18				Tissue		X	X	X		X									1										
		LWC-4				8-Sep-18				Tissue		X	X	X		X									1										
Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details																																			
Small samples. The critical analyte of interest is selenium; please ensure best possible MDLs. Benthic samples.																																			
Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.																																			
By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.																																			
Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.																																			
SHIPMENT RELEASE (client use)								SHIPMENT RECEPTION (lab use only)								SHIPMENT VERIFICATION (lab use only)																			
Released by: Lisa Bowron		Date (dd-mmm-yy) 12-Sep-18		Time (hh-mm) 13:30		Received by: EHF		Date: 2018 12 Sep		Time: 13:30		Temperature: 6.0 °C		Verified by: IDA		Date: 9/13		Time: 12:30P		Observations: Yes / No ? If Yes add SIF															

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APPENDIX D
PERIPHYTON COMMUNITY DATA

Tables
Laboratory Reports

APPENDIX D
PERIPHYTON COMMUNITY DATA

Tables

Table D.1: Periphyton Community Density (cells/cm²) at Lower Wolverine Creek and Lower Minto Creek, Minto Mine WUL, 2018

Sample Location		Lower Wolverine Creek (Reference)					Lower Minto Creek (Exposed)				
		LWC-1	LWC-2	LWC-3	LWC-4	LWC-5	LMC-1	LMC-2	LMC-3	LMC-4	LMC-5
		8-Sep-18	8-Sep-18	8-Sep-18	8-Sep-18	8-Sep-18	11-Sep-18	6-Sep-18	6-Sep-18	6-Sep-18	6-Sep-18
Group	Genera and species										
Cyanophyte	Pseudanabaena sp.	-	-	861	-	-	96	-	1,034	-	-
	Gloeocapsa punctata	10,250	-	-	-	-	-	-	-	-	4,430
	Phormidium autumnale Agardh	947	766	1,436	246	172	287	738	345	431	615
	Heteroleibeinia profunda Komarek	1,378	383	-	-	1,838	4,402	2,338	5,340	1,723	2,338
Chlorophyte	Chamaesiphon incrustans Smith	-	-	-	-	-	-	738	2,756	-	-
	Homoeothrix varians Komarek & Kalina	-	-	-	-	-	-	-	-	3,338	-
	Ulothrix sp.	3,962	-	-	-	-	-	-	-	-	-
	Ulothrix zonata Kutzing	-	-	-	-	402	-	-	-	-	-
Diatoms	Navicula minima Grunow	-	1,340	-	-	-	-	1,354	-	646	492
	Cymbella minuta Kutzing	258	861	1,723	3,568	258	-	246	1,206	-	-
	Tabellaria flocculosa (Roth) Kutzing	172	-	-	-	-	-	-	-	-	-
	Nitzschia clausii Hantzsch	-	-	-	-	-	-	123	-	-	-
	Achnanthes minutissima Kutzing	4,910	10,719	15,504	12,551	2,756	6,508	13,166	14,815	7,321	10,951
	Nitzschia linearis W. Smith	1,034	1,914	1,292	738	57	11,580	9,598	18,777	11,413	14,520
	Encyonema silesiacum (Bleisch) D.G. Mann	2,584	8,996	7,465	7,629	258	4,020	1,354	1,723	646	1,477
	Nitzschia filiformis (W. Smith) Hustedt	1,120	4,211	3,158	369	172	-	1,477	1,895	861	-
	Diatoma vulgare Bory	861	2,393	5,455	5,537	689	-	-	-	-	-
	Cymbella prostrata (Berkeley) Cleve	-	96	-	123	-	-	-	-	-	-
	Navicula radiosa Kutzing	-	-	-	-	-	-	123	-	108	-
	Gomphonema minutum	775	479	861	984	115	1,053	123	689	-	246
	Cocconies disculus Schum.	603	574	3,445	615	172	1,914	2,092	3,790	2,907	5,045
	Anomoenies vitrea Ross	775	1,436	2,584	738	459	4,402	861	2,929	2,584	2,707
	Gomphonema angustum Agardh	-	-	-	-	-	479	-	-	-	-
	Diatoma mesodon Grun.	-	-	431	-	-	-	-	-	-	-
	Navicula exigua (Greg.) Muller	1,981	3,828	1,436	738	115	383	2,338	2,067	2,584	3,199
	Fragilaria capucina Grunow	86	479	1,579	738	-	2,584	246	689	1,292	1,723
	Hannaea arcus Patrick	258	-	1,148	123	-	-	-	-	-	-
	Meridion circulare Agardh	-	574	574	-	-	-	-	-	1,077	1,969
Red Algae	Audouinella / Chantransia stage. Red alga	-	-	-	-	-	479	-	2,756	-	-

Table D.2: Periphyton Community Biomass (µg/cm²) at Lower Wolverine Creek and Lower Minto Creek, Minto Mine WUL, 2018

Sample Location		Lower Wolverine Creek (Reference)					Lower Minto Creek (Exposed)				
		LWC-1	LWC-2	LWC-3	LWC-4	LWC-5	LMC-1	LMC-2	LMC-3	LMC-4	LMC-5
		8-Sep-18	8-Sep-18	8-Sep-18	8-Sep-18	8-Sep-18	11-Sep-18	6-Sep-18	6-Sep-18	6-Sep-18	6-Sep-18
Group	Genera and species										
Cyanophyte	Pseudanabaena sp.	-	-	0.11	-	-	0.008	-	0.13	-	-
	Gloeocapsa punctata	0.34	-	-	-	-	-	-	-	-	0.16
	Phormidium autumnale Agardh	3.8	2.2	4.1	0.72	0.48	0.84	2.3	1.0	1.2	1.6
	Heteroleibeinia profunda Komarek	0.11	0.035	-	-	0.15	0.43	0.17	0.37	0.11	0.16
Chlorophyte	Chamaesiphon incrustans Smith	-	-	-	-	-	-	0.021	0.073	-	-
	Homoeothrix varians Komarek & Kalina	-	-	-	-	-	-	-	-	1.7	-
	Ulothrix sp.	2.4	-	-	-	-	-	-	-	-	-
	Ulothrix zonata Kutzing	-	-	-	-	20	-	-	-	-	-
Diatoms	Navicula minima Grunow	-	0.067	-	-	-	-	0.062	-	0.030	0.024
	Cymbella minuta Kutzing	0.084	0.34	0.51	1.1	0.092	-	0.096	0.43	-	-
	Tabellaria flocculosa (Roth) Kutzing	0.23	-	-	-	-	-	-	-	-	-
	Nitzschia clausii Hantzsch	-	-	-	-	-	-	0.28	-	-	-
	Achnanthes minutissima Kutzing	0.41	0.86	1.2	1.1	0.23	0.53	1.1	1.2	0.57	0.90
	Nitzschia linearis W. Smith	1.3	2.9	2.0	1.1	0.097	21	17	32	20	25
	Encyonema silesiacum (Bleisch) D.G. Mann	3.0	11	8.8	9.0	0.30	4.7	1.6	2.0	0.76	1.7
	Nitzschia filiformis (W. Smith) Hustedt	0.19	0.64	0.54	0.063	0.030	-	0.20	0.29	0.10	-
	Diatoma vulgare Bory	0.23	0.57	1.4	1.4	0.16	-	-	-	-	-
	Cymbella prostrata (Berkeley) Cleve	-	2.1	-	2.2	-	-	-	-	-	-
	Navicula radiosa Kutzing	-	-	-	-	-	-	0.24	-	0.19	-
	Gomphonema minutum	0.34	0.20	0.35	0.43	0.030	0.46	0.054	0.29	-	0.099
	Cocconies disculus Schum.	0.93	0.88	5.3	0.95	0.18	3.0	3.2	6.0	4.5	7.8
	Anomoenies vitrea Ross	0.27	0.49	0.91	0.24	0.17	1.5	0.28	0.97	0.90	0.89
	Gomphonema angustum Agardh	-	-	-	-	-	0.51	-	-	-	-
	Diatoma mesodon Grun.	-	-	0.90	-	-	-	-	-	-	-
	Navicula exigua (Greg.) Muller	0.58	1.0	0.42	0.20	0.031	0.058	0.64	0.58	0.69	0.90
	Fragilaria capucina Grunow	0.076	0.42	1.6	0.65	-	1.1	0.24	0.61	1.3	1.8
	Hannaea arcus Patrick	0.16	-	0.69	0.072	-	-	-	-	-	-
	Meridion circulare Agardh	-	0.64	0.60	-	-	-	-	-	1.0	3.0
Red Algae	Audouinella / Chantransia stage. Red alga	-	-	-	-	-	0.29	-	1.8	-	-

Table D.3: Summary Statistics for Periphyton Density (cells/cm²) at Lower Wolverine Creek and Lower Minto Creek Stations, Minto Mine WUL, 2018

Sample Location		Lower Wolverine Creek (Reference)					Lower Minto Creek (Exposed)				
Group	Genera and species	Mean	Median	Minimum	Maximum	Standard Deviation	Mean	Median	Minimum	Maximum	Standard Deviation
Cyanophyte	Pseudanabaena sp.	861	861	861	861	-	565	565	96	1,034	-
	Gloeocapsa punctata	10,250	10,250	10,250	10,250	-	4,430	4,430	4,430	4,430	-
	Phormidium autumnale Agardh	713	766	172	1,436	522	483	431	287	738	189
	Heteroleibeinia profunda Komarek	1,199	1,378	383	1,838	744	3,228	2,338	1,723	5,340	1,557
Chlorophyte	Chamaesiphon incrustans Smith	-	-	-	-	-	1,747	1,747	738	2,756	-
	Homoeothrix varians Komarek & Kalina	-	-	-	-	-	3,338	3,338	3,338	3,338	-
	Ulothrix sp.	3,962	3,962	3,962	3,962	-	-	-	-	-	-
	Ulothrix zonata Kutzing	402	402	402	402	-	-	-	-	-	-
Diatoms	Navicula minima Grunow	1,340	1,340	1,340	1,340	-	831	646	492	1,354	459
	Cymbella minuta Kutzing	1,334	861	258	3,568	1,386	726	726	246	1,206	-
	Tabellaria flocculosa (Roth) Kutzing	172	172	172	172	-	-	-	-	-	-
	Nitzschia clausii Hantzsch	-	-	-	-	-	123	123	123	123	-
	Achnanthes minutissima Kutzing	9,288	10,719	2,756	15,504	5,319	10,552	10,951	6,508	14,815	3,604
	Nitzschia linearis W. Smith	1,007	1,034	57	1,914	685	13,177	11,580	9,598	18,777	3,593
	Encyonema silesiacum (Bleisch) D.G. Mann	5,386	7,465	258	8,996	3,759	1,844	1,477	646	4,020	1,280
	Nitzschia filiformis (W. Smith) Hustedt	1,806	1,120	172	4,211	1,790	1,411	1,477	861	1,895	520
	Diatoma vulgare Bory	2,987	2,393	689	5,537	2,385	-	-	-	-	-
	Cymbella prostrata (Berkeley) Cleve	109	109	96	123	-	-	-	-	-	-
	Navicula radiosa Kutzing	-	-	-	-	-	115	115	108	123	-
	Gomphonema minutum	643	775	115	984	349	528	468	123	1,053	426
	Cocconies disculus Schum.	1,082	603	172	3,445	1,334	3,150	2,907	1,914	5,045	1,295
	Anomoenies vitrea Ross	1,198	775	459	2,584	853	2,697	2,707	861	4,402	1,259
	Gomphonema angustum Agardh	-	-	-	-	-	479	479	479	479	-
	Diatoma mesodon Grun.	431	431	431	431	-	-	-	-	-	-
	Navicula exigua (Greg.) Muller	1,620	1,436	115	3,828	1,422	2,114	2,338	383	3,199	1,055
	Fragilaria capucina Grunow	721	608	86	1,579	632	1,307	1,292	246	2,584	910
	Hannaea arcus Patrick	510	258	123	1,148	557	-	-	-	-	-
	Meridion circulare Agardh	574	574	574	574	-	1,523	1,523	1,077	1,969	-
Red Algae	Audouinella / Chantransia stage. Red alga	-	-	-	-	-	1,617	1,617	479	2,756	-

Table D.4: Summary Statistics for Periphyton Biomass (µg/cm²) at Lower Wolverine Creek and Lower Minto Creek Stations, Minto Mine WUL, 2018

Sample Location		Lower Wolverine Creek (Reference)					Lower Minto Creek (Exposed)				
Group	Genera and species	Mean	Median	Minimum	Maximum	Standard Deviation	Mean	Median	Minimum	Maximum	Standard Deviation
Cyanophyte	Pseudanabaena sp.	0.111	0.111	0.111	0.111	-	0.0705	0.0705	0.00782	0.133	-
	Gloeocapsa punctata	0.343	0.343	0.343	0.343	-	0.160	0.160	0.160	0.160	-
	Phormidium autumnale Agardh	2.25	2.19	0.482	4.10	1.68	1.40	1.23	0.836	2.32	0.592
	Heteroleibeinia profunda Komarek	0.0970	0.106	0.0349	0.150	0.0582	0.247	0.166	0.114	0.429	0.143
Chlorophyte	Chamaesiphon incrustans Smith	-	-	-	-	-	0.0468	0.0468	0.0209	0.0728	-
	Homoeothrix varians Komarek & Kalina	-	-	-	-	-	1.68	1.68	1.68	1.68	-
	Ulothrix sp.	2.39	2.39	2.39	2.39	-	-	-	-	-	-
	Ulothrix zonata Kutzinger	20.2	20.2	20.2	20.2	-	-	-	-	-	-
Diatoms	Navicula minima Grunow	0.0674	0.0674	0.0674	0.0674	-	0.0387	0.0298	0.0239	0.0624	0.0207
	Cymbella minuta Kutzinger	0.425	0.344	0.0842	1.09	0.414	0.265	0.265	0.0959	0.435	-
	Tabellaria flocculosa (Roth) Kutzinger	0.230	0.230	0.230	0.230	-	-	-	-	-	-
	Nitzschia clausii Hantzsch	-	-	-	-	-	0.283	0.283	0.283	0.283	-
	Achnanthes minutissima Kutzinger	0.759	0.858	0.231	1.23	0.425	0.869	0.899	0.534	1.24	0.314
	Nitzschia linearis W. Smith	1.47	1.26	0.0972	2.92	1.06	22.9	20.6	16.9	32.4	6.06
	Encyonema silesiacum (Bleisch) D.G. Mann	6.35	8.79	0.304	10.6	4.43	2.17	1.74	0.761	4.74	1.51
	Nitzschia filiformis (W. Smith) Hustedt	0.292	0.192	0.0296	0.635	0.279	0.198	0.204	0.105	0.286	0.0907
	Diatoma vulgare Bory	0.751	0.575	0.160	1.41	0.610	-	-	-	-	-
	Cymbella prostrata (Berkeley) Cleve	2.17	2.17	2.09	2.25	-	-	-	-	-	-
	Navicula radiosa Kutzinger	-	-	-	-	-	0.220	0.220	0.195	0.245	-
	Gomphonema minutum	0.269	0.338	0.0303	0.429	0.156	0.225	0.194	0.0536	0.459	0.186
	Cocconies disculus Schum.	1.65	0.928	0.177	5.30	2.07	4.91	4.48	3.04	7.77	2.00
	Anomoenies vitrea Ross	0.416	0.270	0.169	0.911	0.301	0.898	0.899	0.278	1.45	0.417
	Gomphonema angustum Agardh	-	-	-	-	-	0.514	0.514	0.514	0.514	-
	Diatoma mesodon Grun.	0.902	0.902	0.902	0.902	-	-	-	-	-	-
	Navicula exigua (Greg.) Muller	0.456	0.419	0.0314	1.05	0.390	0.575	0.641	0.0577	0.904	0.314
	Fragilaria capucina Grunow	0.694	0.539	0.0763	1.62	0.663	1.00	1.07	0.239	1.80	0.605
	Hannaea arcus Patrick	0.309	0.161	0.0723	0.693	0.336	-	-	-	-	-
	Meridion circulare Agardh	0.619	0.619	0.601	0.637	-	2.03	2.03	1.01	3.04	-
Red Algae	Audouinella / Chantransia stage. Red alga	-	-	-	-	-	1.03	1.03	0.287	1.76	-

Table D.5: Presence/Absence of Periphyton Taxa at Lower Wolverine Creek and Lower Minto Creek, Minto Mine WUL, 2018

Sample Location		Lower Wolverine Creek (Reference)					Lower Minto Creek (Exposed)				
Group	Genera and species	LWC-1	LWC-2	LWC-3	LWC-4	LWC-5	LMC-1	LMC-2	LMC-3	LMC-4	LMC-5
Cyanophyte	Pseudanabaena sp.	0	0	1	0	0	1	0	1	0	0
	Gloeocapsa punctata	1	0	0	0	0	0	0	0	0	1
	Phormidium autumnale Agardh	1	1	1	1	1	1	1	1	1	1
	Heteroleibeinia profunda Komarek	1	1	0	0	1	1	1	1	1	1
Chlorophyte	Chamaesiphon incrustans Smith	0	0	0	0	0	0	1	1	0	0
	Homoeothrix varians Komarek & Kalina	0	0	0	0	0	0	0	0	1	0
	Ulothrix sp.	1	0	0	0	0	0	0	0	0	0
	Ulothrix zonata Kutzinger	0	0	0	0	1	0	0	0	0	0
Diatoms	Navicula minima Grunow	0	1	0	0	0	0	1	0	1	1
	Cymbella minuta Kutzinger	1	1	1	1	1	0	1	1	0	0
	Tabellaria flocculosa (Roth) Kutzinger	1	0	0	0	0	0	0	0	0	0
	Nitzschia clausii Hantzsch	0	0	0	0	0	0	1	0	0	0
	Achnanthes minutissima Kutzinger	1	1	1	1	1	1	1	1	1	1
	Nitzschia linearis W. Smith	1	1	1	1	1	1	1	1	1	1
	Encyonema silesiacum (Bleisch) D.G. Mann	1	1	1	1	1	1	1	1	1	1
	Nitzschia filiformis (W. Smith) Hustedt	1	1	1	1	1	0	1	1	1	0
	Diatoma vulgare Bory	1	1	1	1	1	0	0	0	0	0
	Cymbella prostrata (Berkeley) Cleve	0	1	0	1	0	0	0	0	0	0
	Navicula radiosa Kutzinger	0	0	0	0	0	0	1	0	1	0
	Gomphonema minutum	1	1	1	1	1	1	1	1	0	1
	Cocconies disculus Schum.	1	1	1	1	1	1	1	1	1	1
	Anomoenies vitrea Ross	1	1	1	1	1	1	1	1	1	1
	Gomphonema angustum Agardh	0	0	0	0	0	1	0	0	0	0
	Diatoma mesodon Grun.	0	0	1	0	0	0	0	0	0	0
	Navicula exigua (Greg.) Muller	1	1	1	1	1	1	1	1	1	1
	Fragilaria capucina Grunow	1	1	1	1	0	1	1	1	1	1
	Hannaea arcus Patrick	1	0	1	1	0	0	0	0	0	0
	Meridion circulare Agardh	0	1	1	0	0	0	0	0	1	1
Red Algae	Audouinella / Chantransia stage. Red alga	0	0	0	0	0	1	0	1	0	0
Total		17	16	16	14	13	13	16	15	14	13

APPENDIX D
PERIPHYTON COMMUNITY DATA

Laboratory Reports

PERIPHYTON COMMUNITY ANALYSIS

PROVIDED BY:

PLANKTON R US INC.

(WINNIPEG, MB)

Epilithic algal biomass ($\mu\text{g}/\text{cm}^2$) for **Minto WUL Monitoring 2018 - (Project 18-48)**
(for Lisa Minnow Environmental Inc.)

R = QAQC recount

Project	Location	Date	Cyanobacteria	Chlorophyte	Diatom	Red Algae	Total
			$\mu\text{g}/\text{cm}^2$	$\mu\text{g}/\text{cm}^2$	$\mu\text{g}/\text{cm}^2$	$\mu\text{g}/\text{cm}^2$	$\mu\text{g}/\text{cm}^2$
1848	LMC - 1	11/Sep/18	1.27	0.00	32.43	0.29	33.99
1848	LMC - 2	6/Sep/18	2.50	0.00	24.90	0.00	27.40
1848	LMC - 3	6/Sep/18	1.58	0.00	44.87	1.76	48.22
1848	LMC - 4	6/Sep/18	3.03	0.00	29.72	0.00	32.75
1848	LMC - 5	6/Sep/18	1.95	0.00	42.23	0.00	44.18
1848	LWC - 1	8/Sep/18	4.23	2.39	7.81	0.00	14.42
1848	LWC - 2	8/Sep/18	2.22	0.00	21.77	0.00	23.99
1848	LWC - 3	8/Sep/18	4.21	0.00	25.25	0.00	29.46
1848	LWC - 3-R	8/Sep/18	5.09	0.00	24.10	0.00	29.18
1848	LWC - 4	8/Sep/18	0.72	0.00	18.48	0.00	19.19
1848	LWC - 5	8/Sep/18	0.63	20.20	1.32	0.00	22.16

Epilithic algal density (cells/cm²) for **Minto WUL Monitoring 2018 - (Project 18-48)**
(for Lisa Minnow Environmental Inc.)

R = QAQC recount

Project	Location	Date	Cyanobacteria	Chlorophyte	Diatom	Red Algae	Total
			cells/cm ²	cells/cm ²	cells/cm ²	cells/cm ²	cells/cm ²
1848	LMC - 1	11/Sep/18	4785	0	32922	479	38185
1848	LMC - 2	6/Sep/18	3814	0	33100	0	36914
1848	LMC - 3	6/Sep/18	9475	0	48579	2756	60810
1848	LMC - 4	6/Sep/18	5491	0	31438	0	36929
1848	LMC - 5	6/Sep/18	7383	0	42328	0	49711
1848	LWC - 1	8/Sep/18	12575	3962	15418	0	31955
1848	LWC - 2	8/Sep/18	1148	0	37898	0	39047
1848	LWC - 3	8/Sep/18	2297	0	46655	0	48952
1848	LWC - 3-R	8/Sep/18	3015	0	46799	0	49813
1848	LWC - 4	8/Sep/18	246	0	34453	0	34699
1848	LWC - 5	8/Sep/18	2010	402	5053	0	7465

Epilithic algal species data for Minto WUL Monitoring 2018 - (Project 18-48) (for Lisa Minnow Environmental Inc.)

** 1st number in species code = group 1=cyanophyte 2=chlorophyte 5=diatoms 8= red algae
** total daily biomass is sum of all species on a date

R = QAQC recount

Project	Location	Date	Species code	Speceis name	density	biomass	length	width	cell volume
					cells/cm ²	µg/cm ²	µ	µ	µ ³
1848	LMC - 1	11-Sep-18	1077	Pseudanabaena sp.	96	0.01	26.00	2.00	81.70
1848	LMC - 1	11-Sep-18	1122	Phormidium autumnale Agardh	287	0.84	103.00	6.00	2912.30
1848	LMC - 1	11-Sep-18	1131	Heteroleibeinia profunda Komarek	4402	0.43	31.00	2.00	97.40
1848	LMC - 1	11-Sep-18	5702	Achnanthes minutissima Kutzing	6508	0.53	19.60	4.00	82.10
1848	LMC - 1	11-Sep-18	5768	Nitzschia linearis W. Smith	11580	20.57	106.00	8.00	1776.00
1848	LMC - 1	11-Sep-18	5836	Encyonema silesiacum (Bleisch) D.G. Mann	4020	4.74	30.00	10.00	1178.10
1848	LMC - 1	11-Sep-18	5873	Gomphonema minutum	1053	0.46	26.00	8.00	435.60
1848	LMC - 1	11-Sep-18	5875	Cocconies disculus Schum.	1914	3.04	31.00	14.00	1590.70
1848	LMC - 1	11-Sep-18	5882	Anomoenies vitrea Ross	4402	1.45	35.00	6.00	329.90
1848	LMC - 1	11-Sep-18	5884	Gomphonema angustum Agardh	479	0.51	41.00	10.00	1073.40
1848	LMC - 1	11-Sep-18	5910	Navicula exigua (Greg.) Muller	383	0.06	36.00	4.00	150.80
1848	LMC - 1	11-Sep-18	5916	Fragilaria capucina Grunow	2584	1.07	44.00	6.00	414.70
1848	LMC - 1	11-Sep-18	8001	Audouinella / Chantransia stage. Red alga	479	0.29	17.90	8.00	599.80
1848	LMC - 2	6-Sep-18	1122	Phormidium autumnale Agardh	738	2.32	111.00	6.00	3138.50
1848	LMC - 2	6-Sep-18	1131	Heteroleibeinia profunda Komarek	2338	0.17	22.60	2.00	71.00
1848	LMC - 2	6-Sep-18	1223	Chamaesiphon incrustans Smith	738	0.02	6.00	3.00	28.30
1848	LMC - 2	6-Sep-18	5306	Navicula minima Grunow	1354	0.06	11.00	4.00	46.10
1848	LMC - 2	6-Sep-18	5311	Cymbella minuta Kutzing	246	0.10	15.50	8.00	389.60
1848	LMC - 2	6-Sep-18	5541	Nitzschia clausii Hantzsch	123	0.28	88.00	10.00	2303.80
1848	LMC - 2	6-Sep-18	5702	Achnanthes minutissima Kutzing	13166	1.10	19.90	4.00	83.40
1848	LMC - 2	6-Sep-18	5768	Nitzschia linearis W. Smith	9598	16.89	105.00	8.00	1759.30
1848	LMC - 2	6-Sep-18	5836	Encyonema silesiacum (Bleisch) D.G. Mann	1354	1.59	30.00	10.00	1178.10
1848	LMC - 2	6-Sep-18	5857	Nitzschia filiformis (W. Smith) Hustedt	1477	0.20	33.00	4.00	138.20
1848	LMC - 2	6-Sep-18	5870	Navicula radiosa Kutzing	123	0.24	76.00	10.00	1989.70
1848	LMC - 2	6-Sep-18	5873	Gomphonema minutum	123	0.05	26.00	8.00	435.60
1848	LMC - 2	6-Sep-18	5875	Cocconies disculus Schum.	2092	3.22	30.00	14.00	1539.40
1848	LMC - 2	6-Sep-18	5882	Anomoenies vitrea Ross	861	0.28	34.30	6.00	323.30
1848	LMC - 2	6-Sep-18	5910	Navicula exigua (Greg.) Muller	2338	0.64	29.10	6.00	274.30
1848	LMC - 2	6-Sep-18	5916	Fragilaria capucina Grunow	246	0.24	103.00	6.00	970.80
1848	LMC - 3	6-Sep-18	1077	Pseudanabaena sp.	1034	0.13	41.00	2.00	128.80
1848	LMC - 3	6-Sep-18	1122	Phormidium autumnale Agardh	345	1.00	103.00	6.00	2912.30
1848	LMC - 3	6-Sep-18	1131	Heteroleibeinia profunda Komarek	5340	0.37	22.20	2.00	69.70
1848	LMC - 3	6-Sep-18	1223	Chamaesiphon incrustans Smith	2756	0.07	5.60	3.00	26.40
1848	LMC - 3	6-Sep-18	5311	Cymbella minuta Kutzing	1206	0.43	15.90	7.60	360.60
1848	LMC - 3	6-Sep-18	5702	Achnanthes minutissima Kutzing	14815	1.24	20.00	4.00	83.80
1848	LMC - 3	6-Sep-18	5768	Nitzschia linearis W. Smith	18777	32.41	103.00	8.00	1725.80
1848	LMC - 3	6-Sep-18	5836	Encyonema silesiacum (Bleisch) D.G. Mann	1723	2.03	30.00	10.00	1178.10
1848	LMC - 3	6-Sep-18	5857	Nitzschia filiformis (W. Smith) Hustedt	1895	0.29	36.00	4.00	150.80
1848	LMC - 3	6-Sep-18	5873	Gomphonema minutum	689	0.29	25.00	8.00	418.90
1848	LMC - 3	6-Sep-18	5875	Cocconies disculus Schum.	3790	6.03	31.00	14.00	1590.70
1848	LMC - 3	6-Sep-18	5882	Anomoenies vitrea Ross	2929	0.97	35.00	6.00	329.90
1848	LMC - 3	6-Sep-18	5910	Navicula exigua (Greg.) Muller	2067	0.58	30.00	6.00	282.70
1848	LMC - 3	6-Sep-18	5916	Fragilaria capucina Grunow	689	0.61	94.00	6.00	885.90
1848	LMC - 3	6-Sep-18	8001	Audouinella / Chantransia stage. Red alga	2756	1.76	19.10	8.00	640.00
1848	LMC - 4	6-Sep-18	1122	Phormidium autumnale Agardh	431	1.23	101.00	6.00	2855.70
1848	LMC - 4	6-Sep-18	1131	Heteroleibeinia profunda Komarek	1723	0.11	21.00	2.00	66.00
1848	LMC - 4	6-Sep-18	1239	Homoeothrix varians Komarek & Kalina	3338	1.68	59.00	3.30	504.60
1848	LMC - 4	6-Sep-18	5306	Navicula minima Grunow	646	0.03	11.00	4.00	46.10
1848	LMC - 4	6-Sep-18	5702	Achnanthes minutissima Kutzing	7321	0.57	18.60	4.00	77.90
1848	LMC - 4	6-Sep-18	5768	Nitzschia linearis W. Smith	11413	19.70	103.00	8.00	1725.80
1848	LMC - 4	6-Sep-18	5836	Encyonema silesiacum (Bleisch) D.G. Mann	646	0.76	30.00	10.00	1178.10
1848	LMC - 4	6-Sep-18	5857	Nitzschia filiformis (W. Smith) Hustedt	861	0.10	29.00	4.00	121.50
1848	LMC - 4	6-Sep-18	5870	Navicula radiosa Kutzing	108	0.19	69.00	10.00	1806.40
1848	LMC - 4	6-Sep-18	5875	Cocconies disculus Schum.	2907	4.48	30.00	14.00	1539.40
1848	LMC - 4	6-Sep-18	5882	Anomoenies vitrea Ross	2584	0.90	36.90	6.00	347.80
1848	LMC - 4	6-Sep-18	5910	Navicula exigua (Greg.) Muller	2584	0.69	28.30	6.00	266.70
1848	LMC - 4	6-Sep-18	5916	Fragilaria capucina Grunow	1292	1.29	106.00	6.00	999.00
1848	LMC - 4	6-Sep-18	5986	Meridion circulare Agardh	1077	1.01	36.00	10.00	942.50
1848	LMC - 5	6-Sep-18	1084	Gloeocapsa punctata	4430	0.16	4.10	4.10	36.10
1848	LMC - 5	6-Sep-18	1122	Phormidium autumnale Agardh	615	1.64	94.00	6.00	2657.80
1848	LMC - 5	6-Sep-18	1131	Heteroleibeinia profunda Komarek	2338	0.16	21.10	2.00	66.30
1848	LMC - 5	6-Sep-18	5306	Navicula minima Grunow	492	0.02	11.60	4.00	48.60
1848	LMC - 5	6-Sep-18	5702	Achnanthes minutissima Kutzing	10951	0.90	19.60	4.00	82.10
1848	LMC - 5	6-Sep-18	5768	Nitzschia linearis W. Smith	14520	25.06	103.00	8.00	1725.80
1848	LMC - 5	6-Sep-18	5836	Encyonema silesiacum (Bleisch) D.G. Mann	1477	1.74	30.00	10.00	1178.10
1848	LMC - 5	6-Sep-18	5873	Gomphonema minutum	246	0.10	24.10	8.00	403.80
1848	LMC - 5	6-Sep-18	5875	Cocconies disculus Schum.	5045	7.77	30.00	14.00	1539.40
1848	LMC - 5	6-Sep-18	5882	Anomoenies vitrea Ross	2707	0.89	35.00	6.00	329.90
1848	LMC - 5	6-Sep-18	5910	Navicula exigua (Greg.) Muller	3199	0.90	30.00	6.00	282.70
1848	LMC - 5	6-Sep-18	5916	Fragilaria capucina Grunow	1723	1.80	111.00	6.00	1046.20
1848	LMC - 5	6-Sep-18	5986	Meridion circulare Agardh	1969	3.04	41.00	12.00	1545.70
1848	LWC - 1	8-Sep-18	1084	Gloeocapsa punctata	10250	0.34	4.00	4.00	33.50
1848	LWC - 1	8-Sep-18	1122	Phormidium autumnale Agardh	947	3.78	141.00	6.00	3986.70
1848	LWC - 1	8-Sep-18	1131	Heteroleibeinia profunda Komarek	1378	0.11	24.50	2.00	77.00
1848	LWC - 1	8-Sep-18	2226	Ulothrix sp.	3962	2.39	12.00	8.00	603.20
1848	LWC - 1	8-Sep-18	5311	Cymbella minuta Kutzing	258	0.08	16.00	7.20	325.70
1848	LWC - 1	8-Sep-18	5514	Tabellaria flocculosa (Roth) Kutzing	172	0.23	26.00	14.00	1334.10
1848	LWC - 1	8-Sep-18	5702	Achnanthes minutissima Kutzing	4910	0.41	20.00	4.00	83.80
1848	LWC - 1	8-Sep-18	5768	Nitzschia linearis W. Smith	1034	1.26	73.00	8.00	1223.10
1848	LWC - 1	8-Sep-18	5836	Encyonema silesiacum (Bleisch) D.G. Mann	2584	3.04	30.00	10.00	1178.10
1848	LWC - 1	8-Sep-18	5857	Nitzschia filiformis (W. Smith) Hustedt	1120	0.19	41.00	4.00	171.70
1848	LWC - 1	8-Sep-18	5860	Diatoma vulgare Bory	861	0.23	28.00	6.00	263.90
1848	LWC - 1	8-Sep-18	5873	Gomphonema minutum	775	0.34	26.00	8.00	435.60
1848	LWC - 1	8-Sep-18	5875	Cocconies disculus Schum.	603	0.93	30.00	14.00	1539.40
1848	LWC - 1	8-Sep-18	5882	Anomoenies vitrea Ross	775	0.27	37.00	6.00	348.70
1848	LWC - 1	8-Sep-18	5910	Navicula exigua (Greg.) Muller	1981	0.58	31.00	6.00	292.20
1848	LWC - 1	8-Sep-18	5916	Fragilaria capucina Grunow	86	0.08	94.00	6.00	885.90
1848	LWC - 1	8-Sep-18	5917	Hannaea arcus Patrick	258	0.16	66.00	6.00	622.00

Epilithic algal species data for Minto WUL Monitoring 2018 - (Project 18-48) (for Lisa Minnow Environmental Inc.)

** 1st number in species code = group 1=cyanophyte 2=chlorophyte 5=diatoms 8= red algae

** total daily biomass is sum of all species on a date

R = QAQC recount

Project	Location	Date	Species code	Speceis name	density	biomass	length	width	cell volume
					cells/cm ²	µg/cm ²	µ	µ	µ ³
1848	LWC - 2	8-Sep-18	1122	Phormidium autumnale Agardh	766	2.19	101.00	6.00	2855.70
1848	LWC - 2	8-Sep-18	1131	Heteroleibeinia profunda Komarek	383	0.03	29.00	2.00	91.10
1848	LWC - 2	8-Sep-18	5306	Navicula minima Grunow	1340	0.07	12.00	4.00	50.30
1848	LWC - 2	8-Sep-18	5311	Cymbella minuta Kutzing	861	0.34	15.90	8.00	399.60
1848	LWC - 2	8-Sep-18	5702	Achnanthes minutissima Kutzing	10719	0.86	19.10	4.00	80.00
1848	LWC - 2	8-Sep-18	5768	Nitzschia linearis W. Smith	1914	2.92	91.00	8.00	1524.70
1848	LWC - 2	8-Sep-18	5836	Encyonema silesiacum (Bleisch) D.G. Mann	8996	10.60	30.00	10.00	1178.10
1848	LWC - 2	8-Sep-18	5857	Nitzschia filiformis (W. Smith) Hustedt	4211	0.64	36.00	4.00	150.80
1848	LWC - 2	8-Sep-18	5860	Diatoma vulgare Bory	2393	0.57	25.50	6.00	240.30
1848	LWC - 2	8-Sep-18	5865	Cymbella prostrata (Berkeley) Cleve	96	2.09	115.00	22.00	21857.60
1848	LWC - 2	8-Sep-18	5873	Gomphonema minutum	479	0.20	25.00	8.00	418.90
1848	LWC - 2	8-Sep-18	5875	Cocconies disculus Schum.	574	0.88	30.00	14.00	1539.40
1848	LWC - 2	8-Sep-18	5882	Anomoenies vitrea Ross	1436	0.49	36.00	6.00	339.30
1848	LWC - 2	8-Sep-18	5910	Navicula exigua (Greg.) Muller	3828	1.05	29.00	6.00	273.30
1848	LWC - 2	8-Sep-18	5916	Fragilaria capucina Grunow	479	0.42	94.00	6.00	885.90
1848	LWC - 2	8-Sep-18	5986	Meridion circulare Agardh	574	0.64	35.00	11.00	1108.70
1848	LWC - 2	8-Sep-18	1077	Pseudanabaena sp.	861	0.11	41.00	2.00	128.80
1848	LWC - 3	8-Sep-18	1122	Phormidium autumnale Agardh	1436	4.10	101.00	6.00	2855.70
1848	LWC - 3	8-Sep-18	5311	Cymbella minuta Kutzing	1723	0.51	15.00	7.10	296.90
1848	LWC - 3	8-Sep-18	5702	Achnanthes minutissima Kutzing	15504	1.23	18.90	4.00	79.20
1848	LWC - 3	8-Sep-18	5768	Nitzschia linearis W. Smith	1292	1.99	92.00	8.00	1541.50
1848	LWC - 3	8-Sep-18	5836	Encyonema silesiacum (Bleisch) D.G. Mann	7465	8.79	30.00	10.00	1178.10
1848	LWC - 3	8-Sep-18	5857	Nitzschia filiformis (W. Smith) Hustedt	3158	0.54	41.00	4.00	171.70
1848	LWC - 3	8-Sep-18	5860	Diatoma vulgare Bory	5455	1.38	26.90	6.00	253.50
1848	LWC - 3	8-Sep-18	5873	Gomphonema minutum	861	0.35	24.00	8.00	402.10
1848	LWC - 3	8-Sep-18	5875	Cocconies disculus Schum.	3445	5.30	30.00	14.00	1539.40
1848	LWC - 3	8-Sep-18	5882	Anomoenies vitrea Ross	2584	0.91	37.40	6.00	352.50
1848	LWC - 3	8-Sep-18	5890	Diatoma mesodon Grun.	431	0.90	20.00	20.00	2094.40
1848	LWC - 3	8-Sep-18	5910	Navicula exigua (Greg.) Muller	1436	0.42	31.00	6.00	292.20
1848	LWC - 3	8-Sep-18	5916	Fragilaria capucina Grunow	1579	1.62	109.00	6.00	1027.30
1848	LWC - 3	8-Sep-18	5917	Hannaea arcus Patrick	1148	0.69	64.00	6.00	603.20
1848	LWC - 3	8-Sep-18	5986	Meridion circulare Agardh	574	0.60	40.00	10.00	1047.20
1848	LWC - 3R	8-Sep-18	1077	Pseudanabaena sp.	1292	0.17	41.00	2.00	128.80
1848	LWC - 3R	8-Sep-18	1122	Phormidium autumnale Agardh	1723	4.92	101.00	6.00	2855.70
1848	LWC - 3R	8-Sep-18	5311	Cymbella minuta Kutzing	2010	0.60	15.00	7.10	296.90
1848	LWC - 3R	8-Sep-18	5460	Gomphonema truncatum Ehrenberg	144	0.15	40.00	10.00	1047.20
1848	LWC - 3R	8-Sep-18	5702	Achnanthes minutissima Kutzing	17370	1.38	18.90	4.00	79.20
1848	LWC - 3R	8-Sep-18	5768	Nitzschia linearis W. Smith	861	1.33	92.00	8.00	1541.50
1848	LWC - 3R	8-Sep-18	5836	Encyonema silesiacum (Bleisch) D.G. Mann	9187	10.82	30.00	10.00	1178.10
1848	LWC - 3R	8-Sep-18	5857	Nitzschia filiformis (W. Smith) Hustedt	2440	0.42	41.00	4.00	171.70
1848	LWC - 3R	8-Sep-18	5860	Diatoma vulgare Bory	4450	1.13	26.90	6.00	253.50
1848	LWC - 3R	8-Sep-18	5873	Gomphonema minutum	574	0.23	24.00	8.00	402.10
1848	LWC - 3R	8-Sep-18	5875	Cocconies disculus Schum.	2728	4.20	30.00	14.00	1539.40
1848	LWC - 3R	8-Sep-18	5882	Anomoenies vitrea Ross	2153	0.76	37.40	6.00	352.50
1848	LWC - 3R	8-Sep-18	5910	Navicula exigua (Greg.) Muller	2153	0.63	31.00	6.00	292.20
1848	LWC - 3R	8-Sep-18	5916	Fragilaria capucina Grunow	718	0.74	109.00	6.00	1027.30
1848	LWC - 3R	8-Sep-18	5917	Hannaea arcus Patrick	861	0.52	64.00	6.00	603.20
1848	LWC - 3R	8-Sep-18	5986	Meridion circulare Agardh	1148	1.20	40.00	10.00	1047.20
1848	LWC - 4	8-Sep-18	1122	Phormidium autumnale Agardh	246	0.72	103.00	6.00	2912.30
1848	LWC - 4	8-Sep-18	5311	Cymbella minuta Kutzing	3568	1.09	15.90	7.00	306.00
1848	LWC - 4	8-Sep-18	5702	Achnanthes minutissima Kutzing	12551	1.07	20.30	4.00	85.00
1848	LWC - 4	8-Sep-18	5768	Nitzschia linearis W. Smith	738	1.06	86.00	8.00	1440.90
1848	LWC - 4	8-Sep-18	5836	Encyonema silesiacum (Bleisch) D.G. Mann	7629	8.99	30.00	10.00	1178.10
1848	LWC - 4	8-Sep-18	5857	Nitzschia filiformis (W. Smith) Hustedt	369	0.06	41.00	4.00	171.70
1848	LWC - 4	8-Sep-18	5860	Diatoma vulgare Bory	5537	1.41	27.00	6.00	254.50
1848	LWC - 4	8-Sep-18	5865	Cymbella prostrata (Berkeley) Cleve	123	2.25	96.00	22.00	18246.40
1848	LWC - 4	8-Sep-18	5873	Gomphonema minutum	984	0.43	26.00	8.00	435.60
1848	LWC - 4	8-Sep-18	5875	Coconies disculus Schum.	615	0.95	30.00	14.00	1539.40
1848	LWC - 4	8-Sep-18	5882	Anomoenies vitrea Ross	738	0.24	35.00	6.00	329.90
1848	LWC - 4	8-Sep-18	5910	Navicula exigua (Greg.) Muller	738	0.20	29.40	6.00	277.10
1848	LWC - 4	8-Sep-18	5916	Fragilaria capucina Grunow	738	0.65	94.00	6.00	885.90
1848	LWC - 4	8-Sep-18	5917	Hannaea arcus Patrick	123	0.07	62.30	6.00	587.20
1848	LWC - 5	8-Sep-18	1122	Phormidium autumnale Agardh	172	0.48	99.00	6.00	2799.20
1848	LWC - 5	8-Sep-18	1131	Heteroleibeinia profunda Komarek	1838	0.15	26.00	2.00	81.70
1848	LWC - 5	8-Sep-18	2511	Ulothrix zonata Kutzing	402	20.20	40.00	40.00	50265.50
1848	LWC - 5	8-Sep-18	5311	Cymbella minuta Kutzing	258	0.09	14.10	8.00	354.40
1848	LWC - 5	8-Sep-18	5702	Achnanthes minutissima Kutzing	2756	0.23	20.00	4.00	83.80
1848	LWC - 5	8-Sep-18	5768	Nitzschia linearis W. Smith	57	0.10	101.00	8.00	1692.30
1848	LWC - 5	8-Sep-18	5836	Encyonema silesiacum (Bleisch) D.G. Mann	258	0.30	30.00	10.00	1178.10
1848	LWC - 5	8-Sep-18	5857	Nitzschia filiformis (W. Smith) Hustedt	172	0.03	41.00	4.00	171.70
1848	LWC - 5	8-Sep-18	5860	Diatoma vulgare Bory	689	0.16	24.60	6.00	231.80
1848	LWC - 5	8-Sep-18	5873	Gomphonema minutum	115	0.03	28.00	6.00	263.90
1848	LWC - 5	8-Sep-18	5875	Cocconies disculus Schum.	172	0.18	20.00	14.00	1026.30
1848	LWC - 5	8-Sep-18	5882	Anomoenies vitrea Ross	459	0.17	39.00	6.00	367.60
1848	LWC - 5	8-Sep-18	5910	Navicula exigua (Greg.) Muller	115	0.03	29.00	6.00	273.30

APPENDIX E

BENTHIC INVERTEBRATE COMMUNITY DATA

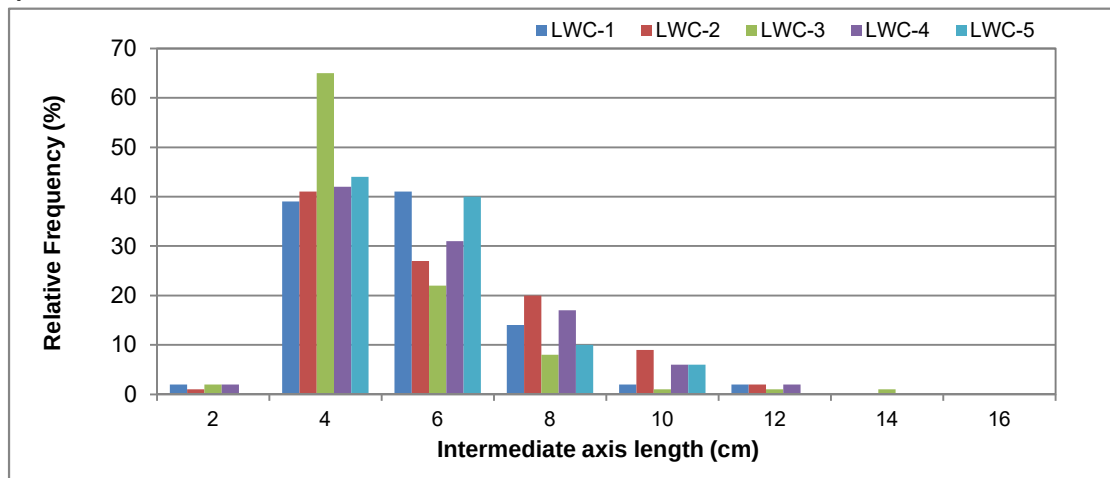
Figures and Tables

Laboratory Reports

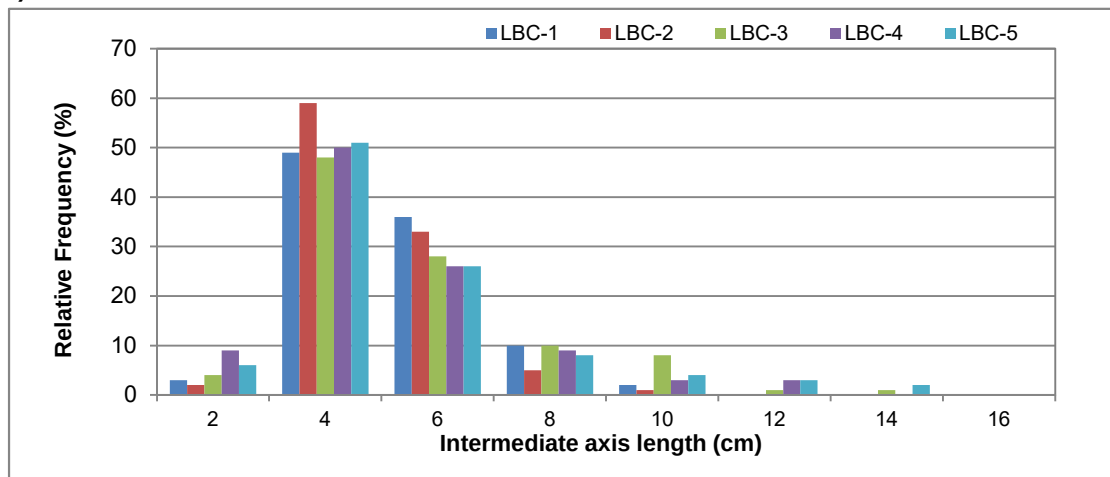
APPENDIX E
BENTHIC INVERTEBRATE COMMUNITY DATA

Figures and Tables

a)



b)



c)

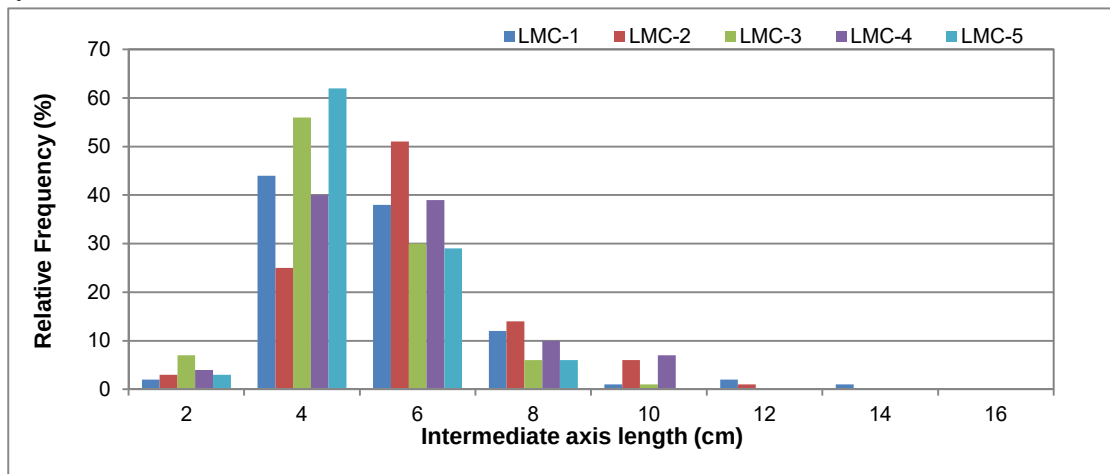


Figure E.1: Intermediate Axis Length of 100 Rocks Measured at Five Benthic Stations in a) Lower Wolverine Creek, b) Lower Big Creek, and c) Lower Minto Creek, Minto Mine, 2018

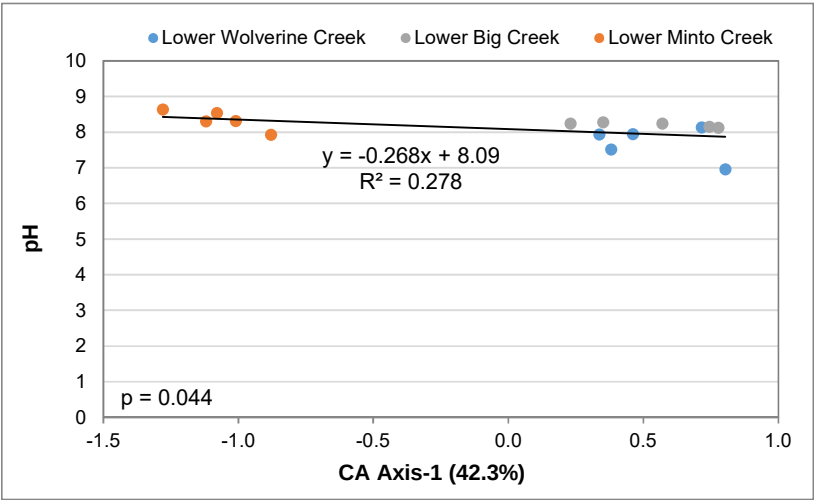
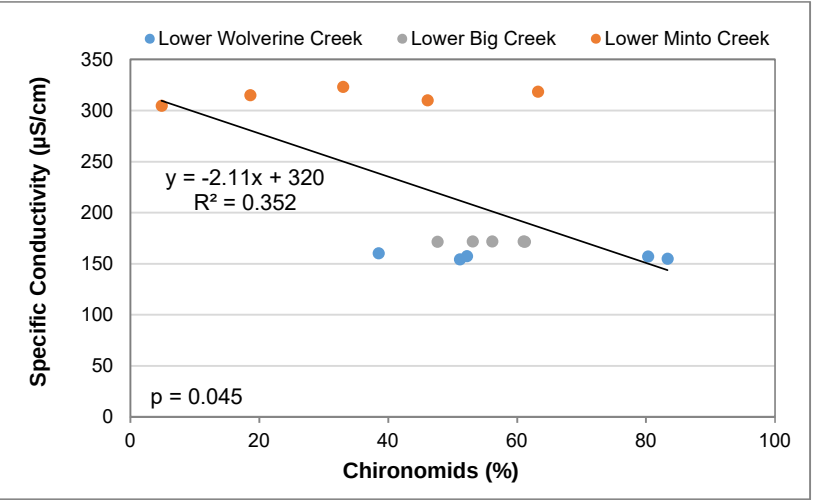
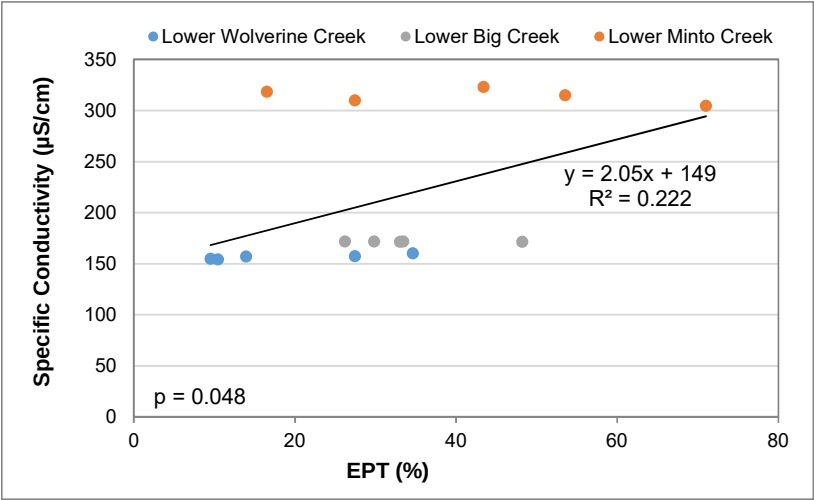
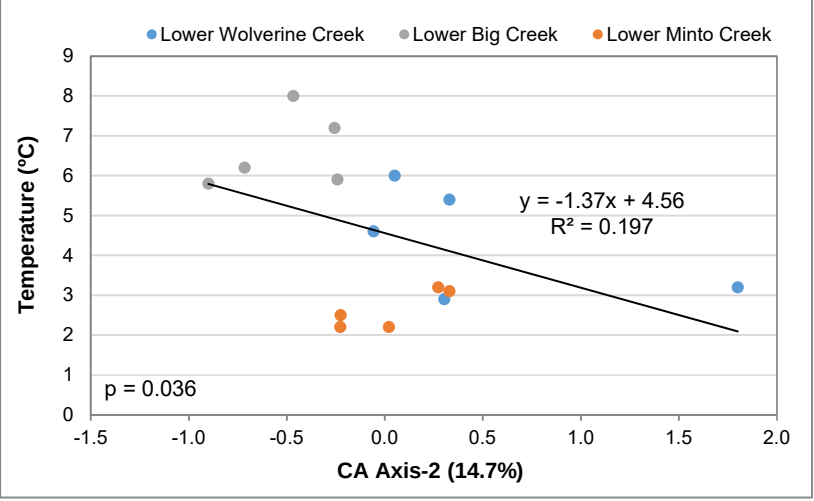
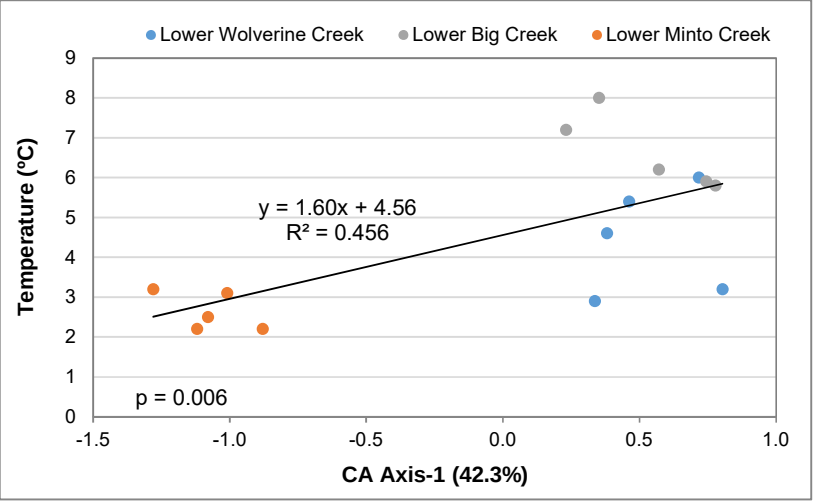
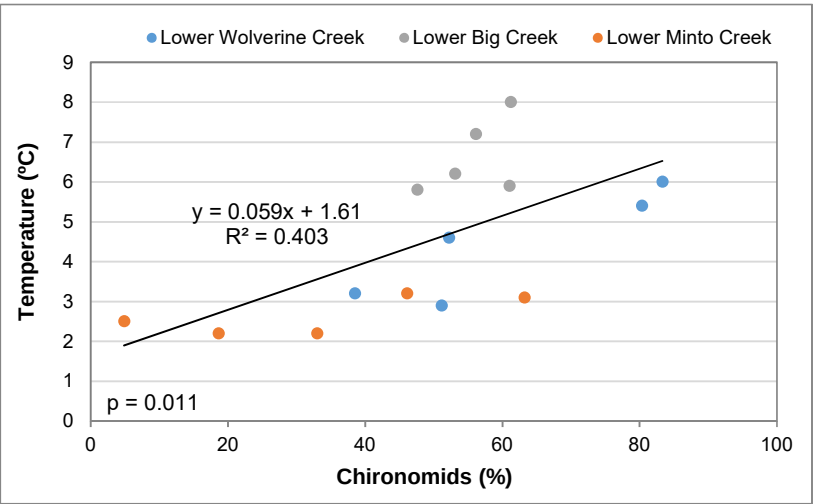
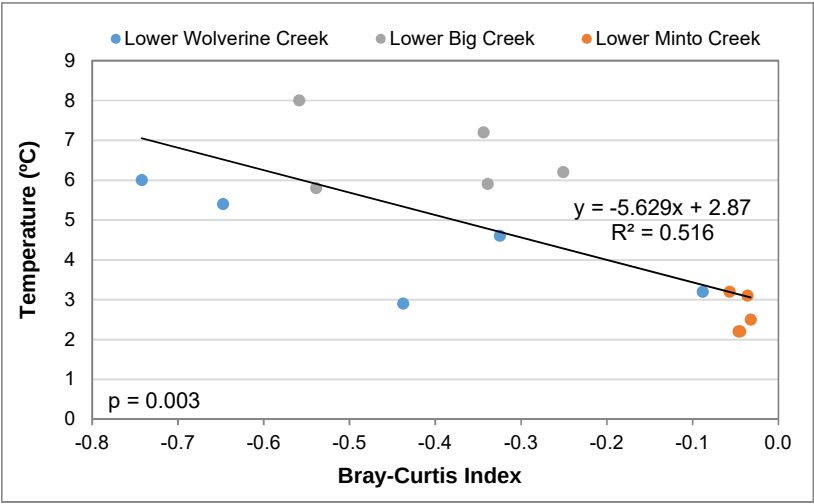


Figure E.2: Scatterplots of Relationships ($p < 0.050$) between Selected Benthic Invertebrate Environmental Measurements and Biological Endpoints, Minto Mine WUL, 2018

Table E.1: Benthic Invertebrates (Organisms per Sample) Collected by Surber Sampler and Screened Through a 500 µm Sieve, Minto Mine WUL, 2018

Invertebrate	Lower Wolverine Creek (Reference)					Lower Big Creek (Reference)					Lower Minto Creek (Exposed)				
	LWC-1	LWC-2	LWC-3	LWC-4	LWC-5	LBC-1	LBC-2	LBC-3	LBC-4	LBC-5	LMC-1	LMC-2	LMC-3	LMC-4	LMC-5
Phylum: Arthropoda	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Order: Collembola	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
Family: Entomobryidae	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Family: Isotomidae	-	-	-	-	-	-	-	1	-	-	-	-	-	-	22
Family: Onychiuridae	-	-	-	-	-	-	-	-	-	-	8	-	-	-	-
Subphylum: Hexapoda	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Class: Insecta	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Order: Ephemeroptera	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Family: Ameletidae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Ameletus</i>	-	-	-	-	1	-	-	-	1	2	-	-	-	-	-
Family: Baetidae	-	6	2	-	2	3	-	2	1	2	4	-	1	1	2
<i>Acentrella</i>	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-
<i>Baetis</i>	9	-	-	6	13	11	8	3	8	3	23	10	1	38	72
<i>Baetis fuscatus</i> gr.	-	-	-	2	1	-	-	-	-	-	-	-	-	-	-
<i>Baetis rhodani</i> group	-	-	-	-	-	-	-	1	-	-	6	-	-	-	-
<i>Baetis bicaudatus</i>	-	-	-	-	-	-	-	-	-	-	-	7	1	9	16
Family: Ephemerellidae	1	-	-	1	1	-	-	-	-	-	-	-	-	-	2
<i>Drunella</i>	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Drunella doddsii</i>	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
<i>Drunella spinifera</i>	-	-	1	1	-	-	-	-	2	2	-	-	-	-	-
<i>Ephemerella</i>	3	-	-	1	-	4	-	-	-	1	-	-	-	-	-
<i>Ephemerella excrucians</i> complex	-	-	1	4	1	-	-	-	2	1	-	-	-	-	-
Family: Heptageniidae	2	-	4	1	3	28	4	84	58	43	-	-	-	1	-
<i>Cinygmula</i>	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
<i>Rhithrogena</i>	-	-	-	-	-	-	-	-	3	1	-	-	-	-	-
Order: Plecoptera	-	-	-	-	1	-	-	-	1	-	-	-	8	-	-
Family: Capniidae	-	-	1	1	1	9	3	27	8	12	-	-	-	-	2
Family: Chloroperlidae	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
<i>Neaviperla</i>	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
<i>Suwallia</i>	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
<i>Sweltsa</i>	-	-	-	-	-	-	-	1	1	1	-	-	-	-	-
Family: Nemouridae	-	-	-	1	1	-	1	1	-	-	39	6	22	19	66
<i>Nemoura</i>	-	-	-	-	-	-	-	-	-	-	-	7	5	28	128
<i>Ostrocerca</i>	-	-	-	-	-	-	-	-	-	-	16	32	6	83	24
<i>Zapada cinctipes</i>	-	-	1	1	1	-	-	1	3	2	-	-	-	-	-
Family: Perlodidae	3	-	2	1	12	1	1	1	1	1	-	-	-	-	-
<i>Kogotus</i>	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Family: Taeniopterygidae	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
<i>Taenionema</i>	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-

Notes: Dash represents zero taxa or no taxa identified to that taxonomic level.

Table E.1: Benthic Invertebrates (Organisms per Sample) Collected by Surber Sampler and Screened Through a 500 µm Sieve, Minto Mine WUL, 2018

Invertebrate	Lower Wolverine Creek (Reference)					Lower Big Creek (Reference)					Lower Minto Creek (Exposed)				
	LWC-1	LWC-2	LWC-3	LWC-4	LWC-5	LBC-1	LBC-2	LBC-3	LBC-4	LBC-5	LMC-1	LMC-2	LMC-3	LMC-4	LMC-5
Order: Trichoptera	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
Family: Brachycentridae	1	-	-	-	-	1	-	-	1	1	-	-	-	-	-
Family: Glossosomatidae	1	-	-	-	1	1	-	-	-	-	-	-	-	-	-
<i>Glossosoma</i>	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Family: Lepidostomatidae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Lepidostoma</i>	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-
Family: Limnephilidae	1	-	-	2	1	-	-	1	-	-	-	-	-	16	6
<i>Dicosmoecus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Family: Polycentropodidae	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Family: Rhyacophilidae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Rhyacophila</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Order: Coleoptera	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Family: Dytiscidae	-	-	-	-	-	-	-	-	-	-	1	-	-	-	2
<i>Oreodytes</i>	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Order: Diptera	1	-	-	-	1	-	-	7	-	1	-	-	-	-	2
Family: Ceratopogonidae	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
<i>Ceratopogon</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Family: Chironomidae	35	3	39	46	29	27	7	18	9	10	10	19	-	5	8
Subfamily: Chironominae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tribe: Tanytarsini	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Micropsectra</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	-	4
<i>Paratanytarsus</i>	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-
<i>Rheotanytarsus</i>	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Subfamily: Diamesinae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tribe: Diamesini	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Diamesa</i>	-	-	-	-	-	1	-	-	-	-	276	74	-	10	38
<i>Pagastia</i>	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
<i>Potthastia</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Potthastia longimana</i> group	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
<i>Pseudodiamesa</i>	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Subfamily: Orthocladiinae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Eukiefferiella</i>	16	1	9	9	14	5	3	1	3	1	36	7	1	48	166
<i>Limnophyes</i>	2	-	-	1	-	-	-	-	-	-	5	2	1	-	-
<i>Metriocnemus</i>	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-
<i>Orthocladius</i>	57	3	51	66	27	81	21	164	79	163	5	1	1	5	18
<i>Smittia</i>	-	-	-	2	-	-	-	2	-	-	1	-	-	-	-
<i>Tvetenia</i>	2	3	6	15	9	-	-	-	-	1	4	2	-	-	6
Family: Empididae	-	1	-	-	-	1	-	1	-	1	1	-	1	-	4

Notes: Dash represents zero taxa or no taxa identified to that taxonomic level.

Table E.1: Benthic Invertebrates (Organisms per Sample) Collected by Surber Sampler and Screened Through a 500 µm Sieve, Minto Mine WUL, 2018

Invertebrate	Lower Wolverine Creek (Reference)					Lower Big Creek (Reference)					Lower Minto Creek (Exposed)				
	LWC-1	LWC-2	LWC-3	LWC-4	LWC-5	LBC-1	LBC-2	LBC-3	LBC-4	LBC-5	LMC-1	LMC-2	LMC-3	LMC-4	LMC-5
<i>Clinocerinae</i> Unknown Genus A	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
<i>Neoplasta</i>	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
Family: Ephydriidae	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Family: Psychodidae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Pericoma/Telmatoscopus</i>	-	-	-	-	1	-	-	-	-	-	-	-	-	2	2
Family: Simuliidae	-	-	2	1	10	-	1	-	1	2	5	7	3	6	14
<i>Simulium</i>	-	-	-	-	5	1	-	-	-	-	59	29	8	37	54
Family: Tabanidae	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Family: Tipulidae	-	-	-	-	-	2	-	-	-	2	-	-	-	2	2
<i>Dicranota</i>	-	-	-	-	-	1	-	-	-	-	-	-	-	5	4
<i>Rhabdomastix</i>	-	-	6	-	-	-	-	-	-	1	-	-	-	-	-
Order: Lepidoptera	-	-	-	-	1	-	-	-	-	1	-	-	-	-	2
Order: Thysanoptera	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-
Subphylum: Chelicerata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Class: Arachnida	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Order: Trombidiformes	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Family: Hygrobatidae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Atractides</i>	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
<i>Hygrobates</i>	-	-	-	-	-	-	2	-	1	-	-	-	-	-	-
Family: Lebertiidae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Lebertia</i>	-	3	-	1	-	1	3	2	-	2	-	-	-	-	-
Family: Sperchontidae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Sperchon</i>	-	-	-	1	-	1	1	-	-	-	16	11	-	40	62
Order: Sarcoptiformes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Family: Hydrozetidae	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Phylum: Mollusca	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Class: Gastropoda	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-
Phylum: Annelida	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Subphylum: Clitellata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Class: Oligochaeta	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Order: Lumbriculida	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Family: Lumbriculidae	82	3	-	7	14	2	1	38	2	20	16	14	2	3	4
<i>Lumbriculus</i>	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-
<i>Rhynchelmis</i>	-	-	-	-	-	-	-	1	-	1	-	-	-	3	-
Order: Tubificida	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Family: Naididae	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
<i>Nais</i>	-	-	-	-	-	1	-	5	4	4	-	-	-	-	-
Totals	221	26	126	174	154	188	57	365	191	292	539	230	62	367	734

Notes: Dash represents zero taxa or no taxa identified to that taxonomic level.

Table E.2: Benthic Invertebrate Community Metrics by Station for Samples Collected by Surber Sampler, Minto Mine WUL, 2018

Area	Station	Density (organisms/m ²)	Number of Taxa	BC Index to LWC Median	BC Index to LBC Median	BC Index to Combined Reference Median	Simpson's Diversity ^a	Simpson's Evenness ^a	Ephemeroptera (%)	Plecoptera (%)	Trichoptera (%)	EPT (%)	Chironomids (%)	Oligochaeta (%)	Acari (%)	CA Axis-1 (42.3%)	CA Axis-2 (14.7%)
Lower Wolverine Creek (Reference)	LWC-1	792	15.0	0.322	0.496	0.365	0.705	0.226	6.79	2.26	1.36	10.4	51.1	37.1	0	0.336	0.302
	LWC-2	93.2	9.00	0.807	0.890	0.816	0.839	0.691	30.8	0	3.85	34.6	38.5	11.5	11.5	0.803	1.80
	LWC-3	452	13.0	0.092	0.390	0.181	0.562	0.176	6.35	0	3.17	9.52	83.3	0	0	0.716	0.0486
	LWC-4	620	20.0	0.163	0.339	0.225	0.647	0.142	9.25	1.73	2.89	13.9	80.3	4.05	1.16	0.461	0.329
	LWC-5	548	19.0	0.359	0.612	0.473	0.855	0.363	15.7	1.31	10.5	27.4	52.2	9.15	0.654	0.380	-0.0579
Lower Big Creek (Reference)	LBC-1	674	21.0	0.350	0.125	0.276	0.650	0.136	24.5	2.13	6.38	33.0	61.2	1.60	1.06	0.351	-0.468
	LBC-2	204	13.0	0.542	0.589	0.453	0.740	0.295	21.1	0	8.77	29.8	56.1	1.75	10.5	0.230	-0.257
	LBC-3	1,308	19.0	0.596	0.357	0.561	0.664	0.156	24.7	0.274	8.49	33.4	53.1	12.1	0.822	0.570	-0.717
	LBC-4	685	16.0	0.369	0.124	0.289	0.681	0.196	39.3	1.57	7.33	48.2	47.6	3.14	0.524	0.777	-0.901
	LBC-5	1,039	24.0	0.505	0.238	0.458	0.610	0.107	19.0	0.690	6.55	26.2	61.0	8.62	1.03	0.744	-0.243
Lower Minto Creek (Exposed)	LMC-1	1,928	18.0	0.884	0.941	0.920	0.686	0.177	6.32	0	10.2	16.5	63.2	3.35	3.16	-1.010	0.328
	LMC-2	824	14.0	0.854	0.921	0.877	0.784	0.331	7.39	0	20.0	27.4	46.1	6.09	4.78	-1.280	0.272
	LMC-3	222	11.0	0.932	0.932	0.928	0.745	0.356	4.84	0	66.1	71.0	4.84	4.84	0	-1.080	-0.227
	LMC-4	1,312	15.0	0.860	0.925	0.898	0.860	0.475	13.4	4.64	35.5	53.5	18.6	1.64	10.9	-1.120	-0.228
	LMC-5	2,624	21.0	0.875	0.917	0.902	0.848	0.313	12.6	0.820	30.1	43.4	33.0	0.546	8.47	-0.880	0.0205

^a Calculated as recommended by Environment Canada 2012.

Table E.3: Statistical Comparisons of Benthic Invertebrate Community Characteristics Among Areas, Minto Mine WUL, 2018

Endpoint	Overall 3-group Comparison			Post-hoc comparisons ^b			Magnitude of Difference (Group 1 - Group 2) /Pooled SD
	Data Transformation	Test ^a	Test p-value	Groups		Test P-value	
				Group 1	Group 2		
Density (Individuals/m ²)	none	ANOVA	0.106	LMC	LWC	-	1.40
					LBC	-	0.980
				LWC	LBC	-	0.460
Number of Taxa	none	ANOVA	0.422	LMC	LWC	-	0.140
					LBC	-	-0.660
				LWC	LBC	-	0.810
BC Index to LWC Median	log ₁₀	ANOVA	0.009	LMC	LWC	0.007	2.40
					LBC	0.142	1.30
				LWC	LBC	0.234	1.10
BC Index to LBC Median	log ₁₀	ANOVA	0.002	LMC	LWC	0.135	1.30
					LBC	0.001	3.00
				LWC	LBC	0.047	-1.70
BC Index to Combined Reference Median	log ₁₀	ANOVA	0.005	LMC	LWC	0.007	2.40
					LBC	0.014	2.10
				LWC	LBC	0.919	0.250
Simpson's Diversity	none	ANOVA	0.157	LMC	LWC	-	0.720
					LBC	-	1.30
				LWC	LBC	-	-0.600
Simpson's Evenness	log ₁₀	ANOVA	0.134	LMC	LWC	-	0.330
					LBC	-	1.30
				LWC	LBC	-	-1.00
Ephemeroptera (%)	log ₁₀	ANOVA	0.011	LMC	LWC	0.558	-0.670
					LBC	0.010	-2.30
				LWC	LBC	0.063	1.60
Plecoptera (%)	fourth-root	ANOVA	<0.001	LMC	LWC	<0.001	3.40
					LBC	0.007	2.40
				LWC	LBC	0.305	0.980
Trichoptera (%)	fourth-root	ANOVA	0.722	LMC	LWC	-	-0.340
					LBC	-	-0.510
				LWC	LBC	-	0.170
EPT (%)	none	ANOVA	0.079	LMC	LWC	0.069	1.60
					LBC	0.660	0.560
				LWC	LBC	0.283	1.00
Chironomids (%)	none	ANOVA	0.063	LMC	LWC	0.068	-1.60
					LBC	0.149	-1.30
				LWC	LBC	0.887	-0.300
Oligochaeta (%)	log ₁₀ (x+1)	ANOVA	0.526	LMC	LWC	-	-0.740
					LBC	-	-0.340
				LWC	LBC	-	-0.400
Acari (%)	fourth-root	ANOVA	0.468	LMC	LWC	-	0.780
					LBC	-	0.220
				LWC	LBC	-	0.560
CA Axis-1 (42.3%)	none	ANOVA	<0.001	LMC	LWC	<0.001	-8.00
					LBC	<0.001	-8.00
				LWC	LBC	0.999	-0.025
CA Axis-2 (14.7%)	rank	Kruskal-Wallis	0.006	LMC	LWC	0.358	-
					LBC	0.028	-
				LWC	LBC	0.002	-

Note: Magnitude of Difference = (group 1 mean - group 2 mean)/pooled standard deviation.

Highlighted values indicate significance differences; p-value < 0.10.

Effect size magnitude > 2.

^a ANOVA= Analysis of Variance; K-W = Kruskal-Wallis

^b Pairwise comparisons calculated using Least-squares means with Tukey's adjustment for multiple comparisons for ANOVAs and Dunn's Test with no adjustment for K-W

Table E.4: Correspondence Analysis Axis Station Scores Using Benthic Invertebrate Abundances at the Lowest Practical Level of Taxonomic Resolution

Area	CA Axis-1 (42.3%)	CA Axis-2 (14.7%)
LWC-1	0.336	0.302
LWC-2	0.803	1.80
LWC-3	0.716	0.0486
LWC-4	0.461	0.329
LWC-5	0.380	-0.0579
LBC-1	0.351	-0.468
LBC-2	0.230	-0.257
LBC-3	0.570	-0.717
LBC-4	0.777	-0.901
LBC-5	0.744	-0.243
LMC-1	-1.01	0.328
LMC-2	-1.28	0.272
LMC-3	-1.08	-0.227
LMC-4	-1.12	-0.228
LMC-5	-0.880	0.0205

Notes: Relative taxon densities were 4th root transformed before CA calculation.

Taxa present at two or fewer stations or accounted for less than 10% of the total abundance at any station were removed from the analysis.

Table E.5: Spearman Correlation of Station Correspondence Analysis (CA) Axes Scores with Benthic Taxa

Invertebrate	CA Axis-1 (42.3%)		CA Axis-2 (14.7%)	
	r-value	p-value	r-value	p-value
<i>Entomobryidae</i>	-0.370	0.173	-0.120	0.660
<i>Isotomidae</i>	-0.0180	0.949	-0.210	0.463
<i>Onychiuridae</i>	-0.250	0.374	0.310	0.262
<i>Ameletus</i>	0.470	0.079	-0.380	0.161
<i>Acentrella</i>	0.380	0.162	0.340	0.218
<i>Baetis</i>	-0.530	0.044	-0.0860	0.763
<i>Baetis fuscatus</i>	0.140	0.622	0.290	0.295
<i>Baetis rhodani group</i>	-0.710	0.003	0.0400	0.887
<i>Drunella doddsii</i>	0.0620	0.827	0	1.000
<i>Drunella spinifera</i>	0.770	<0.001	0.0380	0.892
<i>Ephemerella</i>	0.350	0.203	0.0230	0.936
<i>Heptageniidae</i>	0.540	0.040	-0.710	0.003
<i>Capniidae</i>	0.490	0.063	-0.730	0.002
<i>Suwallia</i>	0.330	0.236	0.110	0.700
<i>Sweltsa</i>	0.310	0.265	-0.470	0.077
<i>Nemoura</i>	-0.740	0.002	-0.0740	0.792
<i>Ostrocera</i>	-0.810	<0.001	0.200	0.475
<i>Zapada cinctipes</i>	0.630	0.012	-0.310	0.253
<i>Perlodidae</i>	0.670	0.007	-0.100	0.724
<i>Taeniopterygidae</i>	0.210	0.450	-0.370	0.177
<i>Brachycentridae</i>	0.380	0.165	-0.420	0.119
<i>Glossosomatidae</i>	0.0550	0.845	0.200	0.479
<i>Lepidostoma</i>	0	1.000	-0.310	0.262
<i>Limnephilidae</i>	-0.210	0.443	0.100	0.720
<i>Polycentropodidae</i>	0.310	0.262	-0.190	0.508
<i>Rhyacophila</i>	-0.0620	0.827	0.250	0.374
<i>Dytiscidae</i>	-0.270	0.324	0.0430	0.878
<i>Ceratopogonidae</i>	0.0240	0.932	0.130	0.637
<i>Micropsectra</i>	-0.440	0.100	0.180	0.533
<i>Paratanytarsus</i>	0.360	0.193	-0.420	0.122
<i>Rheotanytarsus</i>	0	1.000	-0.310	0.262
<i>Diamesa</i>	-0.680	0.006	0.170	0.544
<i>Pagastia</i>	-0.120	0.660	-0.250	0.374
<i>Potthastia longimana group</i>	0.190	0.508	-0.370	0.173
<i>Pseudodiamesa</i>	-0.250	0.374	0.310	0.262
<i>Eukiefferiella</i>	-0.430	0.113	0.380	0.161
<i>Limnophyes</i>	-0.480	0.068	0.580	0.022
<i>Metriocnemus</i>	-0.250	0.374	0.310	0.262
<i>Orthocladius complex</i>	0.580	0.025	-0.460	0.083
<i>Smittia</i>	0.0690	0.807	0.200	0.483
<i>Tvetenia</i>	0.200	0.485	0.760	<0.001
<i>Empididae</i>	0.120	0.682	-0.130	0.646
<i>Ephydriidae</i>	-0.0620	0.827	0.250	0.374
<i>Pericoma/Telmatoscopus</i>	-0.330	0.235	-0.0330	0.907
<i>Simuliidae</i>	-0.630	0.012	0.100	0.710
<i>Tabanidae</i>	-0.0620	0.827	0.250	0.374
<i>Dicranota</i>	-0.380	0.168	-0.210	0.443
<i>Rhabdomastix</i>	0.400	0.135	-0.0300	0.915
<i>Atractides</i>	0.190	0.508	-0.370	0.173
<i>Hygrobatas</i>	0.160	0.576	-0.490	0.064
<i>Lebertia</i>	0.480	0.071	-0.140	0.630
<i>Sperchon</i>	-0.680	0.005	0.170	0.556
<i>Hydrozetidae</i>	0.310	0.262	-0.190	0.508
<i>Lumbriculidae</i>	-0.0860	0.760	0.210	0.461
<i>Naididae</i>	0.370	0.176	-0.740	0.002

 Indicates absolute r-values > 0.60.
 Indicates p-value < 0.05.

Table E.6: Intermediate Axis Length and Embeddedness of 100 Rocks Washed during Surber Sampling at Benthic Invertebrate Stations, Minto Mine WUL, 2018

Rock Number	Lower Wolverine Creek (Reference)									
	LWC-1		LWC-2		LWC-3		LWC-4		LWC-5	
	Intermediate Axis Length (cm)	Embeddedness (%)	Intermediate Axis Length (cm)	Embeddedness (%)	Intermediate Axis Length (cm)	Embeddedness (%)	Intermediate Axis Length (cm)	Embeddedness (%)	Intermediate Axis Length (cm)	Embeddedness (%)
1	12.0	-	10.4	-	10.8	-	3.5	-	9.0	-
2	8.0	-	7.4	-	6.5	-	3.7	-	7.7	-
3	10.5	-	5.3	-	3.5	-	4.6	-	4.1	-
4	5.8	-	2.5	-	5.1	-	3.2	-	7.5	-
5	6.0	-	5.1	-	4.7	-	8.6	-	8.2	-
6	4.6	-	5.9	-	3.8	-	9.6	-	5.3	-
7	6.6	-	5.8	-	6.7	-	6.0	-	4.6	-
8	7.0	-	4.8	-	4.0	-	7.5	-	4.0	-
9	6.5	-	2.5	-	6.6	-	3.9	-	7.5	-
10	5.3	25	3.0	0	6.4	25	4.0	0	5.3	0
11	3.6	-	5.2	-	7.7	-	3.2	-	4.7	-
12	4.7	-	6.9	-	3.5	-	6.6	-	4.2	-
13	4.6	-	8.5	-	2.7	-	5.0	-	6.9	-
14	5.3	-	6.1	-	2.7	-	5.6	-	7.0	-
15	4.6	-	8.2	-	4.3	-	3.8	-	7.5	-
16	7.0	-	8.1	-	5.0	-	6.3	-	3.4	-
17	7.1	-	7.8	-	3.1	-	4.3	-	3.3	-
18	8.9	-	7.0	-	2.6	-	4.0	-	3.5	-
19	5.9	-	7.2	-	3.0	-	6.2	-	6.0	-
20	6.7	25	5.7	75	4.6	25	4.2	25	4.5	0
21	5.8	-	6.2	-	4.5	-	2.6	-	2.4	-
22	5.5	-	4.9	-	4.2	-	3.0	-	2.6	-
23	4.2	-	4.2	-	2.5	-	3.8	-	6.0	-
24	5.1	-	3.3	-	6.1	-	3.5	-	5.3	-
25	5.6	-	5.5	-	3.5	-	3.2	-	3.0	-
26	4.2	-	2.9	-	4.6	-	3.0	-	4.0	-
27	7.0	-	3.0	-	6.0	-	2.0	-	8.0	-
28	4.3	-	7.2	-	3.0	-	3.0	-	5.7	-
29	2.9	-	3.6	-	5.5	-	2.4	-	3.1	-
30	8.1	0	7.0	0	4.1	25	7.8	25	3.2	25
31	3.3	-	6.9	-	13.7	-	4.1	-	2.9	-
32	7.0	-	6.8	-	6.1	-	5.6	-	2.8	-
33	4.5	-	8.0	-	3.1	-	8.5	-	4.9	-
34	3.8	-	2.9	-	3.0	-	3.8	-	3.7	-
35	3.4	-	4.3	-	4.7	-	3.3	-	5.0	-
36	3.5	-	7.2	-	2.9	-	2.1	-	4.2	-
37	4.3	-	5.5	-	4.1	-	4.4	-	3.2	-
38	5.7	-	3.3	-	2.1	-	5.0	-	4.0	-
39	4.7	-	4.0	-	3.2	-	8.0	-	5.5	-
40	4.5	0	2.5	0	4.6	0	5.9	0	6.1	0
41	6.8	-	4.4	-	4.0	-	5.1	-	5.0	-
42	5.4	-	4.3	-	3.1	-	4.5	-	4.1	-
43	3.2	-	4.0	-	4.2	-	5.0	-	3.0	-
44	3.7	-	2.5	-	4.5	-	3.9	-	3.3	-
45	4.1	-	7.2	-	5.6	-	4.5	-	4.1	-
46	4.5	-	9.0	-	3.0	-	6.4	-	3.5	-
47	5.1	-	3.5	-	3.6	-	6.7	-	4.2	-
48	4.3	-	6.6	-	2.7	-	4.4	-	3.0	-
49	4.2	-	2.3	-	2.2	-	7.5	-	2.6	-
50	5.0	0	2.1	25	2.3	50	7.6	25	5.6	0
51	3.5	-	4.5	-	2.4	-	7.0	-	5.0	-
52	2.3	-	5.0	-	2.2	-	6.3	-	3.0	-
53	3.7	-	2.3	-	2.4	-	3.7	-	2.5	-
54	4.6	-	3.6	-	4.3	-	5.4	-	3.5	-
55	4.9	-	3.5	-	6.7	-	7.8	-	2.5	-
56	4.1	-	2.8	-	6.0	-	6.0	-	3.1	-
57	3.4	-	6.8	-	5.2	-	11.5	-	10.0	-
58	3.0	-	5.5	-	3.3	-	8.5	-	3.5	-
59	2.9	-	4.1	-	2.9	-	10.2	-	4.3	-
60	2.5	25	3.0	0	9.5	25	8.3	0	3.5	25
61	7.0	-	2.8	-	3.5	-	4.6	-	5.9	-
62	2.5	-	3.6	-	3.5	-	6.6	-	4.1	-
63	3.0	-	3.4	-	3.5	-	4.0	-	9.2	-
64	4.1	-	2.4	-	4.0	-	5.5	-	8.5	-
65	3.9	-	5.1	-	3.5	-	6.1	-	4.3	-
66	3.5	-	2.2	-	2.5	-	5.5	-	4.1	-
67	4.6	-	2.8	-	2.8	-	3.4	-	7.5	-
68	2.1	-	2.4	-	5.2	-	5.5	-	4.2	-
69	5.0	-	9.5	-	4.7	-	3.5	-	6.0	-
70	5.0	0	3.5	50	4.0	0	6.1	0	4.8	0
71	4.5	-	4.1	-	2.2	-	5.2	-	4.2	-
72	6.1	-	3.1	-	2.4	-	3.0	-	3.6	-
73	5.2	-	4.2	-	2.6	-	5.3	-	4.5	-
74	3.6	-	9.5	-	2.7	-	5.1	-	4.6	-
75	2.5	-	9.8	-	3.1	-	3.2	-	7.1	-
76	4.2	-	6.7	-	3.0	-	3.3	-	4.8	-
77	5.0	-	10.3	-	4.0	-	3.0	-	4.1	-
78	3.5	-	9.5	-	2.6	-	3.2	-	3.7	-
79	3.9	-	3.8	-	3.5	-	5.7	-	5.6	-
80	4.2	25	3.0	0	3.0	50	1.9	25	3.1	0
81	2.9	-	3.7	-	3.5	-	6.1	-	3.2	-
82	2.8	-	7.9	-	4.0	-	4.0	-	2.8	-
83	2.7	-	6.3	-	2.1	-	3.1	-	2.7	-
84	3.0	-	4.2	-	4.0	-	3.5	-	4.4	-
85	7.0	-	7.1	-	2.2	-	3.3	-	2.6	-
86	4.8	-	5.0	-	2.0	-	4.3	-	9.2	-
87	1.9	-	5.7	-	2.6	-	4.0	-	3.7	-
88	3.4	-	5.4	-	2.4	-	4.7	-	3.2	-
89	3.2	-	3.0	-	2.9	-	4.0	-	4.7	-
90	3.6	25	4.0	25	3.3	25	9.2	0	2.1	0
91	3.1	-	9.0	-	3.2	-	4.4	-	3.2	-
92	2.8	-	4.1	-	2.6	-	3.1	-	3.9	-
93	2.9	-	4.3	-	2.8	-	4.9	-	5.5	-
94	2.0	-	3.3	-	2.4	-	2.5	-	3.0	-
95	7.0	-	3.2	-	2.0	-	4.1	-	5.8	-
96	3.4	-	3.0	-	3.3	-	3.3	-	2.3	-
97	2.4	-	3.5	-	2.7	-	2.1	-	3.5	-
98	3.0	-	2.7	-	2.6	-	2.5	-	3.6	-
99	2.6	-	2.6	-	2.7	-	2.7	-	4.9	-
100	2.5	0	2.0	75	3.0	0	3.7	50	3.5	25
Minimum	1.9		2.0		2.0		1.9		2.1	
Maximum	12.0		10.4		13.7		11.5		10.0	
Mean	4.6		5.0		3.9		4.9		4.6	
Geometric mean	4.3		4.6		3.6		4.5		4.3	
Median	4.3	13	4.3	13	3.5	25	4.4	13	4.2	0

Notes: The intermediate axis is measured perpendicular to the longest axis and is the axis in which the substrate rolls downstream. Embeddedness refers to how deeply the rock is surrounded or buried by other substrate.

Table E.6: Intermediate Axis Length and Embeddedness of 100 Rocks Washed during Surber Sampling at Benthic Invertebrate Stations, Minto Mine WUL, 2018

Rock Number	Lower Big Creek (Reference)									
	LBC-1		LBC-2		LBC-3		LBC-4		LBC-5	
	Intermediate Axis Length (cm)	Embeddedness (%)	Intermediate Axis Length (cm)	Embeddedness (%)	Intermediate Axis Length (cm)	Embeddedness (%)	Intermediate Axis Length (cm)	Embeddedness (%)	Intermediate Axis Length (cm)	Embeddedness (%)
1	4.2	-	4.9	-	6.1	-	6.6	-	5.8	-
2	4.6	-	5.2	-	11.0	-	3.6	-	3.6	-
3	2.5	-	6.5	-	8.2	-	2.8	-	6.0	-
4	7.5	-	3.9	-	9.5	-	9.0	-	4.5	-
5	6.0	-	4.8	-	6.2	-	2.4	-	3.6	-
6	4.2	-	6.0	-	4.8	-	10.8	-	3.6	-
7	5.9	-	4.0	-	3.7	-	4.0	-	5.0	-
8	4.0	-	8.2	-	8.4	-	2.8	-	5.0	-
9	5.3	-	4.2	-	2.5	-	3.2	-	5.5	-
10	9.3	25	5.3	25	3.1	0	3.4	0	3.8	0
11	2.0	-	6.4	-	4.7	-	3.4	-	4.7	-
12	6.1	-	4.2	-	2.7	-	6.0	-	3.3	-
13	3.5	-	3.2	-	4.0	-	9.0	-	3.5	-
14	5.6	-	3.5	-	2.1	-	7.5	-	4.5	-
15	4.1	-	5.8	-	5.2	-	4.5	-	5.0	-
16	2.7	-	4.8	-	3.1	-	3.9	-	5.1	-
17	3.8	-	5.5	-	6.6	-	3.5	-	2.9	-
18	2.7	-	4.3	-	10.0	-	3.4	-	3.7	-
19	4.2	-	4.8	-	6.5	-	3.7	-	2.9	-
20	4.0	25	4.2	25	2.8	0	5.7	0	2.0	25
21	3.8	-	5.4	-	4.2	-	6.2	-	2.3	-
22	5.8	-	6.8	-	3.5	-	5.5	-	2.5	-
23	3.9	-	5.5	-	3.4	-	5.8	-	7.2	-
24	2.6	-	5.2	-	6.0	-	7.2	-	3.0	-
25	2.5	-	3.2	-	8.2	-	11.6	-	2.0	-
26	5.1	-	3.5	-	3.2	-	5.1	-	2.2	-
27	4.0	-	3.9	-	2.5	-	10.2	-	4.0	-
28	3.5	-	4.2	-	3.5	-	5.2	-	3.1	-
29	3.0	-	6.8	-	3.0	-	5.3	-	3.0	-
30	4.4	0	4.2	25	4.0	0	5.3	25	7.2	0
31	3.4	-	4.8	-	4.4	-	5.2	-	2.0	-
32	3.7	-	2.4	-	3.1	-	8.8	-	3.2	-
33	4.2	-	5.0	-	2.0	-	6.2	-	3.7	-
34	3.5	-	3.6	-	4.4	-	5.0	-	3.8	-
35	2.0	-	3.3	-	8.0	-	2.3	-	3.1	-
36	4.0	-	3.2	-	8.5	-	2.8	-	2.0	-
37	8.6	-	3.0	-	2.0	-	3.6	-	3.0	-
38	7.0	-	6.0	-	3.8	-	3.0	-	2.4	-
39	4.9	-	3.5	-	4.5	-	4.9	-	2.0	-
40	5.2	0	3.9	25	4.5	0	6.3	25	11.2	25
41	4.8	-	3.0	-	7.0	-	7.0	-	7.9	-
42	4.6	-	4.1	-	2.4	-	4.2	-	5.0	-
43	3.2	-	3.2	-	2.7	-	3.7	-	6.0	-
44	3.6	-	3.7	-	4.6	-	2.0	-	5.5	-
45	4.5	-	3.1	-	2.0	-	4.1	-	3.0	-
46	6.7	-	2.2	-	3.5	-	3.0	-	7.1	-
47	3.6	-	4.0	-	4.5	-	3.0	-	2.3	-
48	7.2	-	5.3	-	5.7	-	2.0	-	10.0	-
49	3.3	-	4.3	-	2.1	-	2.4	-	3.1	-
50	3.3	25	2.1	50	2.9	0	5.0	0	2.7	75
51	3.6	-	2.8	-	3.0	-	5.1	-	6.5	-
52	2.9	-	4.3	-	8.0	-	2.7	-	11.2	-
53	5.2	-	2.3	-	4.1	-	3.5	-	7.0	-
54	4.1	-	2.1	-	5.0	-	6.6	-	7.1	-
55	7.2	-	4.5	-	3.0	-	3.4	-	5.8	-
56	6.0	-	5.6	-	2.5	-	5.0	-	5.5	-
57	8.0	-	3.8	-	3.0	-	2.5	-	5.5	-
58	3.2	-	2.2	-	5.6	-	4.5	-	3.4	-
59	6.0	-	2.5	-	2.7	-	2.5	-	2.0	-
60	5.0	50	3.3	25	5.8	25	6.0	50	2.6	50
61	2.8	-	2.6	-	8.7	-	2.0	-	3.0	-
62	3.6	-	2.5	-	2.5	-	3.9	-	3.5	-
63	2.4	-	2.6	-	3.5	-	1.9	-	2.5	-
64	2.1	-	2.1	-	2.5	-	3.1	-	4.3	-
65	2.1	-	2.2	-	6.7	-	4.8	-	8.3	-
66	2.6	-	2.3	-	14.0	-	2.0	-	5.6	-
67	2.7	-	3.7	-	5.3	-	2.0	-	11.2	-
68	3.6	-	3.9	-	2.3	-	3.5	-	3.1	-
69	4.0	-	2.0	-	4.1	-	3.1	-	2.3	-
70	3.0	25	2.5	25	7.6	75	2.3	0	9.5	75
71	2.9	-	2.1	-	3.3	-	3.2	-	7.0	-
72	3.0	-	2.2	-	5.7	-	2.0	-	4.8	-
73	2.5	-	2.1	-	4.9	-	3.3	-	3.7	-
74	3.0	-	2.3	-	5.2	-	2.1	-	3.5	-
75	4.0	-	3.0	-	3.3	-	2.1	-	4.5	-
76	2.2	-	4.6	-	2.0	-	2.7	-	13.6	-
77	5.7	-	3.2	-	3.2	-	2.0	-	9.3	-
78	6.5	-	5.0	-	4.1	-	2.5	-	5.2	-
79	4.6	-	3.2	-	2.7	-	2.1	-	5.2	-
80	4.5	50	8.0	25	2.1	0	2.2	0	3.3	0
81	4.1	-	4.0	-	3.2	-	2.3	-	2.2	-
82	3.0	-	3.6	-	4.5	-	2.3	-	2.4	-
83	1.9	-	4.0	-	2.7	-	3.0	-	2.2	-
84	2.1	-	2.6	-	5.3	-	2.3	-	3.6	-
85	2.5	-	4.0	-	4.7	-	3.1	-	3.0	-
86	2.3	-	4.1	-	4.7	-	4.2	-	3.0	-
87	2.5	-	2.7	-	2.7	-	5.3	-	12.1	-
88	4.5	-	2.6	-	4.3	-	3.0	-	3.0	-
89	3.0	-	3.5	-	2.4	-	4.2	-	6.0	-
90	6.0	25	3.5	0	3.2	0	3.8	0	4.5	75
91	4.4	-	4.2	-	3.7	-	5.0	-	2.3	-
92	2.4	-	2.5	-	6.0	-	6.2	-	4.0	-
93	7.5	-	4.9	-	2.4	-	2.3	-	3.7	-
94	5.1	-	2.5	-	6.4	-	4.8	-	5.7	-
95	6.2	-	4.1	-	8.8	-	4.3	-	2.5	-
96	4.1	-	3.1	-	3.4	-	2.0	-	3.2	-
97	5.8	-	1.9	-	2.3	-	2.5	-	2.6	-
98	4.2	-	3.5	-	2.5	-	2.3	-	2.2	-
99	4.2	-	2.9	-	3.1	-	2.4	-	3.4	-
100	4.7	25	3.0	25	3.0	0	3.0	0	4.7	0
Minimum	1.9		1.9		2.0		1.9		2.0	
Maximum	9.3		8.2		14.0		11.6		13.6	
Mean	4.2		3.8		4.5		4.1		4.6	
Geometric mean	3.9		3.6		4.1		3.7		4.0	
Median	4.0	25	3.7	25	3.9	0	3.5	0	3.7	25

Notes: The intermediate axis is measured perpendicular to the longest axis and is the axis in which the substrate rolls downstream. Embeddedness refers to how deeply the rock is surrounded or buried by other substrate.

Table E.6: Intermediate Axis Length and Embeddedness of 100 Rocks Washed during Surber Sampling at Benthic Invertebrate Stations, Minto Mine WUL, 2018

Rock Number	Lower Minto Creek (Exposed)									
	LMC-1		LMC-2		LMC-3		LMC-4		LMC-5	
	Intermediate Axis Length (cm)	Embeddedness (%)	Intermediate Axis Length (cm)	Embeddedness (%)	Intermediate Axis Length (cm)	Embeddedness (%)	Intermediate Axis Length (cm)	Embeddedness (%)	Intermediate Axis Length (cm)	Embeddedness (%)
1	6.4	-	9.5	-	3.1	-	9.0	-	6.5	-
2	5.8	-	9.4	-	7.5	-	9.7	-	4.3	-
3	7.2	-	2.9	-	5.7	-	4.5	-	5.2	-
4	4.0	-	4.3	-	5.0	-	4.0	-	6.7	-
5	5.2	-	3.5	-	5.2	-	5.5	-	3.3	-
6	5.5	-	5.0	-	3.8	-	7.0	-	4.2	-
7	4.8	-	8.3	-	4.6	-	4.0	-	3.2	-
8	3.8	-	5.6	-	3.2	-	2.9	-	5.0	-
9	3.9	-	7.0	-	4.7	-	3.5	-	3.6	-
10	6.7	25	5.7	50	2.5	0	6.0	0	4.5	0
11	7.4	-	5.9	-	3.4	-	8.5	-	2.5	-
12	6.6	-	4.8	-	7.0	-	6.4	-	4.3	-
13	4.2	-	4.9	-	7.2	-	9.0	-	6.3	-
14	3.8	-	5.2	-	3.9	-	7.0	-	5.2	-
15	9.3	-	7.0	-	4.0	-	6.3	-	3.8	-
16	3.4	-	5.7	-	4.2	-	9.1	-	4.0	-
17	3.8	-	3.2	-	6.2	-	2.0	-	2.8	-
18	4.1	-	4.1	-	5.0	-	4.8	-	3.2	-
19	6.0	-	4.1	-	5.4	-	4.0	-	2.7	-
20	6.9	50	3.3	25	4.6	25	6.0	25	2.3	50
21	7.0	-	4.7	-	3.6	-	3.5	-	2.5	-
22	4.7	-	3.3	-	3.7	-	5.5	-	2.0	-
23	3.5	-	4.7	-	3.6	-	2.0	-	2.7	-
24	3.3	-	6.3	-	2.5	-	5.2	-	3.0	-
25	11.2	-	10.1	-	4.4	-	5.5	-	6.0	-
26	2.6	-	5.0	-	8.7	-	7.7	-	4.0	-
27	7.5	-	4.5	-	6.4	-	3.5	-	3.8	-
28	5.6	-	6.0	-	5.0	-	4.5	-	3.3	-
29	11.0	-	5.7	-	6.0	-	3.4	-	3.8	-
30	12.4	25	4.0	25	6.0	50	2.2	50	2.9	25
31	3.8	-	6.0	-	4.1	-	5.0	-	4.6	-
32	2.9	-	2.7	-	5.4	-	4.5	-	3.4	-
33	3.5	-	3.7	-	3.3	-	4.6	-	4.5	-
34	4.0	-	5.8	-	4.9	-	6.7	-	3.0	-
35	3.8	-	7.0	-	4.7	-	4.7	-	4.1	-
36	2.3	-	9.0	-	5.8	-	6.9	-	1.9	-
37	5.6	-	5.3	-	6.0	-	8.7	-	4.0	-
38	4.7	-	3.2	-	6.1	-	3.0	-	5.5	-
39	4.3	-	2.1	-	4.0	-	4.4	-	7.0	-
40	5.7	50	8.0	25	5.0	25	4.9	25	2.5	0
41	5.4	-	3.3	-	4.5	-	2.6	-	2.7	-
42	3.3	-	4.8	-	4.0	-	2.8	-	3.9	-
43	5.0	-	6.6	-	4.8	-	2.5	-	4.3	-
44	4.6	-	4.5	-	4.0	-	5.0	-	3.5	-
45	4.2	-	6.3	-	3.6	-	2.6	-	2.1	-
46	3.2	-	5.2	-	4.8	-	3.7	-	4.5	-
47	5.8	-	7.5	-	2.5	-	3.8	-	4.6	-
48	6.1	-	5.0	-	4.0	-	3.5	-	4.0	-
49	6.9	-	6.9	-	3.5	-	3.3	-	6.3	-
50	7.1	25	10.0	25	2.4	0	3.3	25	2.8	25
51	4.5	-	2.3	-	2.3	-	3.8	-	4.0	-
52	4.9	-	5.1	-	4.7	-	4.0	-	3.1	-
53	5.0	-	3.0	-	4.2	-	2.5	-	3.3	-
54	4.4	-	2.0	-	4.7	-	2.8	-	3.4	-
55	3.0	-	2.8	-	3.5	-	4.5	-	3.0	-
56	4.2	-	4.1	-	3.7	-	4.1	-	4.3	-
57	5.7	-	2.0	-	3.8	-	4.4	-	7.5	-
58	3.9	-	2.1	-	4.4	-	4.4	-	4.8	-
59	6.5	-	5.9	-	2.4	-	3.2	-	2.9	-
60	5.0	25	5.6	50	3.0	25	3.7	0	2.2	25
61	4.3	-	5.1	-	2.4	-	4.9	-	4.4	-
62	4.7	-	5.5	-	4.2	-	3.4	-	4.4	-
63	5.1	-	4.1	-	3.2	-	2.5	-	4.9	-
64	3.0	-	5.0	-	4.1	-	3.2	-	3.0	-
65	2.2	-	7.0	-	2.5	-	3.4	-	3.0	-
66	4.0	-	6.6	-	3.6	-	2.0	-	4.9	-
67	3.6	-	6.7	-	2.9	-	2.4	-	3.9	-
68	3.5	-	8.8	-	2.4	-	5.0	-	4.5	-
69	3.0	-	4.1	-	2.2	-	6.5	-	5.6	-
70	4.1	25	4.7	25	2.8	0	8.6	0	2.4	0
71	3.8	-	5.5	-	2.4	-	6.6	-	3.3	-
72	4.8	-	4.0	-	2.2	-	5.6	-	3.9	-
73	2.9	-	2.5	-	3.1	-	3.4	-	3.2	-
74	3.8	-	3.8	-	2.7	-	4.2	-	4.5	-
75	4.0	-	5.4	-	2.4	-	5.9	-	4.0	-
76	2.4	-	6.5	-	2.9	-	2.0	-	3.0	-
77	3.0	-	3.0	-	3.0	-	5.0	-	2.1	-
78	3.8	-	6.6	-	2.5	-	2.7	-	4.0	-
79	2.1	-	4.3	-	2.5	-	3.7	-	2.5	-
80	4.5	0	5.8	25	2.0	0	2.9	25	4.3	25
81	2.0	-	4.8	-	3.9	-	3.1	-	3.0	-
82	3.0	-	2.0	-	2.4	-	4.9	-	3.8	-
83	2.2	-	4.5	-	2.1	-	4.0	-	4.0	-
84	5.5	-	5.2	-	2.6	-	4.4	-	4.4	-
85	5.0	-	4.5	-	3.8	-	4.4	-	3.4	-
86	2.0	-	4.7	-	2.4	-	4.5	-	4.0	-
87	3.9	-	4.2	-	2.3	-	7.2	-	4.7	-
88	4.8	-	2.3	-	2.4	-	4.4	-	4.0	-
89	4.0	-	5.0	-	2.0	-	4.0	-	4.7	-
90	2.4	0	5.0	25	2.0	25	4.5	0	2.0	25
91	4.5	-	4.7	-	2.2	-	5.3	-	3.0	-
92	5.0	-	4.8	-	2.1	-	3.8	-	2.5	-
93	4.6	-	3.6	-	2.0	-	5.0	-	2.4	-
94	4.1	-	4.0	-	3.0	-	4.3	-	2.3	-
95	2.1	-	4.1	-	4.5	-	5.0	-	4.5	-
96	2.6	-	3.3	-	2.2	-	4.9	-	3.1	-
97	3.8	-	5.0	-	2.0	-	3.2	-	2.5	-
98	2.2	-	3.1	-	2.0	-	3.2	-	3.0	-
99	2.3	-	4.2	-	2.3	-	4.4	-	2.7	-
100	4.0	0	2.9	25	2.0	25	4.3	0	2.5	0
Minimum	2.0		2.0		2.0		2.0		1.9	
Maximum	12.4		10.1		8.7		9.7		7.5	
Mean	4.6		5.0		3.8		4.6		3.8	
Geometric mean	4.3		4.7		3.5		4.3		3.6	
Median	4.2	25	4.8	25	3.6	25	4.4	13	3.8	25

Notes: The intermediate axis is measured perpendicular to the longest axis and is the axis in which the substrate rolls downstream. Embeddedness refers to how deeply the rock is surrounded or buried by other substrate.

APPENDIX E
BENTHIC INVERTEBRATE COMMUNITY DATA

Laboratory Reports

BENTHIC INVERTEBRATE COMMUNITY ANALYSIS

PROVIDED BY:

CORDILLERA CONSULTING

(SUMMERLAND, BC)

Methods and QC Report 2019

Project ID: Minto WUL

Client: Minnow Environmental

Cordillera
Consulting

Prepared by:

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Sample Reception

On September 25, 2018, Cordillera Consulting received 15 from Minnow Environmental. When samples arrived to Cordillera Consulting, exterior packaging was initially inspected for damage or wet spots that would have indicated damage to the interior containers.

Samples were logged into a proprietary software database (INSTAR1) where the clients assigned sample name was recorded along with a Cordillera Consulting (CC) number for cross-reference. Each sample was checked to ensure that all sites and replicates recorded on field sheets or packing lists were delivered intact and with adequate preservative. Any missing, mislabelled or extra samples were reported to the client immediately to confirm the total numbers and correct names on the sample jars. The client representative was notified of the arrival of the shipment and provided a sample inventory once intake was completed.

See table below for sample inventory:

Table 1: Summary of sample information including Cordillera Consulting (CC) number

Site	Sample	CC#	Date	Size	# of Jars
LMC	LMC-1	CC191354	9/11/2018	500µM	1
LMC	LMC-2	CC191355	9/6/2018	500µM	1
LMC	LMC-3	CC191356	9/6/2018	500µM	1
LMC	LMC-4	CC191357	9/6/2018	500µM	1
LMC	LMC-5	CC191358	9/6/2018	500µM	1
LBC	LBC-1	CC191359	9/7/2018	500µM	1
LBC	LBC-2	CC191360	9/7/2018	500µM	1
LBC	LBC-3	CC191361	9/7/2018	500µM	1
LBC	LBC-4	CC191362	9/7/2018	500µM	1
LBC	LBC-5	CC191363	9/7/2018	500µM	1
LWC	LWC-1	CC191364	9/10/2018	500µM	1

LWC	LWC-2	CC191365	9/10/2018	500µM	1
LWC	LWC-3	CC191366	9/8/2018	500µM	1
LWC	LWC-4	CC191367	9/8/2018	500µM	1
LWC	LWC-5	CC191368	9/8/2018	500µM	1

Sample Sorting

- Using a gridded Petri dish, fine forceps and a low power stereo-microscope (Olympus, Nikon, Leica) the sorting technicians removed the invertebrates and sorted them into family/orders.
- The sorting technician kept a running tally of total numbers excluding organisms from Porifera, Nemata, Platyhelminthes, Ostracoda, Copepoda, Cladocera and terrestrial drop-ins such as aphids. These organisms were marked for their presence (given a value of 1) only and left in the sample. They were not included towards the 300-organism subsample count.
- Where specimens are broken or damaged, only heads were counted.
- Subsampling was conducted with the use of a Marchant Box.
- When using the Marchant box, cells were extracted at the same time in the order indicated by a random number table. If the 300th organism was found part way into sorting a cell then the balance of that cell was sorted. If the organism count had not reached 300 by the 50th cell then the entire sample was sorted.
- The total number of cells sorted and the number of organisms removed were recorded manually on a bench sheet and then recorded into INSTAR1
- Organisms were stored in vials containing 80% ethanol and an interior label indicating the site names, date of sampling, site code numbers and portion subsampled. This information was also recorded on the laboratory bench sheet and on INSTAR1.
- The sorted portion of the debris was preserved and labeled separately from the unsorted portion and was tested for sorting efficiency (Sorting Quality Control – Sorting Efficiency). The unsorted portion was also labeled and preserved in separate jars.

Percent sub-sampled and total countable invertebrates pulled from the samples were summarized in the table below.

Table 2: Percent sub-sample and invertebrate count for each sample

Sample	Date	CC#	500 micron fraction	
			% Sampled	# Invertebrates
LMC-1	11-Sep-18	CC191354	100%	539
LMC-2	06-Sep-18	CC191355	100%	230
LMC-3	06-Sep-18	CC191356	100%	62
LMC-4	06-Sep-18	CC191357	100%	367
LMC-5	06-Sep-18	CC191358	50%	367
LBC-1	07-Sep-18	CC191359	100%	188

LBC-2	07-Sep-18	CC191360	100%	57
LBC-3	07-Sep-18	CC191361	100%	365
LBC-4	07-Sep-18	CC191362	100%	191
LBC-5	07-Sep-18	CC191363	100%	292
LWC-1	10-Sep-18	CC191364	100%	221
LWC-2	10-Sep-18	CC191365	100%	26
LWC-3	08-Sep-18	CC191366	100%	126
LWC-4	08-Sep-18	CC191367	100%	174
LWC-5	08-Sep-18	CC191368	100%	154

Sorting Quality Control - Sorting Efficiency

As a part of Cordillera's laboratory policy, all projects undergo sorting efficiency checks.

- As sorting progresses, 10% of samples were randomly chosen by senior members of the sorting team for resorting.
- All sorters working on a project had at least 1 sample resorted by another sorter.
- An efficiency of 90 % was expected (95% for CABIN samples).
- If 90/95% efficiency was not met, samples from that sorter were resorted.
- To calculate sorting efficiency the following formula was used:

$$\frac{\#OrganismsMissed}{TotalOrganismsFound} * 100 = \%OM$$

Table 3: Summary of sorting efficiency

CC #	Number of Organisms Recovered (initial sort)	Number of Organisms in Re-sort	Percent Recovery
CC191360	57	1	98%
CC191368	154	3	98%
Average Recovery			98%

Sorting Quality Control - Sub-Sampling QC

Certain Provincial and Mining projects require additional sorting checks in the form of sub-sampling QC, (Environmental Effects Monitoring (EEM) protocol). This ensured that any fraction of the total sample that was examined was actually an accurate representation of the number of total organisms. Organisms from the additional sub-samples were not identified; rather total organism count only was compared.

Sub-Sampling efficiency was measured on 10% of the number of sub-sampled samples in the project. Ex. In a project where 50 of 100 total samples were processed through subsampling using a Marchant box, then 10% of 50; or 5 samples were used for sub sampling efficiency.

Sub-Sampling efficiency was performed by fractioning the entire sample into sub-sample percentages. On each sub-sampled portion, a total organism count was recorded and compared to the rest of the sub-samples. In order to pass, all fractions were required to be within 20% of total organism count.

Example: If 300 organisms are found in 10% of the sample, the sorter will continue to sample in 10% fractions until the entire sample is separated. They will then count the total number of organisms in each of the 10 fractions of 10% and compare the organism count.

When divergence is >20% the sorting manager examines for the source of the problem and takes steps to correct it. With the Marchant box, the problem typically rested with how the box is flipped back to the upright position. For this reason subsampling was performed by experienced employees only. Another common source of area would be the type of debris in the sample. Samples with algae or heavy with periphyton have a higher incident of failure due to clumping than clear samples.

Table 4: Summary of Sub Sample efficiency

Station ID		Organisms in Subsample																				Sorter		Actual Total	Precision Error		Accuracy Error	
CC#	Sample Name																					By	Time		Min (%)	Max (%)	Min (%)	Max (%)
191358	LMC-5	375	356																			DS	140	731	5.07	5.07	2.60	2.60

Taxonomic Effort

The next procedure was the identification to genus-species level where possible of all the organisms in the sample.

- Identifications were made at the genus/species level for all insect organisms found including Chironomidae (Based on CABIN protocol).
- Non-insect organisms (except those not included in CABIN count) were identified to genus/species where possible and to a minimum of family level with intact and mature specimens.
- The Standard Taxonomic Effort lists compiled by the CABIN manual¹, SAFIT², and PNAMP³ were used as a guide line for what level of identification to achieve where the condition and maturity of the organism enabled.
- Organisms from the same families/order were kept in separate vials with 80% ethanol and an interior label of printed laser paper.
- Chironomidae was identified to genus/species level where possible and was aided by slide mounts. CMC-10 was used to clear and mount the slide.
- Oligochaetes was identified to family/genus level with the aid of slide mounts. CMC-10 was used to clear and mount the slide.
- Other Annelida (leeches, polychaetes) were identified to the family/genus/species level with undamaged, mature specimens.
- Mollusca was identified to family and genus/species where possible
- Decapoda, Amphipoda and Isopoda were identified at family/genus/species level where possible.
- Bryozoans and Nemata remained at the phylum level
- Hydrachnidae and Cnidaria were identified at the family/genus level where possible.
- When requested, reference collections were made containing at least one individual from each taxa listed. Organisms represented will have been identified to the lowest practical level.
- Reference collection specimens were stored in 55 mm glass vials with screw-cap lids with polyseal inserts (museum quality). They were labeled with taxa name, site code, date identified and taxonomist name. The same information was applied to labels on the slide mounts.

Taxonomic QC

The taxonomists for this project were certified by the Society of Freshwater Science (SFS) Taxonomic Certification Program at level 2 which is the required certification for CABIN projects:

Scott Finlayson: Group 1 General Arthropods (East/West); Group 2 EPT (East/West);
Group 3 Chironomidae (East/West); Group 4 Oligochaeta

Adam Bliss: Group 1 General Arthropods (East/West); Group 2 EPT (East/West);
Group 3 Chironomidae

Rita Avery: Group 1 General Arthropods (East/West); Group 2 EPT (East/West)

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² Southwest Association of Freshwater Invertebrate Taxonomists. (2015). www.safit.org

³ Pacific Northwest Aquatic Monitoring Partnership (Accessed 2015). www.pnamp.org

Taxonomic Keys

Below is a reference list of taxonomic keys utilized by taxonomists at Cordillera Consulting. Cordillera taxonomists routinely seek out new literature to ensure the most accurate identification keys are being utilized. This is not reflective of the exhaustive list of resources that we use for identification. A more complete list of taxonomic resources can be found at Southwest Association of Freshwater Invertebrate Taxonomists. (2015).

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Project: Minto WUL 2018
Minnow Environmental (BC), Pierre Stecko Lisa Bowron; Katharina Batchelar
Taxonomist: Scott Finlayson
scottfinlayson@cordilleraconsulting.ca
250-494-7553

	Site:	LMC	LMC	LMC	LMC	LMC	LBC	LBC	LBC	LBC	LBC	LWC	LWC	LWC	LWC	LWC
	Sample:	LMC-1	LMC-2	LMC-3	LMC-4	LMC-5	LBC-1	LBC-2	LBC-3	LBC-4	LBC-5	LWC-1	LWC-2	LWC-3	LWC-4	LWC-5
Sample Collection Date:		11-Sep-18	06-Sep-18	06-Sep-18	06-Sep-18	06-Sep-18	07-Sep-18	07-Sep-18	07-Sep-18	07-Sep-18	07-Sep-18	10-Sep-18	10-Sep-18	08-Sep-18	08-Sep-18	08-Sep-18
CC#:		CC191354	CC191355	CC191356	CC191357	CC191358	CC191359	CC191360	CC191361	CC191362	CC191363	CC191364	CC191365	CC191366	CC191367	CC191368
Phylum: Arthropoda		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Order: Collembola		0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Family: Entomobryidae		0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Family: Isotomidae		0	0	0	0	22	0	0	1	0	0	0	0	0	0	0
Family: Onychiuridae		8	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Hexapoda		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Class: Insecta		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Order: Ephemeroptera		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Family: Ameletidae		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<u>Ameletus</u>		0	0	0	0	0	0	0	1	2	0	0	0	0	0	1
Family: Baetidae		4	0	1	1	2	3	0	2	1	2	0	6	2	0	2
<u>Acentrella</u>		0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
<u>Baetis</u>		23	10	1	38	72	11	8	3	8	3	9	0	0	6	13
<u>Baetis fuscatus gr.</u>		0	0	0	0	0	0	0	0	0	0	0	0	0	2	1
<u>Baetis rhodani group</u>		6	0	0	0	0	0	0	1	0	0	0	0	0	0	0
<u>Baetis bicaudatus</u>		0	7	1	9	16	0	0	0	0	0	0	0	0	0	0
Family: Ephemerellidae		0	0	0	0	2	0	0	0	0	0	1	0	0	1	1
<u>Drunella</u>		0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<u>Drunella doddsii</u>		0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
<u>Drunella spinifera</u>		0	0	0	0	0	0	0	0	2	2	0	0	1	1	0
<u>Ephemerella</u>		0	0	0	0	0	4	0	0	0	1	3	0	0	1	0
<u>Ephemerella excrucians complex</u>		0	0	0	0	0	0	0	0	2	1	0	0	1	4	1
Family: Heptageniidae		0	0	0	1	0	28	4	84	58	43	2	0	4	1	3
<u>Cinygmula</u>		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<u>Rhithrogena</u>		0	0	0	0	0	0	0	0	3	1	0	0	0	0	0
Order: Plecoptera		0	0	8	0	0	0	0	0	1	0	0	0	0	0	1
Family: Capniidae		0	0	0	0	2	9	3	27	8	12	0	0	1	1	1
Family: Chloroperlidae		0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
<u>Neaviperla</u>		0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
<u>Suwallia</u>		0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
<u>Sweltsa</u>		0	0	0	0	0	0	0	1	1	1	0	0	0	0	0
Family: Nemouridae		39	6	22	19	66	0	1	1	0	0	0	0	0	1	1
<u>Nemoura</u>		0	7	5	28	128	0	0	0	0	0	0	0	0	0	0
<u>Ostrocerca</u>		16	32	6	83	24	0	0	0	0	0	0	0	0	0	0
<u>Zapada cinctipes</u>		0	0	0	0	0	0	0	1	3	2	0	0	1	1	1
Family: Perlodidae		0	0	0	0	0	1	1	1	1	1	3	0	2	1	12
<u>Koqotus</u>		0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Family: Taeniopterygidae		0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
<u>Taenionema</u>		0	0	0	0	0	1	0	0	0	1	0	0	0	0	0
Order: Trichoptera		0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
Family: Brachycentridae		0	0	0	0	0	1	0	0	1	1	1	0	0	0	0
Family: Glossosomatidae		0	0	0	0	0	1	0	0	0	0	1	0	0	0	1
<u>Glossosoma</u>		0	0	0	0	0	0	0	0	0	0	1	0	0	1	0
Family: Lepidostomatidae		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<u>Lepidostoma</u>		0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Family: Limnephilidae		0	0	0	16	6	0	0	1	0	0	1	0	0	2	1
<u>Dicosmoecus</u>		0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Family: Polycentropodidae		0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Family: Rhyacophilidae		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<u>Rhyacophila</u>		0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Order: Coleoptera		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Family: Dytiscidae		1	0	0	0	2	0	0	0	0	0	0	0	0	0	0
<u>Oreodytes</u>		0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Order: Diptera		0	0	0	0	2	0	0	7	0	1	1	0	0	0	1
Family: Ceratopogonidae		0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
<u>Ceratopogon</u>		0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
Family: Chironomidae		10	19	0	5	8	27	7	18	9	10	35	3	39	46	29
Subfamily: Chironominae		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tribe: Tanytarsini		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<u>Micropsectra</u>		0	1	0	0	4	0	0	0	0	0	0	0	0	0	0
<u>Paratanytarsus</u>		0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
<u>Rheotanytarsus</u>		0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Subfamily: Diamesinae		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tribe: Diamesini		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<u>Diamesa</u>		276	74	0	10	38	1	0	0	0	0	0	0	0	0	0
<u>Paqastia</u>		0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
<u>Potthastia</u>		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<u>Potthastia longimana group</u>		0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
<u>Pseudodiamesa</u>		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subfamily: Orthocladiinae		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<u>Eukiefferiella</u>		36	7	1	48	166	5	3	1	3	1	16	1	9	9	14
<u>Limnophyes</u>		5	2	1	0	0	0	0	0	0	0	2	0	0	1	0
<u>Metriocnemus</u>		2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<u>Orthocladius complex</u>		5	1	1	5	18	81	21	164	79	163	57	3	51	66	27
<u>Smittia</u>		1	0	0	0	0	0	0	2	0	0	0	0	0	2	0
<u>Tvetenia</u>		4	2	0	0	6	0	0	0	0	1	2	3	6	15	9

Project: Minto WUL 2018
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Site:	LMC	LMC	LMC	LMC	LMC	LBC	LBC	LBC	LBC	LBC	LWC	LWC	LWC	LWC	LWC
Sample:	LMC-1	LMC-2	LMC-3	LMC-4	LMC-5	LBC-1	LBC-2	LBC-3	LBC-4	LBC-5	LWC-1	LWC-2	LWC-3	LWC-4	LWC-5
Sample Collection Date:	11-Sep-18	06-Sep-18	06-Sep-18	06-Sep-18	06-Sep-18	07-Sep-18	07-Sep-18	07-Sep-18	07-Sep-18	07-Sep-18	10-Sep-18	10-Sep-18	08-Sep-18	08-Sep-18	08-Sep-18
CC#:	CC191354	CC191355	CC191356	CC191357	CC191358	CC191359	CC191360	CC191361	CC191362	CC191363	CC191364	CC191365	CC191366	CC191367	CC191368
Family: Empididae	1	0	1	0	4	1	0	1	0	1	0	1	0	0	0
<i>Clinocerinae Unknown Genus A</i>	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
<i>Neoplasta</i>	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
Family: Ephydriidae	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
Family: Psychodidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Pericoma/Telmatoscopus</i>	0	0	0	2	2	0	0	0	0	0	0	0	0	0	1
Family: Simuliidae	5	7	3	6	14	0	1	0	1	2	0	0	2	1	10
<i>Simulium</i>	59	29	8	37	54	1	0	0	0	0	0	0	0	0	5
Family: Tabanidae	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Family: Tipulidae	0	0	0	2	2	2	0	0	0	2	0	0	0	0	0
<i>Dicranota</i>	0	0	0	5	4	1	0	0	0	0	0	0	0	0	0
<i>Rhabdomastix</i>	0	0	0	0	0	0	0	0	0	1	0	0	6	0	0
Order: Lepidoptera	0	0	0	0	2	0	0	0	0	1	0	0	0	0	1
Order: Thysanoptera	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0
Subphylum: Chelicerata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Class: Arachnida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Order: Trombidiformes	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Family: Hygrobatidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Atractides</i>	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
<i>Hygrobates</i>	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0
Family: Lebertiidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Lebertia</i>	0	0	0	0	0	1	3	2	0	2	0	3	0	1	0
Family: Sperchontidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Sperchon</i>	16	11	0	40	62	1	1	0	0	0	0	0	0	1	0
Order: Sarcoptiformes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Family: Hydrozetidae	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Phylum: Mollusca	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Class: Gastropoda	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Phylum: Annelida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Clitellata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Class: Oligochaeta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Order: Lumbriculida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Family: Lumbriculidae	16	14	2	3	4	2	1	38	2	20	82	3	0	7	14
<i>Lumbriculus</i>	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Rhynchelmis</i>	0	0	0	3	0	0	0	1	0	1	0	0	0	0	0
Order: Tubificida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Family: Naididae	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
<i>Nais</i>	0	0	0	0	0	1	0	5	4	4	0	0	0	0	0
Totals:	539	230	62	367	734	188	57	365	191	292	221	26	126	174	154

Taxa present but not included:

<i>Terrestrials</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Phylum: Arthropoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Crustacea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Class: Ostracoda	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Phylum: Nemata	1	1	1	1	2	1	0	1	0	1	0	0	0	1	0
Phylum: Platyhelminthes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Class: Turbellaria	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Totals:	1	1	1	3	2	1	0	1	0	1	0	0	0	2	0



Project: Minto WUL 2018

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Total from Sample Percent Efficiency

Site - QC, Sample - QC1, CC# - CC191360, Percent sampled = 100%, Sieve size = 500

Oligochaeta	1		
Total:	1	57	98%

Site - QC, Sample - QC2, CC# - CC191368, Percent sampled = 100%, Sieve size = 500

Chironomidae	1		
Oligochaeta	1		
Collembola	1		
Total:	3	154	98%

Appendix L – Minto Creek Fish Monitoring Program Review and Recommendations



Minto Mine
Fisheries Monitoring Program
2018 Summary Report

December 2018

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1. Introduction

Minto Explorations Ltd. (MEL), a wholly owned subsidiary of Capstone Mining Corp., owns and operates the Minto Mine, a high-grade copper mine, located approximately 240 km northwest of Whitehorse, Yukon Territory (Figure 1-1). The project is located within Selkirk First Nation (SFN) Category A Settlement Land Parcel R6A, and is centered at approximately 62°37'N latitude and 137°15'W longitude. The Minto Mine commenced commercial operation in October 2007 and is permitted to conduct mining and milling operations at a rate of 4,200 tonnes of ore per day (tpd). Some of the Minto ore deposits (copper/gold/silver) currently being mined are located in the upper reaches of the Minto Creek watershed approximately 12 km to the west of the Minto Creek confluence with the Yukon River (Figure 1-2). As of November 2018, Minto is under temporary closure and all mining activity is ceased. The mine is under care and maintenance and is still bound to complying with the Water Use License requirements.

MEL is required, under the terms of its water use license #QZ14-031 (Amendment 1), to conduct an aquatic environmental monitoring program, of which this fisheries monitoring program in Minto Creek is a component. This current report provides details of the monitoring conducted during the open water season in 2018 and the results of the work undertaken. This program was carried out under DFO Scientific Collection Licence number XR 187 2018.

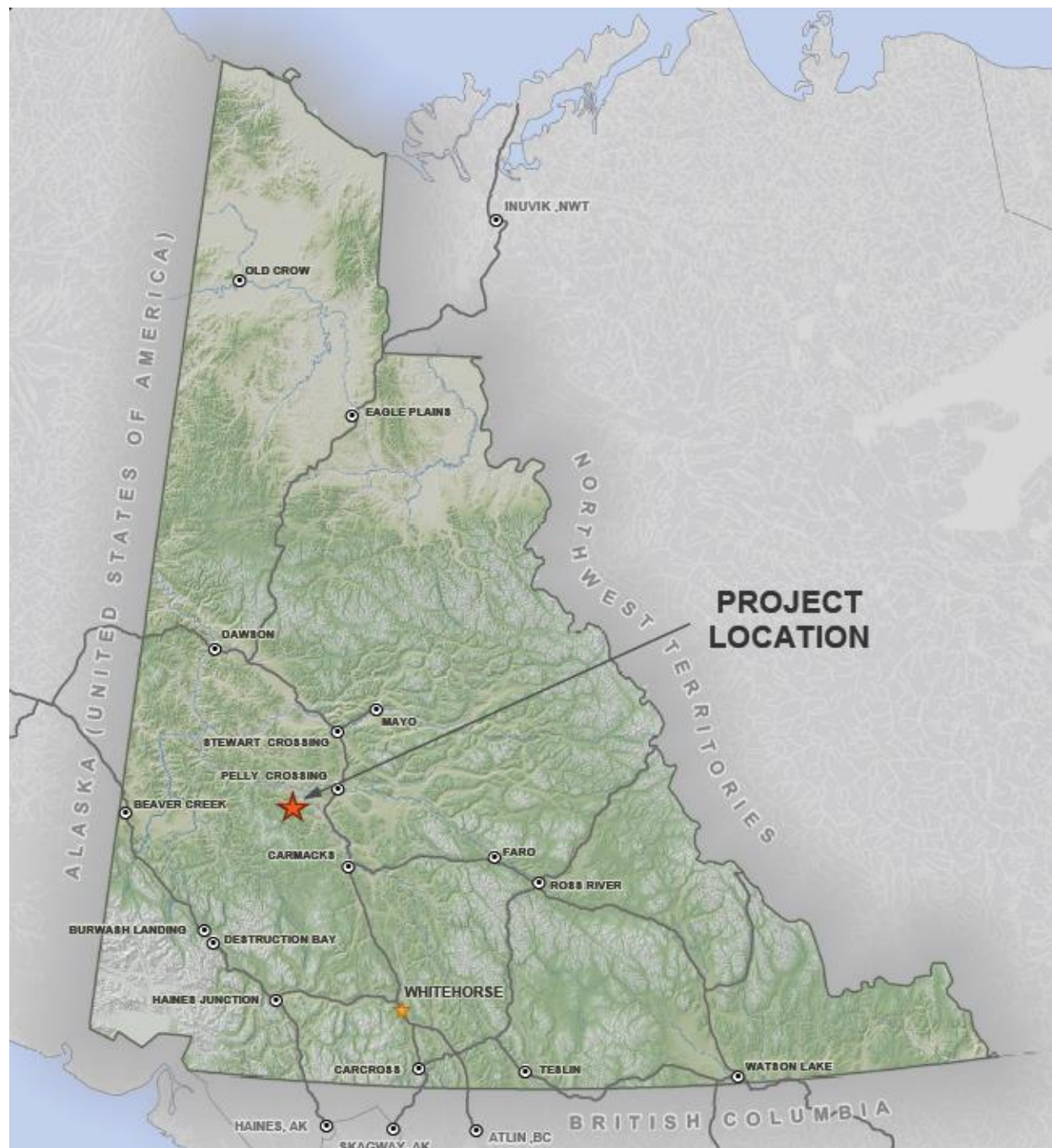


Figure 1-1: Project Location

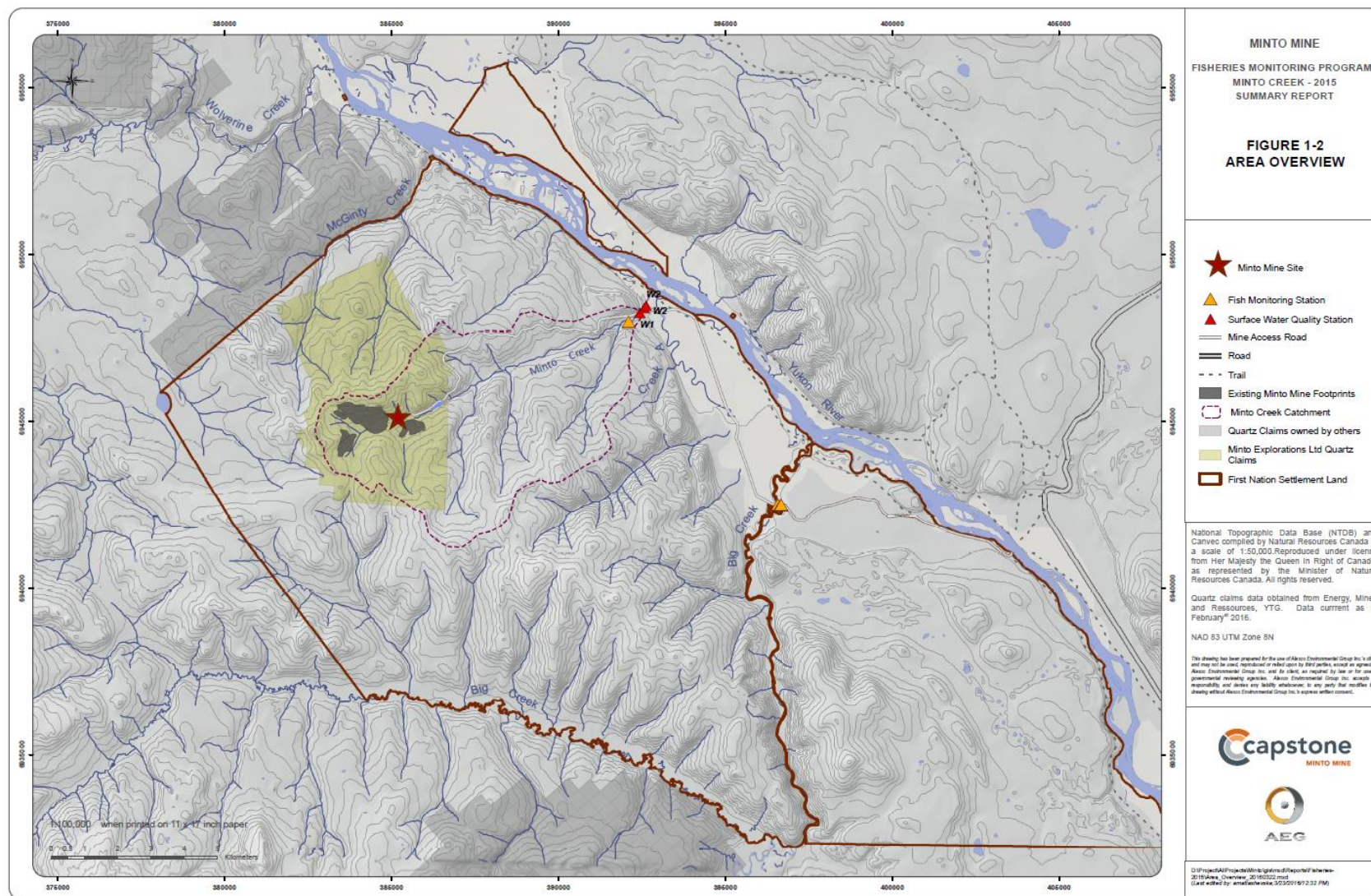


Figure 1-2: Project Overview

2. Previous Studies

Numerous studies on fisheries and fish habitat have been conducted over the recent history of the Minto Mine. These studies are summarized chronologically in Table 2-1, below.

Table 2-1: Minto Creek Fish Investigations

Year	Months	Purpose of Study	Conducted by
1994	June, August, September	Baseline Collection	Hallam Knight Piesold (HKP)
2006	September	Baseline Collection	Access Consulting Group (ACG)
2007	May, June, August, September	Environmental Effects Monitoring Study Design Development	ACG / Minnow Environmental (Minnow)
2008	June, September	Environmental Effects Monitoring, Cycle I	ACG / Minnow
2009	June, July	Monitoring	ACG
2009	September, October	Fish Re-location	ACG
2010	June - October	Juvenile Chinook Salmon Mark-recapture program, compliance Monitoring	ACG
2011	July - October	Environmental Effects Monitoring Cycle II, Compliance Monitoring	ACG, Minnow
2011	July, August	EEM Cycle II – Growth Trials	ACG, Minnow
2012	May - September	Compliance Monitoring Se in tissue study	ACG, MEL (Minto Exploration Ltd.)
2013-2015	May - October	Compliance Monitoring	ACG/AEG, MEL
2016	June - September	Compliance Monitoring	MEL, AEG
2017	June – September	Compliance Monitoring	MEL

Attempts to collect fish in lower Minto Creek while conducting the Phase 1 Metal Mining Effluent Regulation (MMER), Environmental Effects Monitoring (EEM) study in 2008 resulted in the capture of no fish during the entire fisheries program (June – September). This is consistent with the findings of previous fish investigations conducted in the creek (HKP 1994; R&D 2006, 2007). Fish use of Minto Creek is transient and likely short-lived, as has been found in other non-natal chinook rearing creeks (Walker 1976; Scrivener et al. 1994).

The majority of fish previously using the creek system are juvenile chinook salmon (*Onchorynchus tshawytscha*), as determined by the above investigations. Other species that have been found in the creek in low numbers include round whitefish (*Prosopium cylindraceum*), Arctic grayling (*Thymallus arcticus*), Slimy sculpin (*Cottus cognatus*) and Burbot (*Lota lota*). Of these, only slimy sculpin have been captured on a regular basis.

Juvenile chinook salmon (JCS) have never been encountered in the creek before July and their numbers tend to peak in late August or early September. Moreover, the mark-recapture investigation conducted in 2010 on JCS indicates that use of the creek is transient. The majority of JCS using the system stay in the creek for about two to three weeks or less.

A summary of past fish sampling results in Minto Creek is presented in Table 2-2.

Table 2-2: Summary of Fish captures in Minto Creek between 2008 and 2017

Year	Method	Effort	Summary Statistics	Units	Juvenile Chinook Salmon	All Other Species
2008	Backpack Electrofishing	796 secs	Catch	#	1	0
			CPUE	Fish/min	0.075	0
	Baited Gee Minnow Trapping	28.6 days	Catch	#	18	0
			CPUE	Fish/day	0.63	0
2009	Baited Gee Minnow Trapping	28.6 days	Catch	#	136	142
			CPUE	Fish/day	4.76	4.97
2010	Baited Gee Minnow Trapping	145.9 days	Catch	#	2293	2307
			CPUE	Fish/day	15.72	15.81
2011	Baited Gee Minnow Trapping	71 days	Catch	#	12	29
			CPUE	Fish/day	0.17	0.41
2012	Backpack Electrofishing	1051 secs	Catch	#	0	4
			CPUE	Fish/min	0	0.23
	Baited Gee Minnow Trapping	43 days	Catch	#	3	6
			CPUE	Fish/day	0.07	0.14
2013	Backpack Electrofishing	3402 secs	Catch	#	0	4
			CPUE	Fish/min	0	0.07
	Baited Gee Minnow Trapping	62.5 days	Catch	#	121	7
			CPUE	Fish/day	1.94	0.11
2014	Baited Gee Minnow Trapping	70.2 days	Catch	#	151	3
			CPUE	Fish/day	2.15	0.04
2015	Baited Gee Minnow Trapping	67.3 days	Catch	#	6	0
			CPUE	Fish/day	0.089	0
2016	Baited Gee Minnow Trapping	69.3 days	Catch	#	6	0
			CPUE	Fish/day	0.086	0
2017	Baited Gee Minnow Trapping	43.3 days	Catch	#	0	0
			CPUE	Fish/day	0.000	0

JCS presence in Minto creek was observed to be influenced by mine water discharge. During non-discharge periods, and prior to operations (baseline), numbers of JCS and other species of fish in the system were found to be very low. In contrast, during the two major discharge events (2009 and 2010), numbers of JCS were 20 to 30 times higher in the system (see Table 2-3 below), indicating that they may

have been attracted into the system as a likely result of a more consistent temperature and flow regime associated with mine water discharge. Numbers of other species of fish during discharge events did not increase. It is important to note however, that numbers of other species using the system has been consistently very low, prior to mine development and during operations.

Table 2- 3: Maximum Catch per Unit Effort (CPUE) of Juvenile Chinook Salmon in Minto Creek using baited Minnow traps 1994-2018

Year	Month	JCS – CPUE (#fish/trap-day)*	Minto Creek Conditions
1994	September	0	Pre-development – no discharge
2008	September	0.9	Operational – no discharge
2009	September/October	20.0	Discharge
2010	August	30.0	Discharge
2011	September	0.43	No discharge – high TSS contribution from tributary
2012	September	0.19	No discharge – high TSS contribution from tributary
2013	October	5.01	Operational – no discharge
2014	September	5.05	Operational – no discharge
2015	July	0.30	Operational – no discharge
2016	July	0.30	Operational – no discharge
2017	June-September	0.00	Discharge only during June trapping

**CPUE calculated for actual 24-hr period (rather than nominal 24-hr period)*

Minto Creek does not provide preferred spawning habitat for fish because it completely freezes during winter months with no flow in lower Minto Creek. Accordingly, there is no evidence of spawning in Minto Creek (HKP 1994; R&D 2006, 2007), nor is there traditional knowledge indicating spawning occurred in the system (HKP 1994). Lower Minto Creek is also subject to low or zero flow conditions during periods in the summer when a portion (or all) of the flow sometimes infiltrates the ground, preventing the establishment of resident fish populations in this section of the stream. A natural barrier to fish passage exists at approximately km 1.2 upstream in Minto Creek from the Yukon River, therefore limiting fish use upstream of the barrier. This barrier is largely comprised of organic debris and can be considered to be temporary as it will likely degrade over time, although it has been consistently observed since it was first

characterized in 2010. Sampling effort has been applied upstream of the barrier during every sampling event since 2010 and resulted in no fish capture. New temporary barriers may also be established in any given year and could occur both upstream and further downstream of the current barrier location. The canyon located upstream of the current barrier however, is a permanent barrier to fish passage due to its high gradient, thus limiting fish habitat to the lower 2.0 km of the system.

Water temperatures tend to remain cooler in Minto Creek than in the Yukon River. This likely deters fish, in particular JCS, from entering the system until creek temperatures approach or equilibrate with the Yukon River. Minto Creek is subject to large diurnal fluctuations in temperature (up to 5°C or more) throughout the open water season. This daily variation is not ideal for fish and may limit their interest in using the creek for rearing.

Creek bottom substrate is comprised mostly of fines (silt/sand) with limited cobble/gravel sections which are more desirable for fish. In addition, significant input of suspended solids from a tributary in 2011 and 2012 may have further limited the use of the system by JCS during those years.

Bottom substrate at the mouth of Minto Creek and at the Yukon River confluence consists primarily of silt and mud which is not considered suitable substrate for salmonid spawning (grayling, salmon etc.). Aerial surveys for spawning fish were conducted in 2011, 2012, 2013 and 2014, and no adult fish were observed spawning near the Minto Creek/Yukon River confluence. No signs were present during the surveys that this area is used for spawning (such as redds or carcasses).

Starting in 2012, the compliance monitoring program included sampling efforts in Big Creek, which serves as a reference site. The same fish species as in Minto Creek were generally observed in Big Creek, and the CPUE has normally been slightly higher in Big Creek. Table 2-4 summarizes fish captures in Big Creek from 2012 to 2017.

Table 2-4: Summary of Fish captures in Big Creek in 2012 to 2017

Year	Method	Effort	Summary Statistics	Units	Juvenile Chinook Salmon	All Other Species
2012	Backpack Electrofishing	273 secs	Catch	#	1	23
			CPUE	Fish/min	0.22	5.05
	Baited Gee Minnow Trapping	11.8 days	Catch	#	7	2
			CPUE	Fish/day	0.59	0.17
2013	Backpack Electrofishing	911 secs	Catch	#	0	27
			CPUE	Fish/min	0	1.78
	Baited Gee Minnow Trapping	14.8 days	Catch	#	19	2
			CPUE	Fish/day	1.28	0.14
2014	Baited Gee Minnow Trapping	16.4 days	Catch	#	96	3
			CPUE	Fish/day	5.86	0.18
2015	Baited Gee Minnow Trapping	17.1 days	Catch	#	58	5
			CPUE	Fish/day	3.39	0.15
2016	Baited Gee Minnow Trapping	22.2	Catch	#	51	11
			CPUE	Fish/day	2.30	0.49
2017	Baited Gee Minnow Trapping	13.4	Catch	#	27	8
			CPUE	Fish/day	2.01	0.60

3. Objectives

The objectives of the 2018 Fisheries Monitoring Program were to monitor, assess and characterize fish usage in Minto Creek during the open water season, and to provide data for the interpretation of the potential role and influence of the Minto Mine on the fish community. The 2018 fisheries program was a continuation of the previous year's components and targeted all species that have previously been encountered, as well as any new species. As part of the monitoring program since 2012, assessments at Big Creek were made concurrently with sampling in Minto Creek, to compare fish use in a neighboring system relative to Minto Creek. Fish monitoring studies were conducted in support of the requirements of Water Use License QZ14-031.

4. Methodology

4.1 Fish Monitoring

Fish monitoring of Minto Creek and Big Creek was conducted monthly during open water season, from June to September 2018, at trapping sites consistent with the 2010 mark-recapture study and the 2011 to 2017 fish monitoring programs (Figure 4-1). Capture effort included the use of Gee-type Minnow traps with 0.635 cm wire mesh size, baited with Yukon River origin chinook salmon roe. 2 to 15 minnow traps were set during each sampling event in Minto Creek, depending on water levels and availability of pools and backwater areas. Four traps were set during each event in Big Creek, near the Minto access road bridge.

All fish captured were identified, enumerated and measured for fork length or total length (± 1 mm), inspected for abnormalities, and released in the vicinity of their trapping location. JCS were also weighed (± 0.01 g) prior to being released.

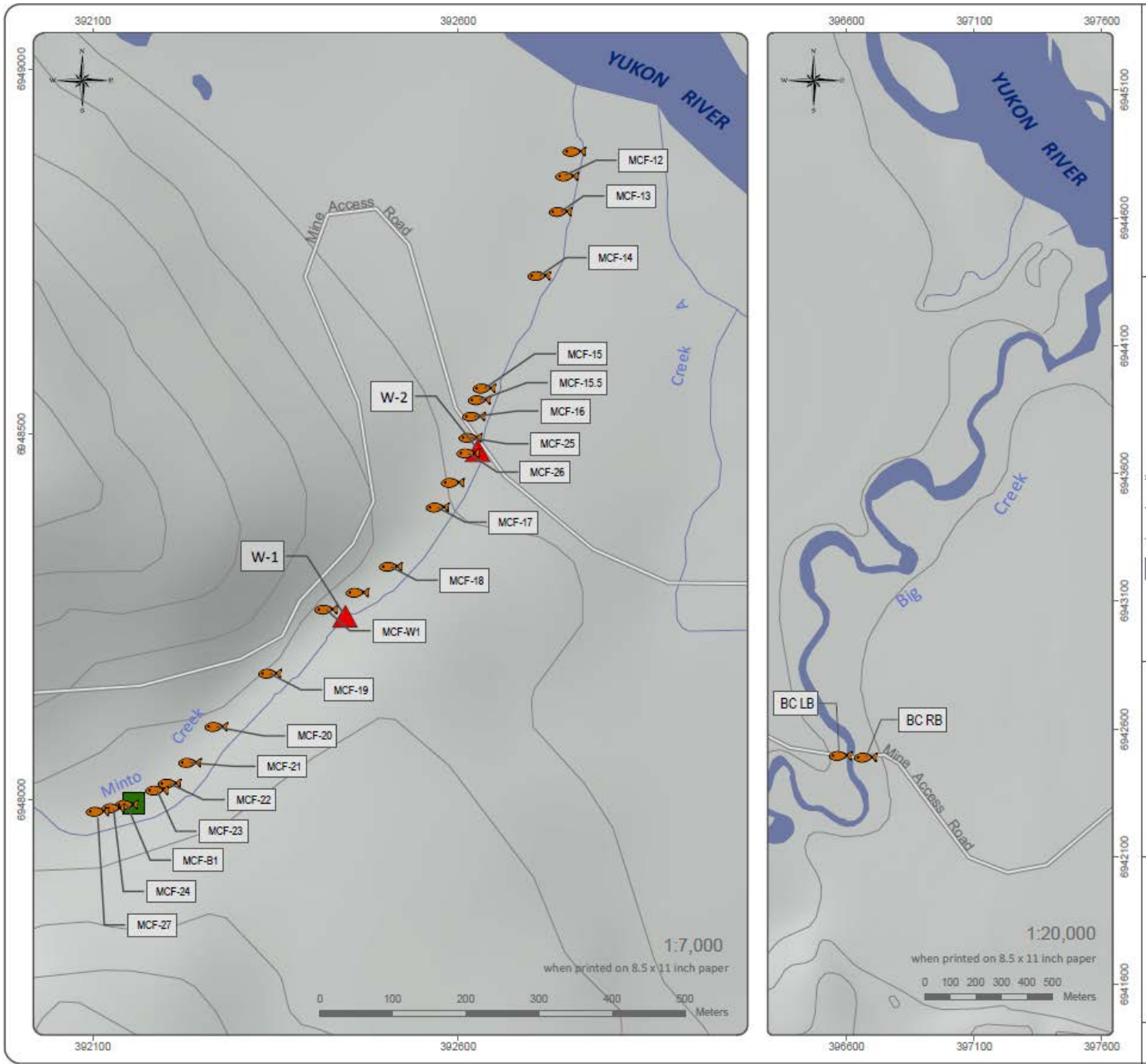
Additional supporting information collected included:

- photo-documentation of the creek,
- water level readings at station W1 staff gauge,
- in situ water parameters in Minto Creek, Big Creek and the Yukon River - temperature, dissolved oxygen, conductivity, pH, ORP,
- flow discharge measured at W1, and once at MC1 due to W1 being dry in July.
- weather conditions at time of sampling.

Continuous temperature loggers (TidbiT) were deployed in the Yukon River and Big Creek for the duration of the project, however the Tidbit from the Yukon river was found to be out of the water on some visits due to low water and human interference. A Levellogger recorded continuous temperature and stage in Minto Creek. Supporting variables also included monitoring of the previously identified fish barrier (1.2 km upstream of the Yukon River confluence) and/or any new barriers that may have developed.

Selected photographs documenting field activities and site conditions are presented in Appendix A.

Figure 4-1: Minto Creek and Big Creek Fisheries Monitoring Stations



5. Results

The following sections present the fisheries statistics and effort in Minto Creek and Big Creek between June and September 2018.

5.1 Fish Usage and Distribution

5.1.1 Minto Creek

Minto Creek was assessed monthly between June and September 2018. No fish were captured in Minto Creek in 2018. A portion of Minto Creek was found to be dry during the fish monitoring event from June and August 2018, which could have played an important role in preventing fish movement up and down Minto Creek. The following table (Table 5-1) presents the effort applied and the summary of fish capture in Minto Creek in 2018.

Table 5-1: Summary Statistics of Minnow Trapping in Minto Creek

Month	Effort (trap-hours)	Effort(trap-days)	Juvenile Chinook Salmon (<i>Onchoryhnchus tshawytscha</i>)	
			Results	CPUE*
June	308	12.8	0	0
July	47.7	2	0	0
August	154.5	6.4	0	0
September	342	14.3	0	0
Total	852.1	41.9	0	0

* CPUE = fish/trap-day (for actual 24-hr period)

5.1.2 Big Creek

Fisheries sampling effort in Big Creek was initiated in June, and conducted monthly until September, concurrent with sampling in Minto Creek, resulting in the capture of 32 fish, 30 of which were JCS. JCS were captured in all sampling events in 2018, with highest numbers fourteen (14) captured in September. In addition, two (2) slimy sculpin were captured during the 2018 sampling season.

The average catch per unit effort for JCS in Big Creek was 0.081 JCS/trap-day and was highest in August (0.152 JCS/trap-day). In comparison, the average JCS CPUE (June to September) in 2017 was higher at 0.090 JCS/trap-day and was as high as 0.165 JCS/trap-day in August 2017. The following table (Table 5-2) presents the effort undertaken and the resulting fish capture in Big Creek in 2018.

Table 6-2: Summary Statistics of Minnow Trapping in Big Creek in 2018

Month	Effort (trap-hours)	Effort (trap-days)	Juvenile Chinook Salmon (<i>Onchoryhnchus tshawytscha</i>)		Slimy Sculpin (<i>Cottus cognatus</i>)	
			Results	CPUE*	Results	CPUE*
June	94	3.9	7	0.074	0	0
July	93.3	3.9	2	0.022	2	0.022
August	90	3.8	7	0.078	0	0
September	92	3.8	14	0.152	0	0

*CPUE = fish/trap-day (for actual 24-hr period)

Figure 5-1 presents a comparison between monthly JCS capture and CPUE in Minto Creek and Big Creek for 2018.

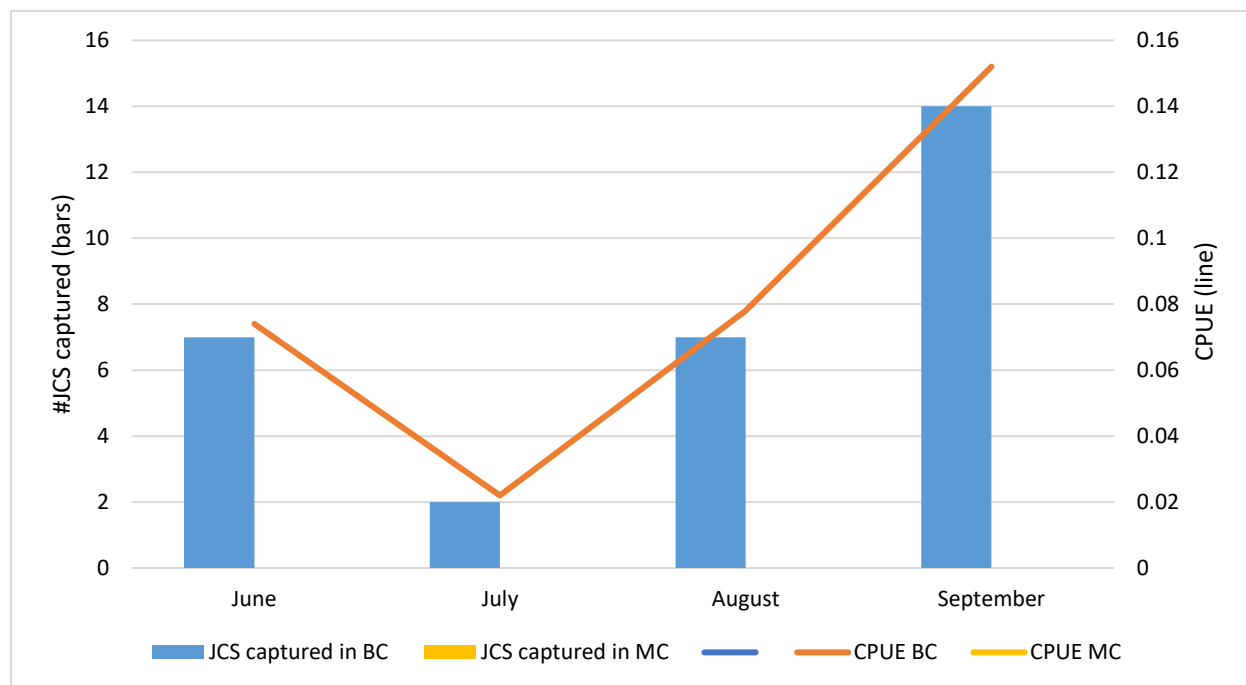


Figure 5-1: Monthly JCS capture in Minto Creek and Big Creek, 2018

5.2 Fish Metrics

Fork lengths of JCS captured in Big Creek ranged from 35 to 82 mm and their weights ranged from 0.98 to 7.40g. There was a notable difference between the JCS lengths and widths during each sampling event. The JCS observed in June were smaller than the JCS captured in September. The lengths and weights observed throughout the season were consistent with 0+ aged fish (young of year).

Figure 5-2 presents the monthly averages for both creeks. Individual results for all fish captured are presented in Appendix B.

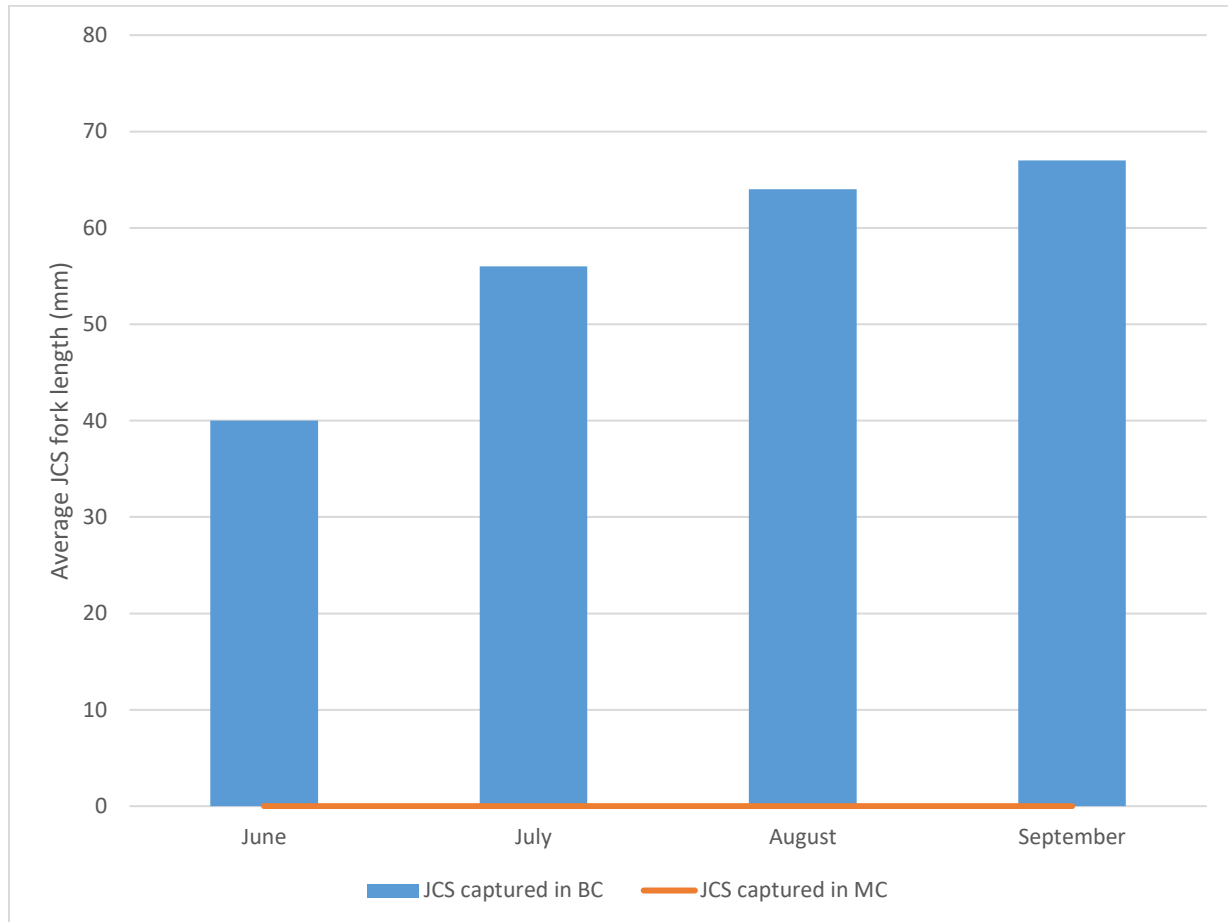


Figure 5-2: Average JCS length (fork) in Big Creek, 2018

5.3 Water Quality Parameters

In situ data was collected in Minto Creek at station W2, and Big Creek (bridge) during each site visit and results are summarized in Table 5-3. In situ data was also collected at the Yukon River (W4) during the June, July and September sampling events. In situ parameters were collected with a YSI Professional Plus multimeter, which was calibrated prior to each trip.

Table 7-3: In situ data from Minto Creek, Big Creek, and Yukon River, 2018

Site	Date	Time	Temperature (°C)	Dissolved Oxygen (%)	Dissolved Oxygen (m/L)	Specific Conductance (µS/cm)	pH
Minto Creek	24-Jun-18	13:55	11.7	103.9	11.28	7.69	160.9
	21-Jul-18	15:45	5.6	57.2	6.91	7.34	195.1
	18-Aug-18	15:05	5	111.6	14.09	7.89	200.4
	15-Sep-18	16:28	1.4	90.8	12.71	8.07	237.2
Big Creek	24-Jun-18	15:55	5.8	102.9	12.87	7.98	165
	20-Jul-18	14:25	11.8	105.4	11.42	8.16	150.8
	18-Aug-18	11:15	8.6	109.8	12.81	7.74	182.1
	15-Sep-18	14:35	3.4	90.1	11.98	7.71	188.4
Yukon River	24-Jun-18	14:35	13.9	103.5	10.68	8.11	136.5
	20-Jul-18	14:50	13.8	103.4	10.67	7.96	159.6
	18-Aug-18	15:00	11.8	119	12.56	7.95	207.8
	15-Sep-18	14:55	6.4	95.3	11.73	7.77	164.1

Tidbit water temperature loggers were deployed in the Yukon River at station W4 (between the barge landing and the mouth of Minto Creek) and in Big Creek (near the bridge) during the open water season, while a continuous logger located at W1 records the water temperature and stage of lower Minto Creek.

Figure 5-3 presents the three temperature curves. This figure indicates that the temperature of Minto Creek is generally colder than that of the Yukon River. The average difference in water temperature over this period between the Yukon River and Big Creek was 2.73°C, while the difference between Big Creek and Minto Creek was 5.94°C.

As shown in figure 5-3 sections of Minto creek ran dry during the fisheries monitoring season. The Yukon river tidbit was also found out of the water on occasion during the season.

The 2018 data record does not indicate that the water temperature of Minto Creek equilibrated with that of the Yukon River during the 2018 open water season, although this has occasionally been observed to happen for a short period in June in the past. In 2013 for example, the maximum water temperature observed in Minto Creek was 15.7°C in late June, at which time the temperature of the Yukon River was very similar. In 2014 and 2015 however, the water temperature in Minto Creek did not exceed 10.6°C and 9.7°C respectively, and did not reach equilibrium with the Yukon River. In 2018 the maximum water temperature observed in Minto Creek was 9.0°C.

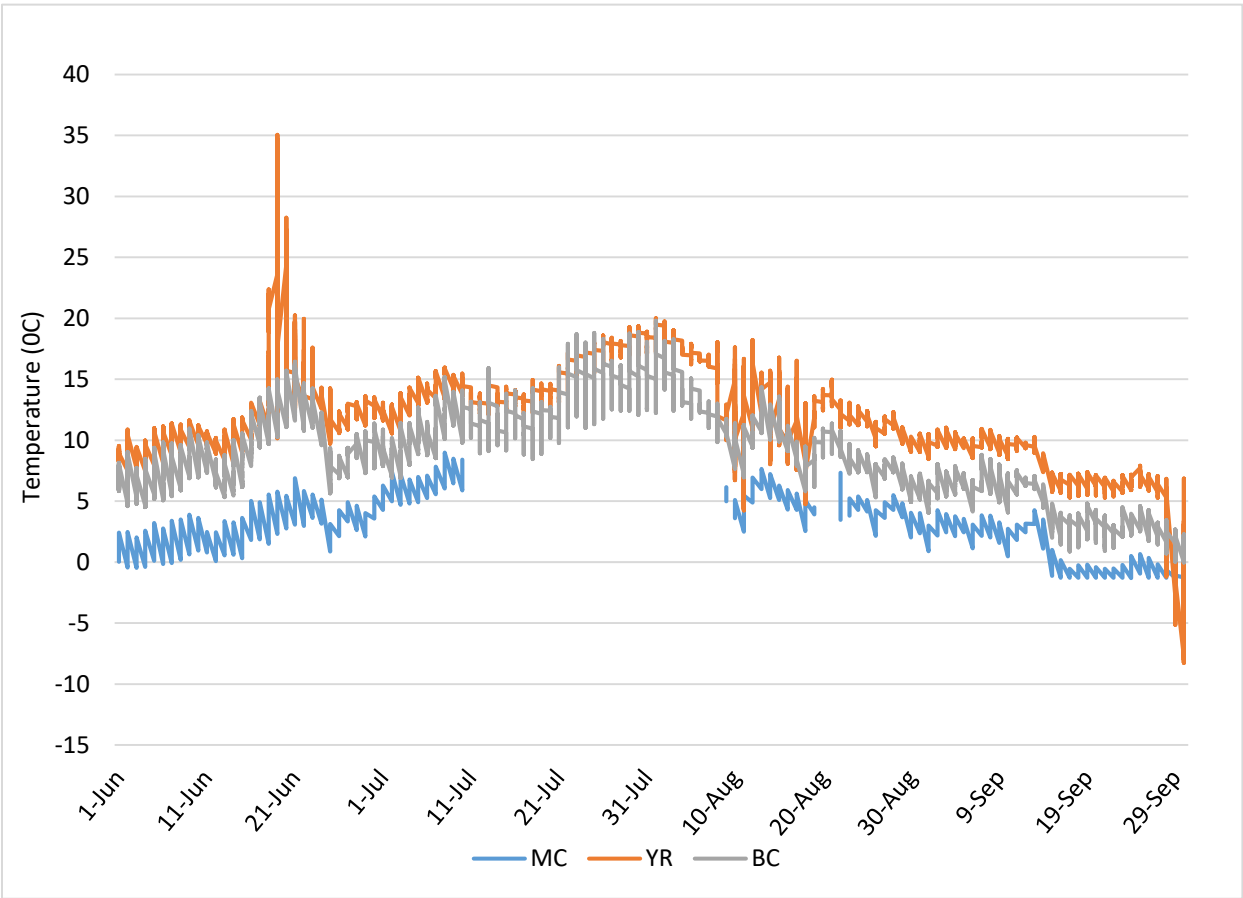


Figure 5-3: Water Temperature, Minto Creek, Big Creek, and Yukon River, 2018

Figure 5-4 presents Total Suspended Solids (TSS) values measured at W2 from June 6th to September 26th, 2018; the dotted line indicates the decreasing trend. As shown in the graph the creek ran dry from July 10th to August 9th and from August 19-22nd during the 2018 Fisheries program season.

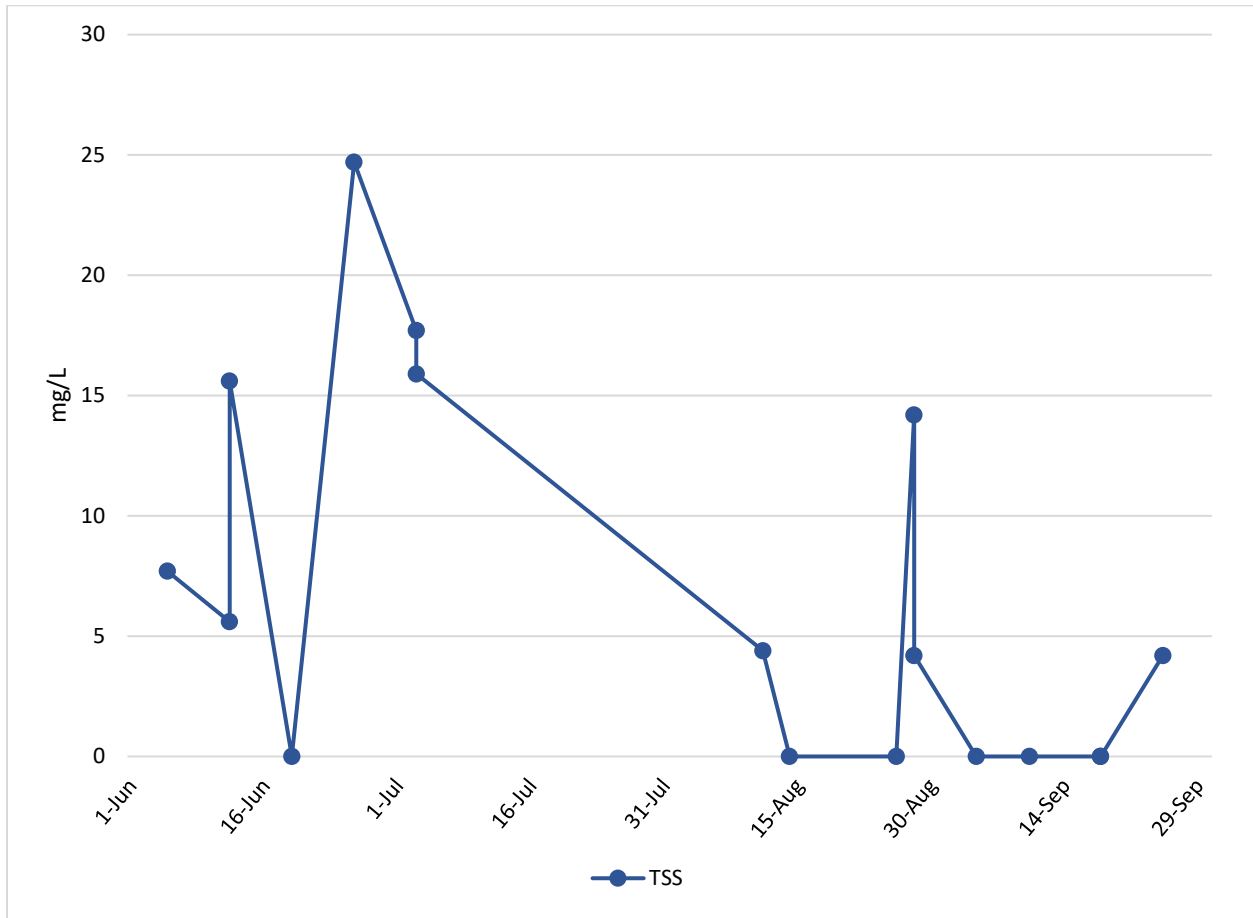


Figure 5-4: Total Suspended Solids (mg/L) measured at W2 in 2018

W2 TSS records for the open water season from 2011 to 2018 are presented in Figure 5-5 for comparison.

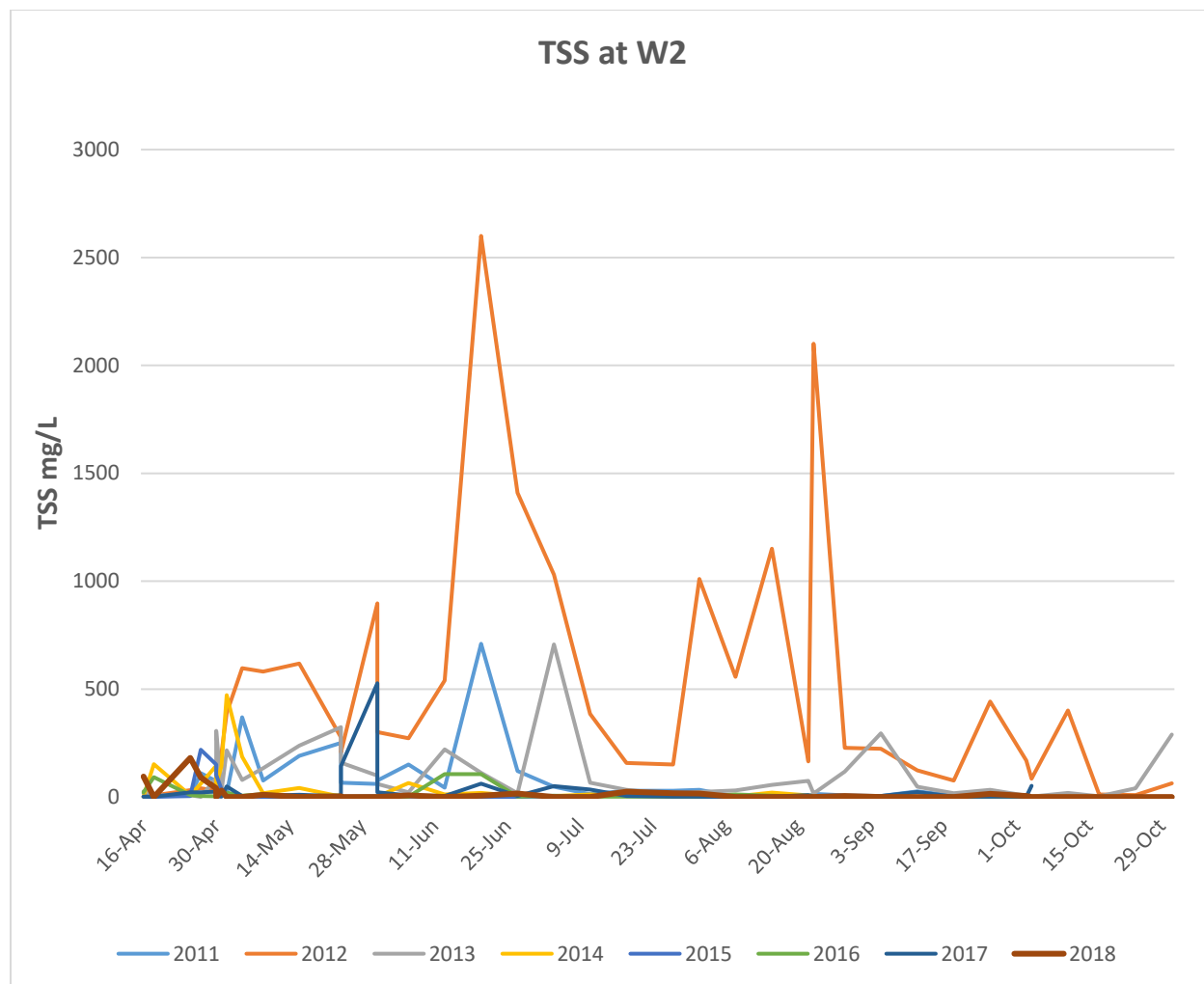


Figure 5-5: Total Suspended Solids (mg/L) measured at W2 during open water, 2011 to 2018

5.4 Stage and Discharge

The staff gauge located at W1 in Minto Creek was read during each trip, and discharge was measured at W1 with a Hach FH950 electromagnetic flow meter. A continuously logging water level and temperature recorder is also located at W1.

Water levels and discharge for Minto Creek and Big Creek are presented in Table 5-4 below, for dates when fisheries surveys occurred. Big Creek values were obtained through the Water Survey of Canada on-line database (Water Survey Canada, 2018) and are subject to change as they have not yet been validated by Water Survey Canada.

Table 8-4: Stage and Discharge in Minto Creek and Big Creek, 2018

Date	Time (PDT)	Minto Creek		Big Creek	
		Stage (m)	Discharge (m ³ /s)	Stage (m)	Discharge (m ³ /s)
6/24/2018	15:40	0.155	0.013	6.313	14
7/21/2018	15:30	0	0	6.141	6.52
8/18/2018	15:50	0.228	0.005	6.392	18.2
9/16/2018	16:13	0.216	0.026	6.393	18.3

Figure 5-6 displays the continuous stage and discharge record available from April to early October in Minto Creek. As shown in the graph the creek ran dry from July 10th to August 9th and from August 19-22nd during the 2018 Fisheries program season. Minto Creek (W1) froze in late September, the last manual flow measurement was taken on September 25th 2018.

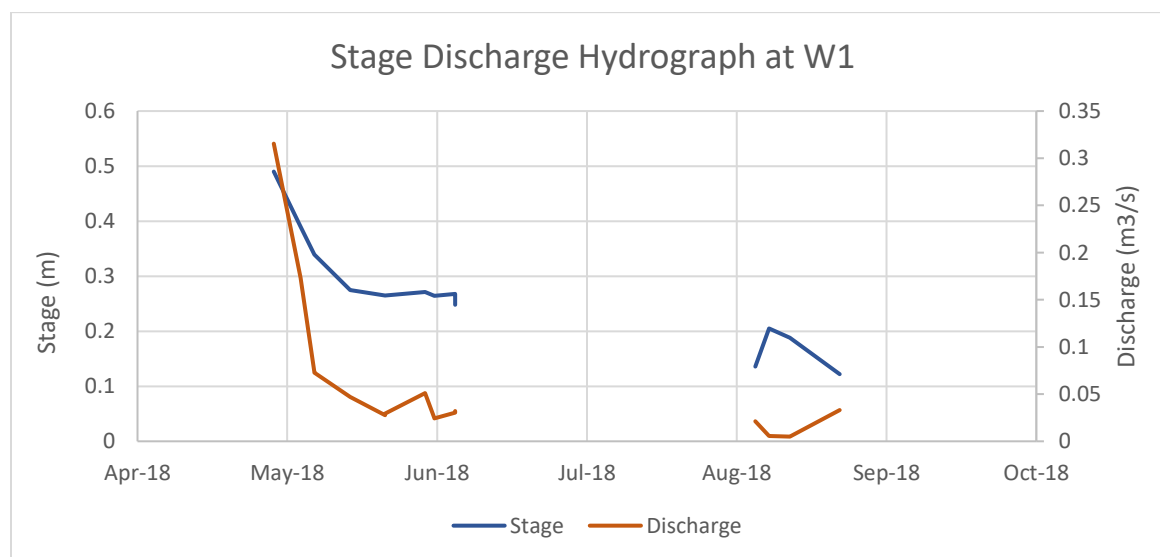


Figure 5-6: Stage and discharge in Minto Creek at monitoring station W1, 2018

The Big Creek hydrometric station (Water Survey of Canada station ID # 09AH003) is located downstream of the Minto access road bridge, near its confluence with the Yukon River, at the following coordinates: 62° 34' 07" N; 137° 00' 58" W. It records continuous water level and discharge. Figure 5-7 presents data from June to October 2018.

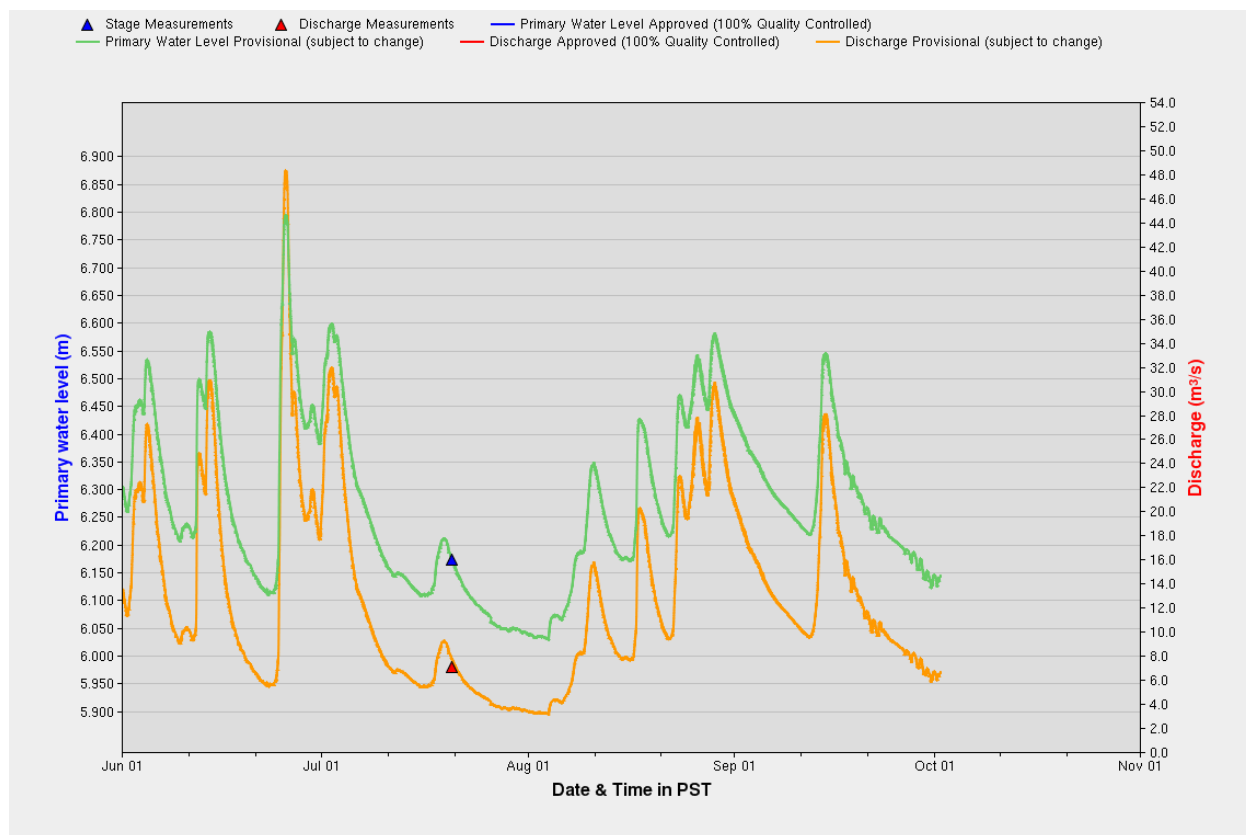


Figure 5-7: Water Level Discharge in Big Creek 2018 (Source: Water Survey of Canada, 2018)

5.5 Fish Barrier

The fish barrier located approximately 1.2 km upstream of the Yukon River (MCF-B1 on Figure 5-8), which was documented in previous years, was re-confirmed in 2018. Another fish barrier exists approximately 200m downstream of MCF-B1 at MCF-21. Fish use upstream of the barriers, which consists of a log jam (Figure 5-9), was assessed by setting traps upstream of it during each sampling event. No fish were captured upstream of the barrier during 2018.



Figure 5-8: Fish Barrier and Minnow Trap at MCF-B1



Figure 5-9: Fish Barrier at MCF-21

6. Discussion

A section of lower Minto Creek was dry during the June sampling event at MFC-12 and MCF-13 trapping locations. These stations are our most downstream trapping sites which indicates fish would have no way of entering Minto creek. Additionally, from July 10 and August 9, 2018, the creek was dry as far as the W1 hydrology station, preventing fish movement up the system. The period which this section of the creek was going dry is unknown, however this could have occurred on other occasions throughout the summer.

In 2018, no JCS were captured in Minto Creek during all sampling events. This may be related in part to the higher water temperatures observed in Big Creek and the lower temperatures observed in Minto Creek during this season. More generally this supports previous findings that JCS do not tend to enter Minto Creek (or Big Creek) until the water temperature has equilibrated with that of the Yukon River or reached a minimum threshold temperature, which was not observed in 2018.

The highest JCS catch per unit effort (CPUE) was observed in September in Big Creek. Figure 6-1: shows the CPUE trends since 2008 for JCS (Minnow trapping only) in Minto Creek and since 2012 in Big Creek. The average CPUE in Minto Creek has shown some variability since 2008 but has generally been relatively low. One exception is the year 2010 where the average CPUE in Minto Creek was 15.7 JCS/trap-day and some trapping events returned over 400 JCS. Those high numbers are thought to be associated with mine water discharge occurring throughout the open water season in Minto Creek that year (ACG, 2010), the more consistent temperature and flow regimes possibly acting as attractants to fish.

No fish were caught in Minto Creek in 2018. This could be explained by a section of the lower creek going dry for periods from June through August, preventing fish movement up or down the creek, combined with a relatively low temperature profile in 2018. In some years, water temperature of Minto Creek and Yukon River reach equilibrium for a short period in June, however this did not happen from 2014 to 2018. In 2018, Minto Creek's maximum water temperature stayed below 9°C, whereas the Yukon River minimum temperature largely stayed above 11°C throughout the summer. The colder temperature profile of Minto Creek in 2018 may have deterred the movement of JCS into the system.

In Big Creek, the average CPUE for 2018 was the lowest recording since 2012. The CPUE was generally higher in Big Creek than in Minto Creek, except in 2013 where it was the opposite. A higher CPUE in Big Creek than in Minto Creek could be explained by the fact that Big Creek is a larger system, with a higher water temperature, generally providing better rearing conditions for JCS. The CPUE has also been noted as following the same trend within both Minto Creek and Big Creek since 2008.

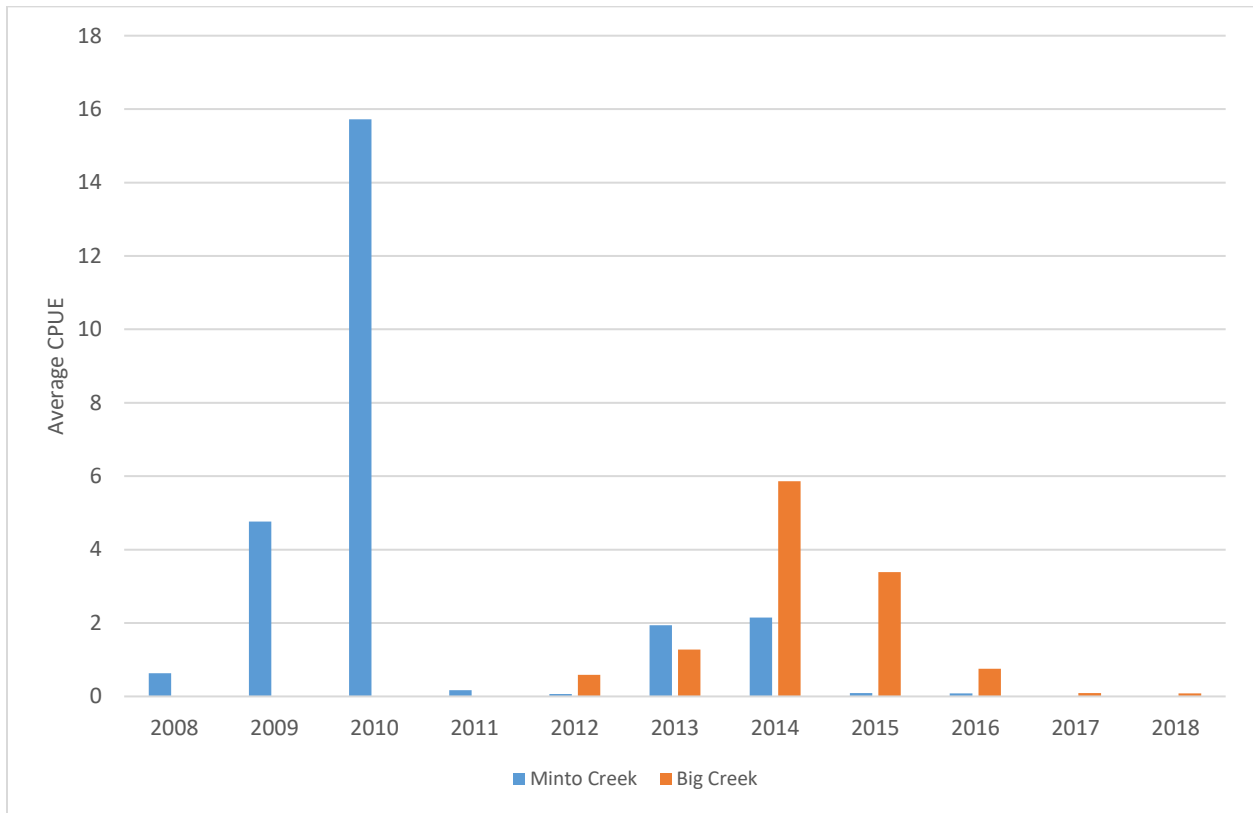


Figure 6-1: JCS Average CPUE, Minnow Trapping, Minto Creek(2008-2018) and Big Creek(2012-2018)

In 2009 and 2010, the mine was discharging water throughout the open water season into Minto Creek, causing higher and more consistent flow and temperature regimes in lower Minto Creek, conditions which may have been more attractive to JCS. Mine water discharge only occurred during spring freshet from 2012 to 2015 and no discharge occurred in 2011. In 2016 the new permitted discharge rate (Q_{EFF}), as per the WUL QZ14-031, was calculated as follows:

- Initial discharge rate: $1/3 (Q_{MC} + Q_{RO}) \geq Q_{EFF-C}$
- Rate after discharge has commenced: $1/3 (Q_{MC} + Q_{RO} - Q_{EFF-M}) \geq Q_{EFF-C}$

Where:

Q_{MC} = daily flow rate in Lower Minto Creek (represented by either W1 or MC1),
 Q_{RO} = daily flow rate of discharged from the RO
 Q_{EFF-M} = measured daily rate of discharge from mine site
 Q_{EFF-C} = calculated rate of water discharge from mine site

In 2018 Minto mine was discharging throughout the open water season. However, this year's discharge was at much lower rates than in 2009 and 2010 because of the new discharge formula.

Following a forest fire in 2010, more sediment entered Minto Creek through runoff in 2011 and 2012, thereby increasing turbidity. A small landslide was also documented by Minto personnel in an upstream tributary in May 2012, likely contributing to high TSS levels observed downstream. The elevated turbidity may have deterred fish from entering Minto Creek. Average TSS values at W2 in 2016 were the lowest since 2011, with the highest being observed in 2012 (see Appendix C for details). Average TSS values at W2 in 2017 were the lowest since 2011, with the highest being observed in 2012 (see Figure 8 for details). Turbidity and TSS did not likely influence fish presence or absence in Minto Creek in 2018 as values remained low throughout the season.

The natural fish barrier identified in Minto Creek in previous years was again confirmed in 2018, as well as a second natural fish barrier 200m downstream. Therefore, the area of usable fish habitat in Minto Creek is limited to the lower 1 km of the creek.

Aerial surveys for spawning fish were carried out near the Minto Creek/Yukon River confluence from 2010 to 2014 and no spawning activity was ever observed or suspected. Bottom substrate in the confluence area consists primarily of silt and mud which is not suitable substrate for salmon spawning.

Minto Mine is under temporary closure as of November 2018 and going into Care and Maintenance in 2019. All mining activities are ceased at this time. The fisheries program is unaffected by this closure and the fisheries study will continue in 2019 as required by the water use license.

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https://wateroffice.ec.gc.ca/search/real_time_e.html

Appendix A - 2018 Photo Log



Figure A-1: Big Creek June 2018



Figure A-2: Fish Barrier MCF-B1 June 2018



Figure A-3 JCS caught at BC1 (Big Creek) June 2018



Figure A-4 MCF-16 Dry July 2018



Figure A-5 MCF-21 dry New fish barrier July 2018



Figure A-6 Juvenile Slimy Sculpin July 2018



Figure A-7 MCF-B1 Fish Barrier August 2018



Figure A-8 Big Creek August 2018



Figure A-9 JCS from BC August 2018



Figure A-10 Trap set at MCF-18



Figure A-11 JCS from Big Creek



Figure A-12 Staff Gauge at W1

Appendix B - Fish Data, Minto Creek and Big Creek, 2018

Table B-1 2018 Fish Collection Data

ID	Date	Location	Location Code	Samplers	Species	Length (mm)	Weight (g)	Fate	Sex	Maturity	Age
XR 187-2018-1	2018/Jun/24	Big Creek	BC1	CH/SR	CH	35	2.23	Released (good)	Unknown	Immature	Juvenile
XR 187-2018-1	2018/Jun/24	Big Creek	BC1	CH/SR	CH	35	0.98	Released (good)	Unknown	Immature	Juvenile
XR 187-2018-1	2018/Jun/24	Big Creek	BC1	CH/SR	CH	40	1.2	Released (good)	Unknown	Immature	Juvenile
XR 187-2018-1	2018/Jun/24	Big Creek	BC1	CH/SR	CH	45	1.64	Released (good)	Unknown	Immature	Juvenile
XR 187-2018-1	2018/Jun/24	Big Creek	BC1	CH/SR	CH	42	1.37	Released (good)	Unknown	Immature	Juvenile
XR 187-2018-1	2018/Jun/24	Big Creek	BC1	CH/SR	CH	38	1.27	Released (good)	Unknown	Immature	Juvenile
XR 187-2018-1	2018/Jun/24	Big Creek	BC1	CH/SR	CH	46	1.41	Released (good)	Unknown	Immature	Juvenile
XR 187-2018-1	2018/Jul/21	Big Creek	BC1	CH/SR	CCG	75	5.3	Released (good)	Unknown	Immature	Juvenile
XR 187-2018-1	2018/Jul/21	Big Creek	BC1	CH/SR	CCG	82	6.21	Released (good)	Unknown	Immature	Juvenile
XR 187-2018-3	2018/Jul/21	Big Creek	BC3	CH/SR	CH	57	2.56	Released (good)	Unknown	Immature	Juvenile
XR 187-2018-4	2018/Jul/21	Big Creek	BC4	CH/SR	CH	55	3.04	Released (good)	Unknown	Immature	Juvenile
XR 187-2018-1	2018/Aug/18	Big Creek	BC1	CH/SR	CH	70	5.16	Released (good)	Unknown	Immature	Juvenile
XR 187-2018-1	2018/Aug/18	Big Creek	BC1	CH/SR	CH	63	3.46	Released (good)	Unknown	Immature	Juvenile
XR 187-2018-1	2018/Aug/18	Big Creek	BC1	CH/SR	CH	63	3.81	Released (good)	Unknown	Immature	Juvenile
XR 187-2018-1	2018/Aug/18	Big Creek	BC1	CH/SR	CH	65	4.28	Released (good)	Unknown	Immature	Juvenile
XR 187-2018-1	2018/Aug/18	Big Creek	BC1	CH/SR	CH	65	3.7	Released (good)	Unknown	Immature	Juvenile
XR 187-2018-1	2018/Aug/18	Big Creek	BC1	CH/SR	CH	67	2.16	Released (good)	Unknown	Immature	Juvenile
XR 187-2018-1	2018/Aug/18	Big Creek	BC1	CH/SR	CH	55	3.28	Released (good)	Unknown	Immature	Juvenile
XR 187-2018-1	2018/Sep/16	Big Creek	BC1	CH/SR	CH	3.55	61	Released (good)	Unknown	Immature	Juvenile
XR 187-2018-1	2018/Sep/16	Big Creek	BC1	CH/SR	CH	5.18	71	Released (good)	Unknown	Immature	Juvenile
XR 187-2018-1	2018/Sep/16	Big Creek	BC1	CH/SR	CH	4.94	60	Released (good)	Unknown	Immature	Juvenile
XR 187-2018-1	2018/Sep/16	Big Creek	BC1	CH/SR	CH	5	60	Released (good)	Unknown	Immature	Juvenile
XR 187-2018-1	2018/Sep/16	Big Creek	BC1	CH/SR	CH	4.66	71	Released (good)	Unknown	Immature	Juvenile
XR 187-2018-1	2018/Sep/16	Big Creek	BC1	CH/SR	CH	3.4	60	Released (good)	Unknown	Immature	Juvenile
XR 187-2018-1	2018/Sep/16	Big Creek	BC1	CH/SR	CH	5.4	65	Released (good)	Unknown	Immature	Juvenile
XR 187-2018-1	2018/Sep/16	Big Creek	BC1	CH/SR	CH	7.27	70	Released (good)	Unknown	Immature	Juvenile

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ID	Date	Location	Location Code	Samplers	Species	Length (mm)	Weight (g)	Fate	Sex	Maturity	Age
XR 187-2018-1	2018/Sep/16	Big Creek	BC1	CH/SR	CH	4.22	60	Released (good)	Unknown	Immature	Juvenile
XR 187-2018-1	2018/Sep/16	Big Creek	BC1	CH/SR	CH	7.4	80	Released (good)	Unknown	Immature	Juvenile
XR 187-2018-1	2018/Sep/16	Big Creek	BC1	CH/SR	CH	4.7	70	Released (good)	Unknown	Immature	Juvenile
XR 187-2018-1	2018/Sep/16	Big Creek	BC1	CH/SR	CH	5.54	65	Released (good)	Unknown	Immature	Juvenile
XR 187-2018-1	2018/Sep/16	Big Creek	BC1	CH/SR	CH	5.4	65	Released (good)	Unknown	Immature	Juvenile
XR 187-2018-4	2018/Sep/16	Big Creek	BC4	CH/SR	CH	5.18	80	Released (good)	Unknown	Immature	Juvenile

Table B-2 Fish Collection Summary Data													
Collection Date (YYYY-MM-DD)	Waterbody Name	Watershed Code	Upper Latitude (Decimal Degree eg. 62.82527)	Upper Longitude (Decimal Degree eg. -137.62750)	Species (see look-up tab)	Lifestage	# Captur ed	# Retaine d	# Of Incidental Mortalities	Method	Effort	Unit of Measure	Comments
2018/Jun/24	Big Creek	80080623801957	62.598706	-137.013264	CH	juvenile	7	0	0	MT	94.33	hr	4 Traps
2018/Jun/24	Minto Creek	800803912	62.65442	-137.0929558	n/a	n/a	0	0	0	MT	308	hr	13 Traps
2018/Jul/21	Big Creek	80080623801957	62.598706	-137.013264	CCG	juvenile	2	0	0	MT	23.2	hr	1 Trap
2018/Jul/21	Big Creek	80080623801957	62.598706	-137.013264	CH	juvenile	1	0	0	MT	23.3	hr	1 Trap
2018/Jul/21	Big Creek	80080623801957	62.598706	-137.013264	CH	juvenile	1	0	0	MT	23.35	hr	1 trap
2018/Jul/21	Big Creek	80080623801957	62.598706	-137.013264	n/a	n/a	0	0	0	MT	23.32	hr	1 Trap
2018/Jul/21	Minto Creek	800803912	62.65442	-137.0929558	n/a	n/a	0	0	0	MT	47.75	hr	2 Traps
2018/Aug/18	Big Creek	80080623801957	62.598706	-137.013264	CH	juvenile	7	0	0	MT	22.43	hr	1 Trap
2018/Aug/18	Big Creek	80080623801957	62.598706	-137.013264	n/a	n/a	0	0	0	MT	67.45	hr	3 Traps
2018/Sep/16	Big Creek	80080623801957	62.598706	-137.013264	CH	juvenile	13	0	0	MT	22.83	hr	1 Trap
2018/Sep/16	Big Creek	80080623801957	62.598706	-137.013264	n/a	n/a	0	0	0	MT	46.12	hr	2 Traps
2018/Sep/16	Big Creek	80080623801957	62.598706	-137.013264	CH	juvenile	1	0	0	MT	23.05	hr	1 Trap
2018/Sep/16	Minto Creek	800803912	62.65442	-137.0929558	n/a	n/a	0	0	0	MT	342.02	hr	15 Traps

Table B-3 Net Times

Site	Date Set	Set	Date Pulled	Pulled	Net Time
BC1	6/23/2018	14:05	6/24/2018	13:35	23.5
BC2	6/23/2018	14:12	6/24/2018	13:50	23.6
BC3	6/23/2018	14:16	6/24/2018	13:53	23.6
BC4	6/23/2018	14:20	6/24/2018	13:55	23.6
MCF14	6/23/2018	14:57	6/24/2018	14:50	23.9
MCF16	6/23/2018	15:03	6/24/2018	14:55	23.9
MCF15	6/23/2018	15:06	6/24/2018	14:56	23.8
MCF25	6/23/2018	15:10	6/24/2018	14:58	23.8
MCF27	6/23/2018	15:35	6/24/2018	15:14	23.7
MCF24	6/23/2018	15:38	6/24/2018	15:16	23.6
MCF-B1	6/23/2018	15:41	6/24/2018	15:20	23.7
MCF22	6/23/2018	15:53	6/24/2018	15:25	23.5
MCF21	6/23/2018	15:59	6/24/2018	15:29	23.5
MCF-W1	6/23/2018	16:08	6/24/2018	15:47	23.6
MCF18	6/23/2018	16:09	6/24/2018	15:48	23.6
MCF17	6/23/2018	16:14	6/24/2018	15:53	23.7
MCF26	6/23/2018	16:18	6/24/2018	15:58	23.7
BC1	7/20/2018	14:23	7/21/2018	13:35	23.20
BC2	7/20/2018	14:31	7/21/2018	13:50	23.32
BC3	7/20/2018	14:36	7/21/2018	13:53	23.28
BC4	7/20/2018	14:34	7/21/2018	13:55	23.35
MCF17	7/20/2018	15:24	7/21/2018	15:21	23.9
MCF21	7/20/2018	15:43	7/21/2018	15:31	23.8
BC1	8/17/2018	16:00	8/18/2018	14:26	22.43
BC2	8/17/2018	16:06	8/18/2018	14:37	22.52
BC3	8/17/2018	16:10	8/18/2018	14:39	22.48
BC4	8/17/2018	16:14	8/18/2018	14:41	22.45
MCF25	8/17/2018	17:00	8/18/2018	15:05	22.1
MCF18	8/17/2018	17:08	8/18/2018	15:11	22.1
MCF24	8/17/2018	17:20	8/18/2018	15:37	22.3
MCF-B1	8/17/2018	17:23	8/18/2018	15:37	22.2
MCF22	8/17/2018	17:28	8/18/2018	15:40	22.2
MCF21	8/17/2018	17:31	8/18/2018	15:30	22.0
MCF26	8/17/2018	17:43	8/18/2018	15:17	21.6
BC1	9/15/2018	14:33	9/16/2018	13:23	22.83
BC2	9/15/2018	14:38	9/16/2018	13:41	23.05
BC3	9/15/2018	14:42	9/16/2018	13:46	23.07
BC4	9/15/2018	14:44	9/16/2018	13:47	23.05
MCF-12	9/15/2018	15:17	9/16/2018	14:11	22.90

Fisheries Monitoring Program
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Site	Date Set	Set	Date Pulled	Pulled	Net Time
MCF-13	9/15/2018	15:19	9/16/2018	14:12	22.88
MCF-14	9/15/2018	15:22	9/16/2018	14:15	22.88
MCF-16	9/15/2018	15:29	9/16/2018	14:22	22.88
MCF-15	9/15/2018	15:31	9/16/2018	14:24	22.88
MCF-25	9/15/2018	15:34	9/16/2018	14:04	22.50
MCF-24	9/15/2018	15:59	9/16/2018	14:42	22.72
MCF-B1	9/15/2018	16:00	9/16/2018	14:40	22.67
MCF-22	9/15/2018	16:05	9/16/2018	14:52	22.78
MCF-21	9/15/2018	16:09	9/16/2018	14:52	22.72
MCF-20	9/15/2018	16:11	9/16/2018	14:59	22.80
MCF-W1	9/15/2018	16:16	9/16/2018	16:03	23.78
MCF-18	9/15/2018	16:17	9/16/2018	16:05	23.80
MCF-17	9/15/2018	16:22	9/16/2018	14:17	21.92
MCF-26	9/15/2018	16:25	9/16/2018	14:19	21.90

Table B-4-1 June Trapping effort and Catch Details Big Creek

Site	# Traps	Date In	Time In	Date Out	Time Out	Soak Time (hrs)	Results	Species	Length (mm)	Weight (g)
BC1	1	6/23/2018	14:05	6/24/2018	13:35	23.5	7	CH	35	2.23
								CH	35	0.98
								CH	40	1.2
								CH	45	1.64
								CH	42	1.37
								CH	38	1.27
								CH	46	1.41
BC2	1	6/23/2018	14:12	6/24/2018	13:50	23.6	0	-	-	-
BC3	1	6/23/2018	14:16	6/24/2018	13:53	23.6	0	-	-	-
BC4	1	6/23/2018	14:20	6/24/2018	13:55	23.6	0	-	-	-

Table B-4-2 June Trapping Effort Minto Creek

Site	# Traps	Date In	Time In	Date Out	Time Out	Soak Time	Results
MCF14	1	6/23/2018	14:57	6/24/2018	14:50	23.9	0
MCF16	1	6/23/2018	15:03	6/24/2018	14:55	23.9	0
MCF15	1	6/23/2018	15:06	6/24/2018	14:56	23.8	0
MCF25	1	6/23/2018	15:10	6/24/2018	14:58	23.8	0
MCF27	1	6/23/2018	15:35	6/24/2018	15:14	23.7	0
MCF24	1	6/23/2018	15:38	6/24/2018	15:16	23.6	0
MCF-B1	1	6/23/2018	15:41	6/24/2018	15:20	23.7	0
MCF22	1	6/23/2018	15:53	6/24/2018	15:25	23.5	0
MCF21	1	6/23/2018	15:59	6/24/2018	15:29	23.5	0
MCF-W1	1	6/23/2018	16:08	6/24/2018	15:47	23.6	0
MCF18	1	6/23/2018	16:09	6/24/2018	15:48	23.6	0
MCF17	1	6/23/2018	16:14	6/24/2018	15:53	23.7	0
MCF26	1	6/23/2018	16:18	6/24/2018	15:58	23.7	0

Table B-4-3 June Water Quality Details

Site	Date	Time	Water Temp (°C)	DO (%)	DO (mg/L)	pH	ORP (mV)
Big Creek (BC1)	6/24/2018	13:55	11.7	103.9	11.28	7.69	160.9
Minto Creek (W2)	6/24/2018	15:55	5.8	102.9	12.87	7.98	165
Yukon River	6/24/2018	14:35	13.9	103.5	10.68	8.11	136.5

Table B-4-4 June Flow – Minto Creek

Site	Date	Time	Water Level (m)	Discharge (m3/s)
Minto Creek (W1)	6/24/2018	15:40	0.155	0.013

Table B-5-1 July Trapping effort and Catch Details Big Creek

Site	# Traps	Date In	Time In	Date Out	Time Out	Soak Time (hrs)	Results	Species	Length (mm)	Weight (g)
BC1	1	7/20/2018	14:23	7/21/2018	13:35	23.20	2	CCG	75	5.3
								CCG	82	6.21
BC2	1	7/20/2018	14:31	7/21/2018	13:50	23.32	0			
BC3	1	7/20/2018	14:36	7/21/2018	13:53	23.28	1	CH	57	2.56
BC4	1	7/20/2018	14:34	7/21/2018	13:55	23.35	1	CH	55	3.04

Table B-5-2 July Trapping Effort Minto Creek

Site	# Traps	Date In	Time In	Date Out	Time Out	Soak Time	Results
MCF17	1	7/20/2018	15:24	7/21/2018	15:21	23.9	0
MCF21	1	7/20/2018	15:43	7/21/2018	15:31	23.8	0

Table B-5-3 July Water Quality Details

Site	Date	Time	Water Temp (°C)	DO (%)	DO (mg/L)	pH	ORP (mV)
Big Creek (BC1)	7/20/2018	14:25	11.8	105.4	11.42	8.16	150.8
Minto Creek (MCF-17)	7/21/2018	15:45	5.6	57.2	6.91	7.34	195.1
Yukon River (W4)	7/20/2018	14:50	13.8	103.4	10.67	7.96	159.6

Table B-5-4 July Flow – Minto Creek

Site	Date	Time	Water Level (m)	Discharge (m3/s)
Minto Creek (W1)	7/21/2018	15:30	0	0

Table B-6-1 August Trapping effort and Catch Details Big Creek

Site	# Traps	Date In	Time In	Date Out	Time Out	Soak Time (hrs)	Results	Species	Length (mm)	Weight (g)
BC1	1	8/17/2018	16:00	8/18/2018	14:26	22.43	7	CH	70	5.16
								CH	63	3.46
								CH	63	3.81
								CH	65	4.28
								CH	65	3.7
								CH	67	2.16
								CH	55	3.28
BC2	1	8/17/2018	16:06	8/18/2018	14:37	22.52	0			
BC3	1	8/17/2018	16:10	8/18/2018	14:39	22.48	0			
BC4	1	8/17/2018	16:14	8/18/2018	14:41	22.45	0			

Table B-6-2 August Trapping Effort Minto Creek

Site	# Traps	Date In	Time In	Date Out	Time Out	Soak Time	Results
MCF25	1	8/17/2018	17:00	8/18/2018	15:05	22.1	0
MCF18	1	8/17/2018	17:08	8/18/2018	15:11	22.1	0
MCF24	1	8/17/2018	17:20	8/18/2018	15:37	22.3	0
MCF-B1	1	8/17/2018	17:23	8/18/2018	15:37	22.2	0
MCF22	1	8/17/2018	17:28	8/18/2018	15:40	22.2	0
MCF21	1	8/17/2018	17:31	8/18/2018	15:30	22.0	0
MCF26	1	8/17/2018	17:43	8/18/2018	15:17	21.6	0

Table B-6-3 August Water Quality Details

Site	Date	Time	Water Temp (°C)	DO (%)	DO (mg/L)	pH	ORP (mV)
Big Creek BC1	18/Aug/2018	11:15	8.6	109.8	12.81	7.74	182.1
Minto Creek W2	18/Aug/2018	15:05	5	111.6	14.09	7.89	200.4
Yukon River W4	18/Aug/2018	15:00	11.8	119	12.56	7.95	207.8

Table B-6-4 August Flow – Minto Creek

Site	Date	Time	Water Level (m)	Discharge (m ³ /s)
Minto Creek (W1)	8/18/2018	15:50	0.228	0.005

Table B-7-1 September Trapping effort and Catch Details Big Creek

Site	# Traps	Date In	Time In	Date Out	Time Out	Soak Time (hrs)	Results	Species	Weight (g)	Length (mm)
BC1	1	9/15/2018	14:33	9/16/2018	13:23	22.83	13	CH	3.55	61
								CH	5.18	71
								CH	4.94	60
								CH	5	60
								CH	4.66	71
								CH	3.4	60
								CH	5.4	65
								CH	7.27	70
								CH	4.22	60
								CH	7.4	80
								CH	4.7	70
								CH	5.54	65
								CH	5.4	65
BC2	1	9/15/2018	14:38	9/16/2018	13:41	23.05	0			
BC3	1	9/15/2018	14:42	9/16/2018	13:46	23.07	0			
BC4	1	9/15/2018	14:44	9/16/2018	13:47	23.05	1	CH	5.18	80

Table B-7-2 September Trapping Effort Minto Creek

Site	# Traps	Date In	Time In	Date Out	Time Out	Soak Time	Results
MCF-12	1	9/15/2018	15:17	9/16/2018	14:11	22.90	0
MCF-13	1	9/15/2018	15:19	9/16/2018	14:12	22.88	0
MCF-14	1	9/15/2018	15:22	9/16/2018	14:15	22.88	0
MCF-16	1	9/15/2018	15:29	9/16/2018	14:22	22.88	0
MCF-15	1	9/15/2018	15:31	9/16/2018	14:24	22.88	0
MCF-25	1	9/15/2018	15:34	9/16/2018	14:04	22.50	0
MCF-24	1	9/15/2018	15:59	9/16/2018	14:42	22.72	0
MCF-B1	1	9/15/2018	16:00	9/16/2018	14:40	22.67	0
MCF-22	1	9/15/2018	16:05	9/16/2018	14:52	22.78	0
MCF-21	1	9/15/2018	16:09	9/16/2018	14:52	22.72	0
MCF-20	1	9/15/2018	16:11	9/16/2018	14:59	22.80	0
MCF-W1	1	9/15/2018	16:16	9/16/2018	16:03	23.78	0
MCF-18	1	9/15/2018	16:17	9/16/2018	16:05	23.80	0
MCF-17	1	9/15/2018	16:22	9/16/2018	14:17	21.92	0
MCF-26	1	9/15/2018	16:25	9/16/2018	14:19	21.90	0

Table B-7-3 September Water Quality Details

Site	Date	Time	Water Temp (°C)	DO (%)	DO (mg/L)	pH	ORP (mV)
Big Creek BC1	15/Sep/2018	14:35	3.4	90.1	11.98	7.71	188.4
Minto Creek W2	15/Sep/2018	16:28	1.4	90.8	12.71	8.07	237.2
Yukon River W4	15/Sep/2018	14:55	6.4	95.3	11.73	7.77	164.1

Table B-7-4 September Flow – Minto Creek

Site	Date	Time	Water Level (m)	Discharge (m3/s)
Minto Creek (W1)	9/16/2018	16:13	0.216	0.026

Table B-8 CPUE – Full Species List

Month	Total net times MC	Total net times BC	CH Caught BC	CH Caught MC	CCG caught BC	CCG caught MC	BB Caught BC	BB Caught MC	CH CPUE BC	CH CPUE MC	CCG CPUE BC	CCG CPUE MC	BB CPUE BC	BB CPUE MC
June	308	94	7	0	0	0	0	0	0.074			0		
July	48	93	2	0	2	0	0	0	0.022	0		0.022		
August	154	90	7	0	0	0	0	0	0.078	0		0		
September	342.02	92	14	0	0	0	0	0	0.152	0	0	0	0	0
									Average CPUE	0.081	0	0	0.005	0

Appendix M – Waste Rock Verification Program Results

2018 Waste Rock Verification Results

Waste Dump Name	Sample ID	Date Sampled	Northing	Easting	Elevation	Cu%	%C(Tot)	%S(Tot)	NP	AP	NP/AP	Pass/Fail
MPD	WRV-MPD -1801-01	25-Feb-18	6944600.973	384432.132	858.738	0.301	0.974	0.205	81.1030	6.42002164	12.633	Pass
MPD	WRV-MPD -1801-02	25-Feb-18	6944579.456	384431.102	859.625	0.297	0.735	0.311	61.1921	9.72047185	6.295	Pass
MPD	WRV-MPD -1801-03	25-Feb-18	6944556.878	384434.925	860.314	0.073	0.188	0.036	15.7019	1.13109586	13.882	Pass
MPD	WRV-MPD -1801-04	25-Feb-18	6944533.975	384439.659	860.38	0.019	0.285	0.012	23.7240	0.37666405	62.985	Pass
MPD	WRV-MPD -1801-05	25-Feb-18	6944536.957	384463.446	860.144	0.038	0.089	0.005	7.4262	0.14101984	52.661	Pass
MPD	WRV-MPD -1801-06	25-Feb-18	6944556.153	384475.479	860.186	0.078	0.247	0.006	20.5480	0.18379604	111.798	Pass
MPD	WRV-MPD -1801-07	25-Feb-18	6944577.601	384476.341	859.635	0.203	0.347	0.032	28.8995	1.01532535	28.463	Pass
MPD	WRV-MPD -1801-08	25-Feb-18	6944599.296	384484.995	859.271	0.169	0.600	0.218	49.9836	6.8130561	7.336	Pass
MPD	WRV-MPD -1801-09	25-Feb-18	6944584.733	384503.445	859.21	0.161	0.368	0.088	30.6463	2.76240068	11.094	Pass
MPD	WRV-MPD -1801-10	25-Feb-18	6944564.026	384504.365	859.47	0.176	0.232	0.017	19.3111	0.52983411	36.448	Pass
MPD	WRV-MPD -1801-11	25-Feb-18	6944541.992	384505.401	860.443	0.036	0.182	0.006	15.1678	0.18809874	80.637	Pass
MPD	WRV-MPD -1801-12	25-Feb-18	6944530.727	384524.211	860.747	0.294	0.378	0.028	31.4564	0.86975884	36.167	Pass
MPD	WRV-MPD -1801-13	25-Feb-18	6944553.596	384533.028	859.807	0.175	0.138	0.046	11.4954	1.4375	7.997	Pass
MPD	WRV-MPD -1801-14	25-Feb-18	6944539.689	384546.373	860.269	0.184	0.164	0.014	13.6612	0.4375	31.226	Pass
MPD	WRV-MPD -1801-15	25-Feb-18	6944533.163	384567.178	860.366	0.319	0.131	0.022	10.9123	0.6875	15.872	Pass
MWDW	WRV-MWDW -1801-01	25-Feb-18	6945108.857	384122.313	891.616	0.092	0.674	0.256	56.1387	7.99614619	7.021	Pass
MWDW	WRV-MWDW -1801-02	25-Feb-18	6945085.291	384116.832	890.062	0.217	1.050	0.704	87.4733	21.9903981	3.978	Pass
MWDW	WRV-MWDW -1801-03	25-Feb-18	6945059.543	384103.141	890.12	0.134	0.405	0.138	33.7737	4.31255575	7.831	Pass
MWDW	WRV-MWDW -1801-04	25-Feb-18	6945039.247	384085.55	890.281	0.140	0.602	0.148	50.1427	4.62949074	10.831	Pass

Waste Dump Name	Sample ID	Date Sampled	Northing	Easting	Elevation	Cu%	%C(Tot)	%S(Tot)	NP	AP	NP/AP	Pass/Fail
MWDW	WRV-MWDW -1801-05	25-Feb-18	6945024.273	384067.324	890.728	0.041	0.415	0.035	34.5767	1.09296579	31.636	Pass
MWDW	WRV-MWDW -1801-06	25-Feb-18	6945007.588	384046.27	890.18	0.119	0.458	0.075	38.1788	2.34521914	16.279	Pass
MWDW	WRV-MWDW -1801-07	25-Feb-18	6944989.086	384023.962	889.497	0.139	0.554	0.150	46.1613	4.68274592	9.858	Pass
MWDW	WRV-MWDW -1801-08	25-Feb-18	6944979.379	383998.501	890.022	0.165	0.294	0.099	24.4527	3.09649371	7.897	Pass
MWDW	WRV-MWDW -1801-09	25-Feb-18	6944976.876	383971.555	890.694	0.026	0.278	0.032	23.1180	0.99226557	23.298	Pass
MWDW	WRV-MWDW -1801-10	25-Feb-18	6944989.192	383938.225	889.879	0.108	0.845	0.398	70.3734	12.4406474	5.657	Pass
MPD	WRV-MPD -1802-01	25-Feb-18	6944773.075	384286.266	846.887	0.375	0.574	0.314	47.8142	9.8125	4.873	Pass
MPD	WRV-MPD -1802-02	25-Feb-18	6944759.897	384305.736	849.286	0.359	0.722	0.288	60.1426	9	6.683	Pass
MPD	WRV-MPD -1802-03	25-Feb-18	6944747.17	384324.932	851.439	0.106	0.353	0.349	29.4049	10.90625	2.696	Fail
MPD	WRV-MPD -1802-04	25-Feb-18	6944729.069	384339.711	854.463	0.010	0.522	0.012	43.4826	0.375	115.954	Pass
MPD	WRV-MPD -1802-05	25-Feb-18	6944706.302	384353.336	856.042	0.065	0.525	0.065	43.7325	2.03125	21.530	Pass
MPD	WRV-MPD -1802-06	25-Feb-18	6944689.681	384372.708	857.283	0.190	0.529	0.126	44.0657	3.9375	11.191	Pass
MPD	WRV-MPD -1802-07	25-Feb-18	6944673.518	384389.107	858.11	0.195	0.690	0.163	57.4770	5.09375	11.284	Pass
MPD	WRV-MPD -1802-08	25-Feb-18	6944652.129	384405.002	858.858	0.245	0.444	0.302	36.9852	9.4375	3.919	Pass
MPD	WRV-MPD -1802-09	25-Feb-18	6944632.803	384417.524	858.629	0.170	0.542	0.154	45.1486	4.8125	9.382	Pass
MPD	WRV-MPD -1802-10	25-Feb-18	6944644.766	384436.764	858.3	0.131	0.720	0.112	59.9760	3.5	17.136	Pass
MPD	WRV-MPD -1802-11	25-Feb-18	6944667.913	384419.778	858.125	0.010	0.547	0.010	45.5651	0.3125	145.808	Pass
MPD	WRV-MPD -1802-12	25-Feb-18	6944699.439	384418.549	858.179	0.031	0.223	0.015	18.5759	0.46875	39.629	Pass
MPD	WRV-MPD -1802-13	25-Feb-18	6944723.44	384403.542	857.977	0.083	0.318	0.059	26.4894	1.84375	14.367	Pass

Waste Dump Name	Sample ID	Date Sampled	Northing	Easting	Elevation	Cu%	%C(Tot)	%S(Tot)	NP	AP	NP/AP	Pass/Fail
MPD	WRV-MPD -1802-14	25-Feb-18	6944748.834	384387.677	858.503	0.041	0.640	0.050	53.3120	1.5625	34.120	Pass
MPD	WRV-MPD -1802-15	25-Feb-18	6944689.233	384403.795	857.925	0.040	0.291	0.022	24.2403	0.6875	35.259	Pass
MPD	WRV-MPD -1802-16	25-Feb-18	6944705.373	384385.528	857.314	0.094	0.632	0.232	52.6456	7.25	7.261	Pass
MPD	WRV-MPD -1802-17	25-Feb-18	6944727.65	384364.191	855.65	0.072	0.697	0.133	58.0601	4.15625	13.969	Pass
MWDW	WRV-MPD -1802-01	6-Mar-18	6945144.417	383760.746	905.264	0.278	0.542	0.173	45.1486	5.40625	8.351	Pass
MWDW	WRV-MPD -1802-02	6-Mar-18	6945126.693	383783.947	905.414	0.163	0.731	0.095	60.8923	2.96875	20.511	Pass
MWDW	WRV-MPD -1802-03	6-Mar-18	6945111.354	383809.971	905.286	0.216	0.734	0.096	61.1422	3	20.381	Pass
MWDW	WRV-MPD -1802-04	6-Mar-18	6945096.396	383835.89	905.045	0.290	0.508	0.052	42.3164	1.625	26.041	Pass
MWDW	WRV-MPD -1802-05	6-Mar-18	6945078.662	383860.02	904.8	0.316	0.737	0.296	61.3921	9.25	6.637	Pass
MWDW	WRV-MPD -1802-06	6-Mar-18	6945062.91	383885.968	904.132	0.126	0.936	0.097	77.9688	3.03125	25.722	Pass
MWDW	WRV-MPD -1802-07	6-Mar-18	6945049.937	383911.73	903.677	0.255	0.848	0.585	70.6384	18.28125	3.864	Pass
MWDW	WRV-MPD -1802-08	6-Mar-18	6945036.924	383938.384	902.887	0.170	1.022	0.502	85.1326	15.6875	5.427	Pass
MWDW	WRV-MPD -1802-09	6-Mar-18	6945027.302	383966.624	902.028	0.153	0.888	0.260	73.9704	8.125	9.104	Pass
MWDW	WRV-MPD -1802-10	6-Mar-18	6945026.917	383996.128	901.204	0.380	0.920	0.538	76.6360	16.8125	4.558	Pass
MWDW	WRV-MPD -1802-11	6-Mar-18	6945040.66	384021.615	900.726	0.256	0.754	0.356	62.8082	11.125	5.646	Pass
MWDW	WRV-MPD -1802-12	6-Mar-18	6945056.489	384046.246	900.226	0.120	0.774	0.239	64.4742	7.46875	8.633	Pass
MWDW	WRV-MPD -1802-13	6-Mar-18	6945076.944	384067.798	899.649	0.149	1.215	0.147	101.2095	4.59375	22.032	Pass
MWDW	WRV-MPD -1802-14	6-Mar-18	6945093.012	384083.342	899.374	0.181	0.836	0.164	69.6388	5.125	13.588	Pass
MPD	WRV-MPD -1803-01	21-May-18	6944546.148	384442.492	862.682	0.249	0.571	0.187	47.5643	5.84375	8.139	Pass

Waste Dump Name	Sample ID	Date Sampled	Northing	Easting	Elevation	Cu%	%C(Tot)	%S(Tot)	NP	AP	NP/AP	Pass/Fail
MPD	WRV-MPD -1803-02	21-May-18	6944527.714	384437.526	863.13	0.301	0.777	0.238	64.7241	7.4375	8.702	Pass
MPD	WRV-MPD -1803-03	21-May-18	6944505.713	384433.353	863.663	0.343	0.808	0.252	67.3064	7.875	8.547	Pass
MPD	WRV-MPD -1803-04	21-May-18	6944510.995	384456.161	863.732	0.435	0.880	0.310	73.3040	9.6875	7.567	Pass
MPD	WRV-MPD -1803-05	21-May-18	6944532.635	384463.446	863.062	0.380	0.841	0.332	70.0553	10.375	6.752	Pass
MPD	WRV-MPD -1803-06	21-May-18	6944553.84	384473.337	862.575	0.163	0.684	0.117	56.9772	3.65625	15.584	Pass
MPD	WRV-MPD -1803-07	21-May-18	6944572.238	384489.657	861.889	0.155	0.741	0.105	61.7253	3.28125	18.812	Pass
MPD	WRV-MPD -1803-08	21-May-18	6944560.499	384511.114	862.431	0.260	0.857	0.260	71.3881	8.125	8.786	Pass
MPD	WRV-MPD -1803-09	21-May-18	6944541.005	384498.291	863.172	0.236	0.774	0.183	64.4742	5.71875	11.274	Pass
MPD	WRV-MPD -1803-10	21-May-18	6944515.313	384489.053	864.195	0.312	0.847	0.255	70.5551	7.96875	8.854	Pass
MPD	WRV-MPD -1803-11	21-May-18	6944511.365	384512.882	864.429	0.275	0.976	0.232	81.3008	7.25	11.214	Pass
MPD	WRV-MPD -1803-12	21-May-18	6944530.977	384525.876	863.443	0.390	0.893	0.328	74.3869	10.25	7.257	Pass
MPD	WRV-MPD -1803-13	21-May-18	6944538.609	384539.859	863.289	0.145	1.024	0.189	85.2992	5.90625	14.442	Pass
MPD	WRV-MPD -1803-14	21-May-18	6944514.368	384543.367	864.549	0.246	1.144	0.257	95.2952	8.03125	11.866	Pass
MPD	WRV-MPD -1803-15	21-May-18	6944503.569	384531.17	865.535	0.308	0.783	0.240	65.2239	7.5	8.697	Pass

Appendix N – ABA Report 2018 GMP Annual Report



Minto Mine
Water Licence QZ14-031 & Quartz Mining Licence QML-0001
2018 Annual Report
Geochemical Monitoring Report

Prepared by:
Minto Explorations Ltd.
Minto Mine
March 2019

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1 Geochemical Monitoring Program Objectives

This report is submitted to meet requirements under Minto Explorations Ltd., (a subsidiary of Capstone Mining Corporation), Minto Mine (Minto) Type “A” Water Licence QZ14-031-1 (WUL) and Quartz Mining Licence QML-0001.

The WUL specifically addresses the requirement in clause 95 which states *“The Licensee shall implement the updated Geochemical Monitoring Program, including the Waste Rock Verification Program, and the results from this program are to be included in the Annual Report.”*

The QML addresses the requirement in Schedule D – Annual Reporting Requirements, under the Environmental Monitoring section, subsection a) which states *“a summary of the programs undertaken for environmental monitoring and surveillance as outlined in the Environmental Monitoring, Surveillance and Reporting Plan”*.

Details regarding the Geochemical Monitoring Program can be found in Minto’s Environmental Monitoring, Surveillance and Reporting Plan (EMSRP) that was approved by the Yukon Water Board and Yukon Government, Energy Mines and Resources Branch on October 4th, 2016 and December 13th, 2016 respectively. In general, the Geochemical Monitoring Program is comprised of the following components:

- The Acid Base Accounting (ABA) Program, the primary focus of this document;
- The Waste Rock Management Verification Program; and
- Low Grade and Oxide Ore Metals Leaching Characterization Program (Leach Pads).

The objective of the ABA Program is to determine the Neutralization Potential Ratio, otherwise referred to as the NPR (Neutralizing Potential divided by Acid Potential [NP/AP]) for overburden and waste rock. An NPR value of 3 or greater generally indicates non-acid generating material. During 2018, 110 waste rock and overburden samples were collected and analyzed from the Area 2 Stage 3 Pit, and another 5 samples of waste rock was sampled from the Minto East and Copper Keel underground developments.

A separate, parallel ABA program was administered to determine the NPR of the tailings solids. During 2018, 9 Tailing samples were collected and analyzed. A sample was analyzed for each month until October 2018. The mill was shut down on October 20th, 2018

The objective of the Waste Rock Management Verification Program is to verify that the on-site waste rock segregation system is performing as expected. The results of the Waste Rock Management Verification Program are available in a separate report and will therefore not be discussed further in this document.

There are currently no details or results for the Low Grade and Oxide Ore Metals Leaching Characterization Program. The leach pad structures were built in August 2017, and ore was added in November 2017 and January 2018. Results from this program are expected to be analyzed in 2019 and will not be discussed further in this document.

2 ABA Program - Waste Rock and Overburden

2.1 Internal Frequency of Sampling – On-site Analysis

On-site total carbon (C(T)) and total sulphur (S(T)) analysis are carried out on drill cuttings from every blast hole. Samples are collected for grade control purposes, and a portion of each sample is sent for S(T) and total carbon C(T) analyses at the on-site laboratory.

2.2 External Frequency of Sampling

External laboratory analysis were completed for composites samples from open pit mining. A sample of drill cuttings was collected from waste blasts with a frequency of approximately one sample for every seven holes drilled. Composite samples from each waste class for each blast are formed from approximately 4-5 individual samples.

External analysis were also carried out for underground ABA samples. The sampling procedure assembles a composite sample every 3300 tonnes (equivalent to approximately 50 m of development) using a grab sample or wall chipping technique.

2.3 Sample Preparation

All composite samples were reduced to 1-2 kg in mass using a riffle splitter. The resulting split sample was labeled according to the ABA Program sample naming standards and shipped to an accredited laboratory. The labeling methodology was consistent with the Mine Environmental ABA Database throughout the reporting period.

2.4 Test Work and Evaluation

Internal samples are analyzed for S(T) and C(T) using an Eltra CS-800 induction furnace with infrared detectors. The resultant S(T) and C(T) data are converted to equivalent acid and neutralization potential and ultimately, NP:AP ratios are calculated. The calculated NP:AP ratios are used for characterization and segregation of waste rock on-site. This data is used for internal classification and waste rock segregation only, therefore, the results of that program will not be reported in this report.

In 2018, ALS Minerals conducted ABA analysis using the MEND (1991) Modified NP method as detailed in the EMSRP for all external samples. Reported results were entered into the Mine Environmental ABA Database. Waste rock and overburden composite samples were also analyzed for total metals for the entire duration of the reporting period.

For the reporting period, the results obtained from ALS were compared against past results found in the Mine Environmental ABA Database and the results are presented in Section 2.6. Sulphide sulphur ($S(S^{-2})$) results from ALS Minerals were calculated using the difference between total sulphur and sulphate sulphur (HCl Leach). In the event that the $S(S^{-2})$ value was zero or negative, the detection limit of <0.01% was used. The acid potential (AP) results from ALS Mineral were calculated using the calculated $S(S^{-2})$ value.

2.5 Discussion

Blasts are numbered by bench (denoted by the toe elevation) and by the sequential blast number for that bench (e.g. 784-01; 784 being the toe elevation of the bench and 01 being the first blast of the bench).

The primary lithology of the deposit is granodiorite. The granodiorite is divided into sub-units and classified as equigranular granodiorite (eG), porphyroblastic granodiorite (pG), and foliated granodiorite (fG). Locally, very highly-weathered granodiorite near the surface is described as residuum, and surface materials comprised of organics and soil is termed overburden. Other minor lithological units are described as pegmatite (Peg), Andesite (And) and Aplite (Ap).

2.6 Results

The 115 samples collected in the reporting period were analyzed by ALS Minerals and results were reported according to the Modified NP method (MEND 1991). In the reporting period, the NPR values ranged from 0.96 to 131.2 with a mean NP/mean AP of 6.13 and a median of 25.60. A summary of the results for ABA analysis are attached as Appendix A. Additionally, the ALS raw lab result files are provided in Appendix B.

2.6.1 NPR

The 2018 NPR results are compared to the results from 2014-2018 in Table 2-1, below.

Table 2-1. NPR Results Summary for 2014 to 2018.

NPR Values from SGS (2014-2016) and from ALS (2016-2018)				
Period Ending	Minimum (NPR)	Maximum (NPR)	(Mean NP)/(Mean AP)	Median (NPR)
2014 (January to December, 2014)	0.60	167.20	5.31	23.80
2015 (January to December, 2015)	-6.10	102.10	5.08	18.70
2016 (January to December, 2016)	0.80	134.40	14.49	35.20
2017 (January to December, 2017)	0.67	208.0	15.26	28.80
2018 (January to September, 2018)	0.96	131.2	6.13	25.60

During the reporting period, 17 samples returned NPR values below the threshold of 3.0. Of the 17 samples with a NPR value less than 3:

- 12 were found to have an increased sulphide sulphur content (and therefore AP) consequently decreasing the NPR;

And of the remaining samples:

- 3 samples represented material classified as NAG (or waste);
- 2 samples represented material that was placed in the SAT dump;
- 1 samples represented material that was placed in the constrution grade;

All waste rock and overburden was dispatched based on Minto's *Waste Rock and Overburden Management Plan*.

2.6.2 Paste pH

The paste pH results for 2018 were between 7.90 and 9.50 with a mean value of 8.90 and a median value of 8.90. The paste pH results for 2018 are compared to 2014-2017 and displayed in Table 2-3, below.

Table 2-2. Paste pH Results Summary for 2014 to 2018.

Paste pH from SGS (2014-2016) and from ALS (2016-2018)				
Period Ending	Minimum (pH)	Maximum (pH)	Mean (pH)	Median (pH)
2014 (January to December, 2014)	6.44	9.43	8.56	8.66
2015 (January to December, 2015)	5.23	9.47	8.70	8.78
2016 (January to December, 2016)	7.61	9.39	8.75	8.77
2017 (January to December, 2017)	7.50	9.20	8.50	8.50
2018 (January to September, 2018)	7.90	9.50	8.90	8.90

The results from 2018 are comparable to previous years results.

2.6.3 Sulphide Sulphur

The sulphide sulphur content $S(S^{2-})$ results for 2018 ranged from <0.01 to 1.40%, with a mean value of 0.124% and a median value of 0.03% as summarized and compared with 2014-2018 values in Table 2-4.

Table 2-3. Sulphide Sulphur Results Summary for 2014 to 2017

Sulphide-Sulphur % from SGS (2014-2016) and from ALS (2016-2018)				
Period Ending	Minimum ($S(S^{2-})$)	Maximum ($S(S^{2-})$)	Mean ($S(S^{2-})$)	Median ($S(S^{2-})$)
2014 (January to December, 2014)	0.01	3.26	0.12	0.02
2015 (January to December, 2015)	<0.01	1.09	0.09	0.02
2016 (January to December, 2016)	<0.01	0.75	0.05	0.02
2017 (January to December, 2017)	<0.01	1.38	0.082	0.03
2018 (January to September, 2018)	<0.01	1.40	0.124	0.03

A total of 14 samples exceeded the sulphide sulphur threshold for construction rock of 0.3% during 2018. Furthermore, 12 samples also had a NPR of less than 3 and therefore represented SAT material. The 2 remaining samples had an NPR greater than 3 and exceeded the sulphide sulphur threshold (1 MEUG and 1 A2S3).

Figure 2-2-1, below, is a plot of sulphide sulphur versus (vs) NPR for all samples analyzed during 2018. Figure 2-1 illustrates that 14 samples had sulphide sulphur content greater than 0.3% and 17 samples had a NPR threshold of less than 3.

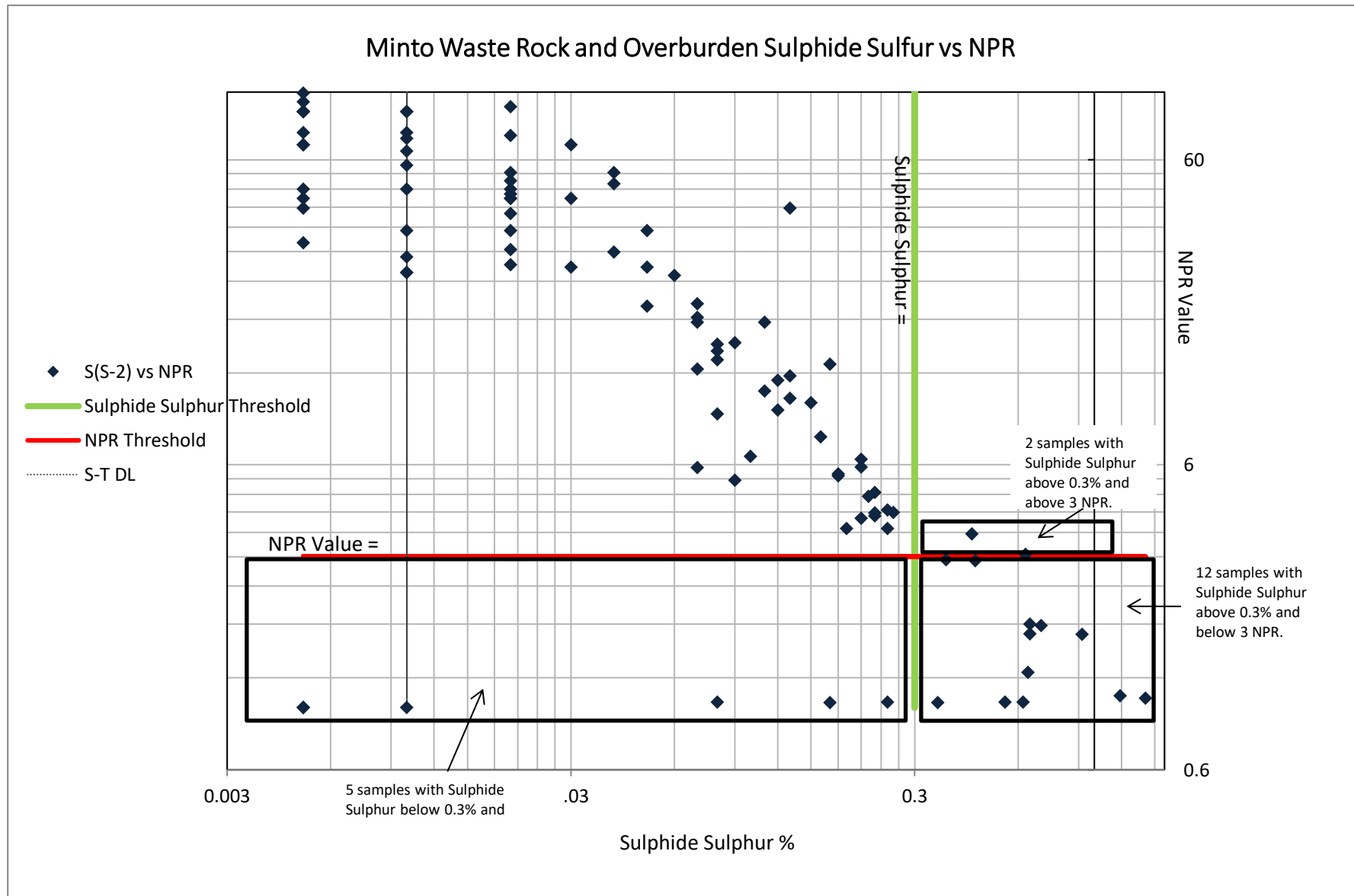


Figure 2-2-1. Minto Waste Rock and Overburden Sulphide Sulfur vs NPR, 2018

3 Tailings

3.1 Frequency of Sampling and Sample Preparation

Minto collects a weekly sample of final tailings. The weekly samples have been filtered and dried in the onsite lab and then combined into a monthly sample which is then riffled down to produce a 1-2 kg composite. Samples are labelled according to the labeling protocol established in the Mine Environmental ABA Database. The last complete sample was collected in September 2018, as the Mill shut down on October 20th, 2018.

3.2 Test work and Evaluation

Mirroring the waste rock and overburden analysis, ALS Minerals conducted ABA analysis using the MEND (1991) Modified NP method as detailed in the EMSRP. Reported results were entered into the Mine Environmental ABA Database. Monthly tailings composite samples were also analyzed for total metals for the 9 months of available samples.

3.3 Results

The results from the ALS Minerals laboratory analyses indicate that 2018 tailings samples were within the threshold of NPR greater than 4 and contain lower than 0.3% sulphide sulphur content as presented in Figure 3-1, below. The tailings results are summarized in Appendix C and the raw lab results are presented in Appendix B.

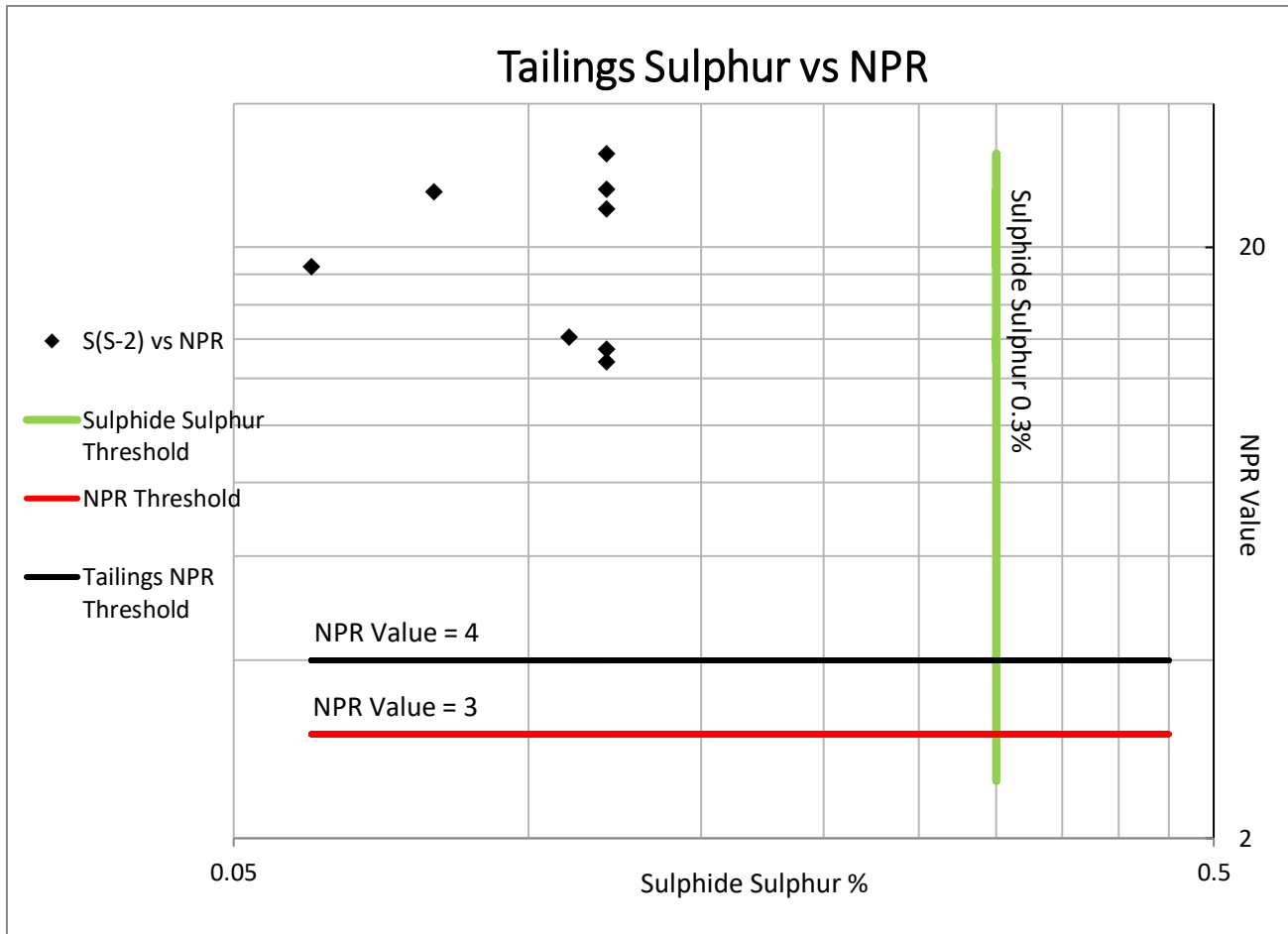


Figure 3-1: Tailings Sulphide Sulphur vs NPR, 2018

4 Conclusion

The results displayed in this report combined with the previous reporting periods are the foundation for the Mine Environmental ABA Database. Overburden and waste rock development will continue through the subsequent phases of mining and milling and will be sampled, analyzed and reported as required by the WUL and QML and in accordance with the EMSRP if mining resumes.

5 References

MEND. (1991). *Mine Environment Neutral Drainage Program: Acid Rock Drainage Prediction Manual*, MEND Project 1.16.1 (b). Prepared by Coastech Research Inc., North Vancouver, B.C. March 1991.

Appendix A: 2018 Modified NP Method (MEND 1991) ABA Results for Waste Rock and Overburden

Appendix A. Summary A2S3 Pits ABA Analysis Results from ALS Mineral for 2018												
Sample	ABA ID	Sample	Waste	Paste	TIC	S(T)	S(SO ₄)	S(S ²⁻)	AP	Net	NP:AP Ratio	NP
Date		Source	Type	pH	%	%	%	%	CaCO ₃ kg / tonne	NP	(NP/AP)	Modified
1-Jan-18	146737	A2S3	CGW	8.9	0.56	0.02	<0.01	0.02	0.625	44	72.00	45
1-Jan-18	146738	A2S3	NAG	8.9	0.34	0.01	<0.01	0.01	0.3125	32	102.40	32
2-Jan-18	146740	A2S3	CGW	9	0.07	0.02	0.02	<0.01	0.3125	13	44.80	14
2-Jan-18	146739	A2S3	NAG	9	0.12	0.01	<0.01	0.01	0.3125	18	57.60	18
3-Jan-18	146741	A2S3	NAG	9	0.4	0.23	<0.01	0.23	7.1875	23	4.17	30
3-Jan-18	146742	A2S3	CGW	8.8	0.66	0.01	0.02	<0.01	0.3125	41	131.20	41
5-Jan-18	146743	A2S3	SAT	8.9	0.13	0.09	<0.01	0.09	2.8125	12	5.33	15
5-Jan-18	146744	A2S3	NAG	8.7	0.15	<0.01	<0.01	<0.01	0.3125	21	67.20	21
6-Jan-18	146745	A2S3	CGW	8.7	0.31	<0.01	<0.01	<0.01	0.3125	33	105.60	33
6-Jan-18	146746	A2S3	NAG	8.7	0.18	0.01	<0.01	0.01	0.3125	23	73.60	23
8-Jan-18	146748	A2S3	NAG	8.8	0.48	0.16	<0.01	0.16	5.000	32	7.40	37
8-Jan-18	146749	A2S3	CGW	9.5	0.08	<0.01	<0.01	<0.01	0.3125	13	41.60	13
9-Jan-18	146750	A2S3	NAG	8.8	<0.05	0.01	0.01	<0.01	0.3125	8	25.60	8
10-Jan-18	153301	A2S3	NAG	9	0.3	0.02	<0.01	0.02	0.625	24	40.00	25
10-Jan-18	153302	A2S3	CGW	9	0.44	0.05	0.02	0.03	0.9375	31	35.20	33
11-Jan-18	153303	A2S3	NAG	9	0.49	0.11	<0.01	0.11	3.4375	33	10.47	36
12-Jan-18	153304	A2S3	NAG	8.8	0.28	0.08	0.01	0.07	2.1875	27	13.26	29
13-Jan-18	153305	A2S3	NAG	8.8	<0.05	0.01	<0.01	0.01	0.3125	9	28.80	9
13-Jan-18	153306	A2S3	CGW	8.9	0.05	0.01	<0.01	0.01	0.3125	11	35.20	11
15-Jan-18	153307	A2S3	NAG	8.6	<0.05	0.01	0.01	<0.01	0.3125	8	25.60	8
15-Jan-18	153308	A2S3	NAG	9	0.52	0.21	0.02	0.19	5.9375	28	5.89	35
17-Jan-18	153309	A2S3	CGW	8.7	0.33	0.02	<0.01	0.02	0.625	33	54.40	34
17-Jan-18	153310	A2S3	NAG	8.6	0.33	0.02	0.03	<0.01	0.3125	31	102.40	32
18-Jan-18	153315	A2S3	CGW	9	0.29	0.08	0.02	0.06	1.875	26	14.93	28
18-Jan-18	153311	A2S3	NAG	8.8	0.25	0.02	0.03	<0.01	0.3125	27	89.60	28
18-Jan-18	153312	A2S3	NAG	9	0.1	0.02	<0.01	0.02	0.625	16	27.20	17
18-Jan-18	153313	A2S3	CGW	8.6	0.25	0.02	<0.01	0.02	0.625	27	44.80	28

Appendix A. Summary A2S3 Pits ABA Analysis Results from ALS Mineral for 2018												
Sample	ABA ID	Sample	Waste	Paste	TIC	S(T)	S(SO ₄)	S(S ²⁻)	AP	Net	NP:AP Ratio	NP
Date		Source	Type	pH	%	%	%	%	CaCO ₃ kg / tonne	NP	(NP/AP)	Modified
18-Jan-18	153314	A2S3	NAG	9.2	0.12	0.02	<0.01	0.02	0.625	18	30.40	19
20-Jan-18	153317	A2S3	CGW	9	0.06	0.02	0.02	<0.01	0.3125	14	48.00	15
20-Jan-18	153316	A2S3	Waste	8.9	0.21	0.01	<0.01	0.01	0.3125	27	86.40	27
21-Jan-18	153321	A2S3	CGW	9	0.39	<0.01	<0.01	<0.01	0.3125	29	92.80	29
21-Jan-18	153322	A2S3	NAG	9	0.17	0.01	0.01	<0.01	0.3125	15	48.00	15
22-Jan-18	153318	A2S3	NAG	9	0.57	0.01	0.01	<0.01	0.3125	37	118.40	37
22-Jan-18	153319	A2S3	CGW	9	0.52	0.07	<0.01	0.07	2.1875	38	18.29	40
22-Jan-18	153320	A2S3	NAG	9.2	0.23	0.08	<0.01	0.08	2.500	20	8.80	22
22-Jan-18	153323	A2S3	NAG	8.9	0.33	0.05	0.02	0.03	0.9375	23	26.67	25
23-Jan-18	153324	A2S3	CGW	8.7	0.32	<0.01	<0.01	<0.01	0.3125	27	86.40	27
23-Jan-18	153325	A2S3	NAG	8.7	0.09	<0.01	<0.01	<0.01	0.3125	10	32.00	10
24-Jan-18	153326	A2S3	NAG	9	0.13	0.07	0.01	0.06	1.875	9	5.87	11
24-Jan-18	153327	A2S3	CGW	9.2	0.13	<0.01	<0.01	<0.01	0.3125	14	44.80	14
25-Jan-18	153328	A2S3	NAG	8.9	0.45	0.21	0.01	0.2	6.25	18	4.00	25
26-Jan-18	153331	A2S3	NAG	9	0.31	0.55	<0.01	0.55	17.1875	22	1.00	17.2
26-Jan-18	153332	A2S3	SAT	8.8	0.64	0.62	<0.01	0.62	19.375	35	1.00	19.4
26-Jan-18	153330	A2S3	SAT	8.8	0.54	0.25	<0.01	0.25	7.8125	33	1.00	7.8
26-Jan-18	153329	A2S3	NAG	8.9	0.63	<0.01	<0.01	<0.01	0.3125	35	112.00	35
27-Jan-18	153333	A2S3	NAG	9.2	0.25	<0.01	<0.01	<0.01	0.3125	21	0.96	<0.3
28-Jan-18	153334	A2S3	NAG	8.8	0.35	0.17	<0.01	0.17	5.3125	26	1.00	5.3
28-Jan-18	153335	A2S3	SAT	8.7	0.24	0.35	<0.01	0.35	10.9375	22	1.00	10.9
28-Jan-18	153336	A2S3	CGW	9	0.24	0.01	<0.01	0.01	0.3125	23	0.96	0.3
29-Jan-18	153337	A2S3	NAG	8.8	0.55	0.08	<0.01	0.08	2.5	36	1.00	2.5
29-Jan-18	153338	A2S3	CGW	9	0.1	<0.01	<0.01	<0.01	0.3125	13	0.96	<0.3
30-Jan-18	153339	A2S3	NAG	9.1	0.43	<0.01	0.01	<0.01	0.3125	37	0.96	<0.3
30-Jan-18	153340	A2S3	CGW	9.2	0.22	0.03	0.01	0.02	0.625	27	44.80	28
31-Jan-18	153341	A2S3	CGW	8.8	0.21	<0.01	0.01	<0.01	0.3125	27	86.40	27

Appendix A. Summary A2S3 Pits ABA Analysis Results from ALS Mineral for 2018												
Sample	ABA ID	Sample	Waste	Paste	TIC	S(T)	S(SO ₄)	S(S ²⁻)	AP	Net	NP:AP Ratio	NP
Date		Source	Type	pH	%	%	%	%	CaCO ₃ kg / tonne	NP	(NP/AP)	Modified
1-Feb-18	153343	A2S3	CGW	9	0.4	0.18	0.02	0.16	5	22	5.60	28
1-Feb-18	153342	A2S3	NAG	9.1	0.33	0.02	0.01	0.01	0.3125	32	105.60	33
2-Feb-18	153344	A2S3	NAG	8.9	0.42	0.13	0.02	0.11	3.4375	30	9.89	34
2-Feb-18	153346	A2S3	NAG	8.9	0.81	1.41	0.01	1.4	43.75	1	1.03	45
2-Feb-18	153345	A2S3	SAT	9	0.47	0.01	<0.01	0.01	0.3125	41	131.20	41
3-Feb-18	149478	A2S3	NAG	8.9	0.66	0.45	0.01	0.44	13.75	26	2.91	40
4-Feb-18	149479	A2S3	NAG	9	0.44	0.12	<0.01	0.12	3.75	30	9.07	34
5-Feb-18	149480	A2S3	NAG	9.4	0.19	<0.01	<0.01	<0.01	0.3125	21	67.20	21
7-Feb-18	153347	A2S3	NAG	9.4	0.11	<0.01	0.01	<0.01	0.3125	15	48.00	15
8-Feb-18	153349	A2S3	NAG	9.3	0.28	0.03	0.02	0.01	0.3125	20	67.20	21
9-Feb-18	153348	A2S3	NAG	9	0.19	<0.01	<0.01	<0.01	0.3125	23	73.60	23
12-Feb-18	153350	A2S3	NAG	9	0.53	<0.01	0.01	<0.01	0.3125	36	115.20	36
12-Feb-18	149476	A2S3	NAG	9	0.38	0.23	0.01	0.22	6.875	21	4.07	28
13-Feb-18	149482	A2S3	NAG	9	0.61	<0.01	0.02	<0.01	0.3125	41	131.20	41
13-Feb-18	149477	A2S3	NAG	9.1	0.6	0.21	<0.01	0.21	6.5625	34	6.25	41
13-Feb-18	149481	A2S3	CGW	9.2	0.35	<0.01	<0.01	<0.01	0.3125	31	99.20	31
14-Feb-18	149483	A2S3	NAG	8.6	0.31	0.02	<0.01	0.02	0.625	28	46.40	29
14-Feb-18	149484	A2S3	NAG	8.6	0.68	0.15	<0.01	0.15	4.6875	40	9.60	45
16-Feb-18	149486	A2S3	NAG	8.9	0.3	0.03	<0.01	0.03	0.9375	24	26.67	25
16-Feb-18	149485	A2S3	NAG	8.8	0.22	0.19	<0.01	0.19	5.9375	16	3.71	22
18-Feb-18	149489	A2S3	NAG	8.8	0.19	0.07	0.03	0.04	1.25	20	17.60	22
18-Feb-18	149490	A2S3	SAT	8.8	0.41	0.01	<0.01	0.01	0.3125	38	121.60	38
18-Feb-18	149487	A2S3	NAG	8.6	0.35	0.05	<0.01	0.05	1.5625	29	19.84	31
18-Feb-18	149488	A2S3	CGW	8.6	0.27	0.64	<0.01	0.64	20	5	1.25	25
22-Feb-18	149491	A2S3	NAG	8.8	0.7	0.06	<0.01	0.06	1.875	45	25.07	47
23-Feb-18	149492	A2S3	CGW	8.8	0.42	0.01	<0.01	0.01	0.3125	36	115.20	36
23-Feb-18	149493	A2S3	NAG	8.9	0.2	0.01	<0.01	0.01	0.3125	20	64.00	20

Appendix A. Summary A2S3 Pits ABA Analysis Results from ALS Mineral for 2018												
Sample	ABA ID	Sample	Waste	Paste	TIC	S(T)	S(SO ₄)	S(S ²⁻)	AP	Net	NP:AP Ratio	NP
Date		Source	Type	pH	%	%	%	%	CaCO ₃ kg / tonne	NP	(NP/AP)	Modified
24-Feb-18	149495	A2S3	SAT	8.9	0.38	0.25	<0.01	0.25	7.8125	21	3.71	29
24-Feb-18	149494	A2S3	NAG	8.6	1.03	0.63	<0.01	0.63	19.6875	40	3.05	60
25-Feb-18	149497	A2S3	NAG	9	0.2	0.02	<0.01	0.02	0.625	21	35.20	22
25-Feb-18	149496	A2S3	NAG	9	0.21	0.01	<0.01	0.01	0.3125	22	70.40	22
26-Feb-18	149498	A2S3	NAG	8.5	0.55	1.19	0.03	1.16	36.25	1	1.05	38
26-Feb-18	149499	A2S3	NAG	8.8	0.31	0.07	<0.01	0.07	2.1875	25	12.34	27
27-Feb-18	149500	A2S3	SAT	9	0.81	0.92	<0.01	0.92	28.75	19	1.67	48
27-Feb-18	156252	A2S3	CGW	9	0.63	0.23	<0.01	0.23	7.1875	28	4.87	35
27-Feb-18	156251	A2S3	CGW	9	0.88	0.7	<0.01	0.7	21.875	17	1.78	39
28-Feb-18	156253	A2S3	NAG	9	0.47	<0.01	<0.01	<0.01	0.3125	34	108.80	34
1-Mar-18	156254	A2S3	CGW	9	0.24	0.01	<0.01	0.01	0.3125	27	86.40	27
1-Mar-18	156255	A2S3	NAG	9	0.44	0.18	<0.01	0.18	5.625	25	5.51	31
2-Mar-18	156256	A2S3	NAG	9	0.34	0.02	<0.01	0.02	0.625	31	51.20	32
3-Mar-18	156257	A2S3	NAG	9.1	0.28	<0.01	<0.01	<0.01	0.3125	27	86.40	27
4-Mar-18	156258	A2S3	NAG	8.9	0.55	0.37	0.01	0.36	11.25	21	2.93	33
5-Mar-18	156260	A2S3	NAG	9.1	0.52	0.65	<0.01	0.65	20.3125	14	1.67	34
5-Mar-18	156259	A2S3	SAT	9	0.55	0.22	0.01	0.21	6.5625	24	4.72	31
5-Mar-18	156261	A2S3	CGW	9.3	0.41	0.08	0.01	0.07	2.1875	29	14.17	31
6-Mar-18	156262	A2S3	NAG	9.3	0.19	0.1	<0.01	0.1	3.125	17	6.40	20
10-Mar-18	156263	A2S3	NAG	9	0.58	0.12	0.01	0.11	3.4375	35	11.35	39
13-Mar-18	156264	A2S3	NAG	9.1	0.77	0.11	0.01	0.1	3.125	52	17.60	55
14-Mar-18	156266	A2S3	NAG	9.1	0.18	0.04	0.01	0.03	0.9375	27	29.87	28
14-Mar-18	156265	A2S3	NAG	9	0.5	0.04	0.02	0.02	0.625	33	54.40	34
16-Mar-18	156267	A2S3	NAG	9	0.63	0.13	0.01	0.12	3.75	40	11.73	44
18-Mar-18	156268	A2S3	NAG	8.9	0.5	0.04	0.01	0.03	0.9375	46	50.13	47
18-Mar-18	156269	A2S3	NAG	8.8	0.55	0.65	0.01	0.64	20	16	1.80	36
18-Mar-18	156270	A2S3	NAG	9.1	0.41	0.09	0.02	0.07	2.1875	30	15.09	33

Appendix A. Summary A2S3 Pits ABA Analysis Results from ALS Mineral for 2018												
Sample	ABA ID	Sample	Waste	Paste	TIC	S(T)	S(SO ₄)	S(S ²⁻)	AP	Net	NP:AP Ratio	NP
Date		Source	Type	pH	%	%	%	%	CaCO ₃ kg / tonne	NP	(NP/AP)	Modified
18-Mar-18	156271	A2S3	NAG	9.1	0.31	<0.01	0.01	<0.01	0.3125	27	86.40	27
23-Mar-18	156272	A2S3	NAG	8.5	0.64	0.07	0.01	0.06	1.875	36	20.27	38

Appendix A. Summary Minto East and Copper Keel Underground ABA Analysis Results from ALS Mineral for 2018												
Sample	ABA ID	Sample	Waste	Paste	TIC	S(T)	S(SO ₄)	S(S ²⁻)	AP	Net	NP:AP Ratio	NP
Date		Source	Type	pH	%	%	%	%	CaCO ₃ kg /tonne	NP	(NP/AP)	Modified
11-Apr-18	159901	ME UG	SAT	8.1	0.17	0.26	0.13	0.13	4.0625	9	4.18	17
1-Sep-18	156392	CK UG	SAT	8.5	<0.05	0.25	0.19	0.06	1.875		4.27	8
7-Sep-18	168978	ME UG		8.4	0.09	0.13	0.12	0.01	0.3125	9	41.60	13
15-Sep-18	170264	ME UG		8.2	0.19	0.44	0.26	0.18	5.625	6	3.56	20
21-Sep-18	170265	ME UG	SAT	8.4	0.09	0.17	0.13	0.04	1.25	11	12.80	16

Appendix B: 2018 ABA Lab Results for Tailings and Waste Rock Samples



Minto Explorations Ltd.
ATTN: Minto Environment
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 22-JAN-18
Report Date: 01-MAR-18 17:53 (MT)
Version: FINAL

Client Phone: 604-759-0860

Certificate of Analysis

Lab Work Order #: L2047740
Project P.O. #: NOT SUBMITTED
Job Reference:
C of C Numbers: 18-02
Legal Site Desc:

Comments: Please note, the ALS Minerals version of the finalized report and QC can be found at the end of the attachment.

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2047740-1 Waste 02-JAN-18 146739	L2047740-2 Waste 02-JAN-18 146740	L2047740-3 Waste 03-JAN-18 146741	L2047740-4 Waste 03-JAN-18 146742	L2047740-5 Waste 05-JAN-18 146743
Grouping	Analyte					
SOIL						
Physical Tests	pH (Unity)	9.0	9.0	9.0	8.8	8.9
Organic / Inorganic Carbon	Carbon (C) (%)	0.12	0.07	0.40	0.66	0.13
Acid Base Accounting	FIZZ RATING (Unity)	2	2	2	2	2
	MPA (tCaCO3/1Kt)	0.3	0.6	7.2	0.3	2.8
	Neutralization Potential (NP) (tCaCO3/1Kt)	18	14	30	41	15
	NNP (tCaCO3/1Kt)	18	13	23	41	12
	Ratio (NP/MPA) (Unity)	57.60	22.40	4.17	131.20	5.33
	Sulfate Sulfur (carbonate leach) (%)	<0.01	<0.01	<0.01	<0.01	<0.01
	Sulfate Sulfur (HCl leach) (%)	<0.01	0.02	<0.01	0.02	<0.01
	Sulfide Sulfur (T minus HCl leach) (%)	0.01	<0.01	0.23	<0.01	0.09
	Total Sulfur (combustion) (%)	0.01	0.02	0.23	0.01	0.09
Total Metals	Aluminum (Al) (%)	1.09	1.26	0.93	0.72	1.13
	Antimony (Sb) (ppm)	<0.05	<0.05	<0.05	<0.05	<0.05
	Arsenic (As) (ppm)	0.7	0.1	0.6	1.0	0.7
	Barium (Ba) (ppm)	240	300	270	150	320
	Beryllium (Be) (ppm)	0.28	0.21	0.28	0.42	0.28
	Bismuth (Bi) (ppm)	0.03	0.17	0.04	0.02	0.17
	Boron (B) (ppm)	<10	<10	<10	<10	<10
	Cadmium (Cd) (ppm)	0.07	0.06	0.12	0.03	0.27
	Calcium (Ca) (%)	0.74	0.52	0.96	1.34	0.57
	Cerium (Ce) (ppm)	20.8	27.7	20.2	29.3	14.95
	Cesium (Cs) (ppm)	0.36	0.41	0.67	0.72	0.62
	Chromium (Cr) (ppm)	6	5	4	5	6
	Cobalt (Co) (ppm)	5.4	5.6	7.5	5.5	7.6
	Copper (Cu) (ppm)	176.0	843	1050	83.4	2330
	Gallium (Ga) (ppm)	5.16	6.16	4.49	3.94	5.72
	Germanium (Ge) (ppm)	0.11	0.13	0.09	0.11	0.10
	Gold (Au) (ppm)	<0.02	<0.02	<0.02	<0.02	0.06
	Hafnium (Hf) (ppm)	0.06	0.03	0.03	0.05	0.04
	Indium (In) (ppm)	0.025	0.029	0.045	0.037	0.049
	Iron (Fe) (%)	2.20	2.42	2.72	2.30	2.69
	Lanthanum (La) (ppm)	10.5	14.3	11.0	15.1	8.0
	Lead (Pb) (ppm)	2.2	1.9	3.0	3.3	3.0
	Lithium (Li) (ppm)	5.3	5.9	3.4	2.9	4.5
	Magnesium (Mg) (%)	0.56	0.62	0.54	0.54	0.52
	Manganese (Mn) (ppm)	613	533	480	573	511

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2047740-6 Waste 05-JAN-18 146744	L2047740-7 Waste 06-JAN-18 146745	L2047740-8 Waste 06-JAN-18 146746	L2047740-9 Waste 08-JAN-18 146748	L2047740-10 Waste 08-JAN-18 146749
Grouping	Analyte					
SOIL						
Physical Tests	pH (Unity)	8.7	8.7	8.7	8.8	9.5
Organic / Inorganic Carbon	Carbon (C) (%)	0.15	0.31	0.18	0.48	0.08
Acid Base Accounting	FIZZ RATING (Unity)	2	2	2	2	2
	MPA (tCaCO3/1Kt)	<0.3	<0.3	0.3	5.0	<0.3
	Neutralization Potential (NP) (tCaCO3/1Kt)	21	33	23	37	13
	NNP (tCaCO3/1Kt)	21	33	23	32	13
	Ratio (NP/MPA) (Unity)	134.40	211.20	73.60	7.40	83.20
	Sulfate Sulfur (carbonate leach) (%)	<0.01	<0.01	<0.01	<0.01	<0.01
	Sulfate Sulfur (HCl leach) (%)	<0.01	<0.01	<0.01	<0.01	<0.01
	Sulfide Sulfur (T minus HCl leach) (%)	<0.01	<0.01	0.01	0.16	<0.01
	Total Sulfur (combustion) (%)	<0.01	<0.01	0.01	0.16	<0.01
Total Metals	Aluminum (Al) (%)	1.18	1.11	1.29	0.80	1.12
	Antimony (Sb) (ppm)	<0.05	<0.05	<0.05	<0.05	<0.05
	Arsenic (As) (ppm)	0.7	0.8	0.6	1.4	0.2
	Barium (Ba) (ppm)	130	200	210	210	370
	Beryllium (Be) (ppm)	0.49	0.39	0.29	0.30	0.17
	Bismuth (Bi) (ppm)	0.01	0.02	0.04	0.07	0.01
	Boron (B) (ppm)	<10	<10	<10	<10	<10
	Cadmium (Cd) (ppm)	0.06	0.04	0.08	0.15	0.02
	Calcium (Ca) (%)	1.02	1.39	0.96	1.31	0.48
	Cerium (Ce) (ppm)	20.9	22.6	26.1	27.8	23.7
	Cesium (Cs) (ppm)	0.32	0.29	0.38	0.41	0.49
	Chromium (Cr) (ppm)	5	4	5	4	5
	Cobalt (Co) (ppm)	5.8	5.2	6.4	9.2	5.2
	Copper (Cu) (ppm)	47.9	33.1	340	1195	30.3
	Gallium (Ga) (ppm)	6.18	5.70	6.36	4.18	5.12
	Germanium (Ge) (ppm)	0.11	0.09	0.10	0.10	0.10
	Gold (Au) (ppm)	<0.02	<0.02	<0.02	<0.02	<0.02
	Hafnium (Hf) (ppm)	0.06	0.04	0.05	0.04	0.02
	Indium (In) (ppm)	0.021	0.024	0.020	0.051	0.021
	Iron (Fe) (%)	2.18	1.95	2.37	2.48	2.27
	Lanthanum (La) (ppm)	10.5	11.7	13.8	14.7	12.5
	Lead (Pb) (ppm)	3.2	3.0	2.6	4.6	1.9
	Lithium (Li) (ppm)	8.1	7.1	7.6	3.0	4.9
	Magnesium (Mg) (%)	0.58	0.46	0.64	0.44	0.48
	Manganese (Mn) (ppm)	579	610	676	652	485

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2047740-1 Waste 02-JAN-18 146739	L2047740-2 Waste 02-JAN-18 146740	L2047740-3 Waste 03-JAN-18 146741	L2047740-4 Waste 03-JAN-18 146742	L2047740-5 Waste 05-JAN-18 146743
Grouping	Analyte					
SOIL						
Total Metals	Mercury (Hg) (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01
	Molybdenum (Mo) (ppm)	1.29	0.88	7.28	1.10	12.55
	Nickel (Ni) (ppm)	3.2	2.6	2.5	2.3	3.3
	Niobium (Nb) (ppm)	0.19	0.29	0.22	0.09	0.25
	Phosphorus (P) (ppm)	630	580	770	600	810
	Potassium (K) (%)	0.58	0.76	0.58	0.30	0.73
	Rhenium (Re) (ppm)	<0.001	<0.001	0.010	0.001	0.010
	Rubidium (Rb) (ppm)	26.0	36.0	28.9	15.2	39.2
	Scandium (Sc) (ppm)	4.5	8.2	3.9	5.9	4.3
	Selenium (Se) (ppm)	0.3	0.4	1.1	<0.2	1.2
	Silver (Ag) (ppm)	0.04	0.17	0.21	0.03	0.56
	Sodium (Na) (%)	0.09	0.10	0.08	0.07	0.08
	Strontium (Sr) (ppm)	51.9	44.0	71.5	105.0	55.3
	Sulfur (S) (%)	<0.01	0.01	0.24	0.01	0.10
	Tantalum (Ta) (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01
	Tellurium (Te) (ppm)	0.01	0.03	0.03	<0.01	0.07
	Thallium (Tl) (ppm)	0.15	0.21	0.19	0.08	0.24
	Thorium (Th) (ppm)	2.1	3.8	2.4	3.3	1.5
	Tin (Sn) (ppm)	0.5	0.5	0.6	0.6	0.9
	Titanium (Ti) (%)	0.097	0.124	0.086	0.033	0.121
	Tungsten (W) (ppm)	0.79	0.79	0.44	0.35	1.12
	Uranium (U) (ppm)	0.22	0.17	0.23	0.19	0.26
	Vanadium (V) (ppm)	47	48	57	42	72
	Yttrium (Y) (ppm)	8.95	5.01	5.90	10.65	6.81
	Zinc (Zn) (ppm)	74	80	71	68	82
	Zirconium (Zr) (ppm)	1.2	0.6	1.2	1.1	1.3
Permanent Gases	Carbon Dioxide (CO2) (%)	0.4	0.3	1.5	2.4	0.5
Miscellaneous	Carbon (C) (%)	0.21	0.16	0.51	0.82	0.22

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2047740-6 Waste 05-JAN-18 146744	L2047740-7 Waste 06-JAN-18 146745	L2047740-8 Waste 06-JAN-18 146746	L2047740-9 Waste 08-JAN-18 146748	L2047740-10 Waste 08-JAN-18 146749
Grouping	Analyte					
SOIL						
Total Metals	Mercury (Hg) (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01
	Molybdenum (Mo) (ppm)	1.13	0.89	0.75	13.15	1.34
	Nickel (Ni) (ppm)	2.9	1.9	2.5	2.5	4.0
	Niobium (Nb) (ppm)	0.13	0.06	0.15	0.17	0.29
	Phosphorus (P) (ppm)	700	450	650	650	500
	Potassium (K) (%)	0.27	0.26	0.52	0.38	0.80
	Rhenium (Re) (ppm)	<0.001	<0.001	<0.001	0.015	<0.001
	Rubidium (Rb) (ppm)	12.0	12.1	25.1	19.1	38.6
	Scandium (Sc) (ppm)	4.2	4.5	3.7	4.5	3.6
	Selenium (Se) (ppm)	0.2	0.3	0.3	1.2	<0.2
	Silver (Ag) (ppm)	0.01	0.01	0.14	0.29	0.01
	Sodium (Na) (%)	0.09	0.08	0.09	0.07	0.11
	Strontium (Sr) (ppm)	67.1	74.1	62.3	99.9	40.5
	Sulfur (S) (%)	<0.01	<0.01	0.01	0.17	<0.01
	Tantalum (Ta) (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01
	Tellurium (Te) (ppm)	<0.01	<0.01	0.03	0.03	<0.01
	Thallium (Tl) (ppm)	0.06	0.07	0.15	0.12	0.22
	Thorium (Th) (ppm)	2.0	2.5	4.4	3.0	3.1
	Tin (Sn) (ppm)	0.5	0.5	0.6	0.7	0.5
	Titanium (Ti) (%)	0.040	0.023	0.078	0.046	0.136
	Tungsten (W) (ppm)	0.38	0.12	0.33	0.28	0.74
	Uranium (U) (ppm)	0.25	0.29	0.36	0.46	0.12
	Vanadium (V) (ppm)	41	37	49	54	50
	Yttrium (Y) (ppm)	12.10	8.83	8.29	9.41	4.42
	Zinc (Zn) (ppm)	70	57	68	68	64
	Zirconium (Zr) (ppm)	1.2	0.7	1.0	1.4	0.7
Permanent Gases	Carbon Dioxide (CO2) (%)	0.6	1.2	0.7	1.8	0.3
Miscellaneous	Carbon (C) (%)	0.22	0.41	0.26	0.58	0.13

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ABA-OA-VOL08-AX	Soil	Acid Base Accounting	OA-VOL08
CARBON-C-GAS05-AX	Soil	Carbon, TOC and CO2	C-GAS05
CARBON-C-IR07-AX	Soil	Carbon (C) using LECO analyzer	Total Carbon - Method Code C-IR07
Total Carbon & Sulfur - Method Codes C-IR07 & S-IR08			
A 0.1g sample is heated to approximately 1350°C in an induction furnace while passing a stream of oxygen through the sample. Carbon dioxide & sulfur dioxide released from the sample are measured by an IR detection system (Leco analyzer) and the total carbon & sulfur results are provided.			
ME-MS41-AX	Soil	Aqua Regia ICPMS	Aqua Regia ICPMS
A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences.			
PH-OA-ELE07-AX	Soil	pH	OA-ELE07
SULPHUR-S-CAL06A-AX	Soil	Sulfide Sulfur Calc from HCl Leach	ALS Minerals S-CAL06A
Sulfide Sulfur (as S) is calculated by subtracting the HCl Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion.			
SULPHUR-S-GRA06-AX	Soil	Sulfate Sulfur in Soil (Carbonate Leach)	ALS Minerals S-GRA06
A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).			
SULPHUR-S-GRA06A-AX	Soil	Sulfate Sulfur in Soil (HCl Leach)	ALS Minerals S-GRA06A
A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).			
SULPHUR-S-IR08-AX	Soil	Total Sulfur in Soil by Combustion	ALS Minerals S-IR08
The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
AX	ALS MINERALS - VANCOUVER, B.C., CANADA

Chain of Custody Numbers:

18-02

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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To: **ALS ENVIRONMENTAL**
100 - 8081 LOUGHEED HWY.
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Page: 1
Total # Pages: 2 (A - E)
Plus Appendix Pages
Finalized Date: 16-FEB-2018
Account: APN

CERTIFICATE VA18016945

Project: L2047740

This report is for 10 Other samples submitted to our lab in Vancouver, BC, Canada on 24-JAN-2018.

The following have access to data associated with this certificate:

CASDG ALSE

ALSEV DATASUBLET

SHANE STACK

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI-21	Received Sample Weight
SPL-21	Split sample - riffle splitter
LOG-22	Sample login - Rcd w/o BarCode
PUL-31	Pulverize split to 85% <75 um

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	
C-GAS05	Inorganic Carbon (CO2)	
C-IR07	Total Carbon (Leco)	LECO
S-GRA06	Sulfate Sulfur - carbonate leach	WST-SEQ
ME-MS41	Ultra Trace Aqua Regia ICP-MS	
OA-VOL08m	Modified NP	
S-IR08	Total Sulphur (Leco)	LECO
OA-ELE07	Paste pH	
S-CAL06a	Sulfide Sulfur (calculated*)	
S-GRA06a	Sulfate Sulfur (HCl leachable)	WST-SEQ

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ATTN: SHANE STACK
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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature:

Colin Ramshaw, Vancouver Laboratory Manager



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Project: L2047740

CERTIFICATE OF ANALYSIS VA18016945

Sample Description	Method Analyte Units LOR	WEI-21	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-ELE07	S-IR08	S-CAL06a	C-GAS05	C-GAS05	S-GRA06a	C-IR07	S-GRA06	ME-MS41
		Recvd Wt.	FIZZ RAT	MPA	NNP	NP	Ratio (N	pH	S	S	C	CO2	S	C	S	Ag
		kg	Unity	tCaCO3/1Kt	tCaCO3/1Kt	tCaCO3/1Kt	Unity	Unity	%	%	%	%	%	%	%	ppm
		0.02	1	0.3	1	1	0.01	0.1	0.01	0.01	0.05	0.2	0.01	0.01	0.01	0.01
L2047740-1 146739		1.06	2	0.3	18	18	57.60	9.0	0.01	0.01	0.12	0.4	<0.01	0.21	<0.01	0.04
L2047740-2 146740		1.00	2	0.6	13	14	22.40	9.0	0.02	<0.01	0.07	0.3	0.02	0.16	<0.01	0.17
L2047740-3 146741		1.08	2	7.2	23	30	4.17	9.0	0.23	0.23	0.40	1.5	<0.01	0.51	<0.01	0.21
L2047740-4 146742		1.06	2	0.3	41	41	131.20	8.8	0.01	<0.01	0.66	2.4	0.02	0.82	<0.01	0.03
L2047740-5 146743		0.94	2	2.8	12	15	5.33	8.9	0.09	0.09	0.13	0.5	<0.01	0.22	<0.01	0.56
L2047740-6 146744		1.00	2	<0.3	21	21	134.40	8.7	<0.01	<0.01	0.15	0.6	<0.01	0.22	<0.01	0.01
L2047740-7 146745		0.98	2	<0.3	33	33	211.20	8.7	<0.01	<0.01	0.31	1.2	<0.01	0.41	<0.01	0.01
L2047740-8 146746		1.06	2	0.3	23	23	73.60	8.7	0.01	0.01	0.18	0.7	<0.01	0.26	<0.01	0.14
L2047740-9 146748		1.06	2	5.0	32	37	7.40	8.8	0.16	0.16	0.48	1.8	<0.01	0.58	<0.01	0.29
L2047740-10 146749		1.08	2	<0.3	13	13	83.20	9.5	<0.01	<0.01	0.08	0.3	<0.01	0.13	<0.01	0.01



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Project: L2047740

CERTIFICATE OF ANALYSIS VA18016945

Sample Description	Method Analyte Units LOR	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
		Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu
		%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm
		0.01	0.1	0.02	10	10	0.05	0.01	0.01	0.01	0.02	0.1	1	0.05	0.2
L2047740-1 146739		1.09	0.7	<0.02	<10	240	0.28	0.03	0.74	0.07	20.8	5.4	6	0.36	176.0
L2047740-2 146740		1.26	0.1	<0.02	<10	300	0.21	0.17	0.52	0.06	27.7	5.6	5	0.41	843
L2047740-3 146741		0.93	0.6	<0.02	<10	270	0.28	0.04	0.96	0.12	20.2	7.5	4	0.67	1050
L2047740-4 146742		0.72	1.0	<0.02	<10	150	0.42	0.02	1.34	0.03	29.3	5.5	5	0.72	83.4
L2047740-5 146743		1.13	0.7	0.06	<10	320	0.28	0.17	0.57	0.27	14.95	7.6	6	0.62	2330
L2047740-6 146744		1.18	0.7	<0.02	<10	130	0.49	0.01	1.02	0.06	20.9	5.8	5	0.32	47.9
L2047740-7 146745		1.11	0.8	<0.02	<10	200	0.39	0.02	1.39	0.04	22.6	5.2	4	0.29	33.1
L2047740-8 146746		1.29	0.6	<0.02	<10	210	0.29	0.04	0.96	0.08	26.1	6.4	5	0.38	340
L2047740-9 146748		0.80	1.4	<0.02	<10	210	0.30	0.07	1.31	0.15	27.8	9.2	4	0.41	1195
L2047740-10 146749		1.12	0.2	<0.02	<10	370	0.17	0.01	0.48	0.02	23.7	5.2	5	0.49	30.3



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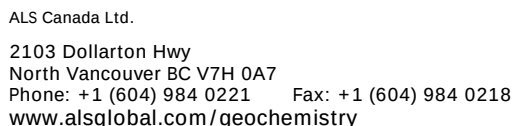
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Plus Appendix Pages
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Account: APN

Project: L2047740

CERTIFICATE OF ANALYSIS VA18016945

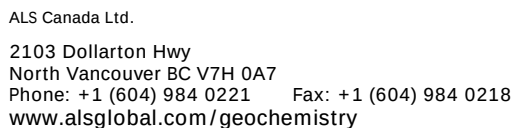
Sample Description	Method Analyte Units LOR	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
		Ga	Ge	Hf	Hg	In	K	La	Li	Mg	Mn	Mo	Na	Nb	Ni
		ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	ppm	%	ppm	ppm
		0.05	0.05	0.02	0.01	0.005	0.01	0.2	0.1	0.01	5	0.05	0.01	0.05	0.2
L2047740-1 146739		5.16	0.11	0.06	<0.01	0.025	0.58	10.5	5.3	0.56	613	1.29	0.09	0.19	3.2
L2047740-2 146740		6.16	0.13	0.03	<0.01	0.029	0.76	14.3	5.9	0.62	533	0.88	0.10	0.29	2.6
L2047740-3 146741		4.49	0.09	0.03	<0.01	0.045	0.58	11.0	3.4	0.54	480	7.28	0.08	0.22	2.5
L2047740-4 146742		3.94	0.11	0.05	<0.01	0.037	0.30	15.1	2.9	0.54	573	1.10	0.07	0.09	2.3
L2047740-5 146743		5.72	0.10	0.04	<0.01	0.049	0.73	8.0	4.5	0.52	511	12.55	0.08	0.25	3.3
L2047740-6 146744		6.18	0.11	0.06	<0.01	0.021	0.27	10.5	8.1	0.58	579	1.13	0.09	0.13	2.9
L2047740-7 146745		5.70	0.09	0.04	<0.01	0.024	0.26	11.7	7.1	0.46	610	0.89	0.08	0.06	1.9
L2047740-8 146746		6.36	0.10	0.05	<0.01	0.020	0.52	13.8	7.6	0.64	676	0.75	0.09	0.15	2.5
L2047740-9 146748		4.18	0.10	0.04	<0.01	0.051	0.38	14.7	3.0	0.44	652	13.15	0.07	0.17	2.5
L2047740-10 146749		5.12	0.10	0.02	<0.01	0.021	0.80	12.5	4.9	0.48	485	1.34	0.11	0.29	4.0



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***** See Appendix Page for comments regarding this certificate *****



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Page: Appendix 1
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Account: APN

Project: L2047740

CERTIFICATE OF ANALYSIS VA18016945

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

C-GAS05	C-IR07	LOG-22	ME-MS41
OA-ELE07	OA-VOL08m	PUL-31	S-CAL06a
S-GRA06	S-GRA06a	S-IR08	SPL-21
WEI-21			



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Finalized Date: **16-FEB-2018**
Account: **APN**

QC CERTIFICATE VA18016945

Project: L2047740

This report is for 10 Other samples submitted to our lab in Vancouver, BC, Canada on 24-JAN-2018.

The following have access to data associated with this certificate:

CASDG ALSE

ALSEV DATASUBLET

SHANE STACK

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI-21	Received Sample Weight
SPL-21	Split sample - riffle splitter
LOG-22	Sample login - Rcd w/o BarCode
PUL-31	Pulverize split to 85% <75 um

ANALYTICAL PROCEDURES

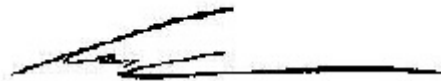
ALS CODE	DESCRIPTION	
C-GAS05	Inorganic Carbon (CO2)	
C-IR07	Total Carbon (Leco)	LECO
S-GRA06	Sulfate Sulfur - carbonate leach	WST-SEQ
ME-MS41	Ultra Trace Aqua Regia ICP-MS	
OA-VOL08m	Modified NP	
S-IR08	Total Sulphur (Leco)	LECO
OA-ELE07	Paste pH	
S-CAL06a	Sulfide Sulfur (calculated*)	
S-GRA06a	Sulfate Sulfur (HCl leachable)	WST-SEQ

To: **ALS ENVIRONMENTAL**
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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature:


Colin Ramshaw, Vancouver Laboratory Manager



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QC CERTIFICATE OF ANALYSIS VA18016945

Sample Description	Method Analyte Units LOR	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-ELE07	S-IR08	C-GAS05	C-GAS05	S-GRA06a	C-IR07	S-GRA06	ME-MS41	ME-MS41	ME-MS41
		FIZZ RAT	MPA	NNP	NP	Ratio (N	pH	S	C	CO2	S	C	S	Ag	Al	As
		Unity	tCaCO3/1Kt	tCaCO3/1Kt	tCaCO3/1Kt	Unity	Unity	%	%	%	%	%	%	ppm	%	ppm
		1	0.3	1	1	0.01	0.1	0.01	0.05	0.2	0.01	0.01	0.01	0.01	0.01	0.1
STANDARDS																
Buffer pH6							6.0									
Buffer pH6							6.0									
Target Range - Lower Bound							5.3									
Upper Bound							6.7									
DS-1								2.70				3.14				
Target Range - Lower Bound								2.51				3.01				
Upper Bound								2.71				3.25				
GS313-8								1.24				0.95				
Target Range - Lower Bound								1.19				0.90				
Upper Bound								1.29				0.98				
KZK-1		2	25.0	31	56	2.24										
KZK-1		2	25.0	31	56	2.24										
Target Range - Lower Bound		<1	22.9	30	54	2.18										
Upper Bound		>4	27.1	38	64	2.53										
MA-2c									1.52	5.6						
Target Range - Lower Bound									1.50	5.5						
Upper Bound									1.84	6.8						
OGGeo08														20.8	2.13	124.0
Target Range - Lower Bound														18.15	2.05	107.0
Upper Bound														22.2	2.53	131.0
OREAS 920														0.10	2.36	4.6
Target Range - Lower Bound														0.07	2.18	3.8
Upper Bound														0.12	2.68	4.9
UTS-1													0.83			
Target Range - Lower Bound													0.83			
Upper Bound													0.93			
UTS-1											0.88					
UTS-1											0.84					
Target Range - Lower Bound											0.81					
Upper Bound											0.95					
UTS-4													1.71			
Target Range - Lower Bound													1.64			
Upper Bound													1.84			
UTS-4											1.75					
UTS-4											1.63					
Target Range - Lower Bound											1.61					
Upper Bound											1.87					

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QC CERTIFICATE OF ANALYSIS VA18016945

Sample Description	Method Analyte Units LOR	ME-MS41 Au ppm 0.02	ME-MS41 B ppm 10	ME-MS41 Ba ppm 10	ME-MS41 Be ppm 0.05	ME-MS41 Bi ppm 0.01	ME-MS41 Ca % 0.01	ME-MS41 Cd ppm 0.01	ME-MS41 Ce ppm 0.02	ME-MS41 Co ppm 0.1	ME-MS41 Cr ppm 1	ME-MS41 Cs ppm 0.05	ME-MS41 Cu ppm 0.2	ME-MS41 Fe % 0.01	ME-MS41 Ga ppm 0.05	ME-MS41 Ge ppm 0.05
STANDARDS																
Buffer pH6																
Buffer pH6																
Target Range - Lower Bound																
Upper Bound																
DS-1																
Target Range - Lower Bound																
Upper Bound																
GS313-8																
Target Range - Lower Bound																
Upper Bound																
KZK-1																
KZK-1																
Target Range - Lower Bound																
Upper Bound																
MA-2c																
Target Range - Lower Bound																
Upper Bound																
OGGeo08		0.07	<10	100	0.69	10.35	0.83	17.60	60.8	95.0	79	9.36	8540	5.10	8.07	0.22
Target Range - Lower Bound		0.03	<10	60	0.61	9.44	0.82	16.75	56.7	87.2	75	8.68	7800	4.51	8.05	0.21
Upper Bound		0.11	30	110	0.89	11.55	1.02	20.5	69.3	107.0	93	10.70	8980	5.53	9.95	0.45
OREAS 920		<0.02	<10	80	0.71	0.61	0.31	0.05	73.0	14.7	41	2.07	112.0	3.66	6.43	0.15
Target Range - Lower Bound		<0.02	<10	50	0.59	0.60	0.28	0.04	64.8	13.4	37	1.84	102.0	3.26	6.12	<0.05
Upper Bound		0.04	20	110	0.87	0.76	0.37	0.09	79.2	16.6	48	2.36	118.0	4.00	7.60	0.22
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
UTS-4																
Target Range - Lower Bound																
Upper Bound																



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Method Analyte Units LOR	ME-MS41 Hf ppm 0.02	ME-MS41 Hg ppm 0.01	ME-MS41 In ppm 0.005	ME-MS41 K % 0.01	ME-MS41 La ppm 0.2	ME-MS41 Li ppm 0.1	ME-MS41 Mg % 0.01	ME-MS41 Mn ppm 5	ME-MS41 Mo ppm 0.05	ME-MS41 Na % 0.01	ME-MS41 Nb ppm 0.05	ME-MS41 Ni ppm 0.2	ME-MS41 P ppm 10	ME-MS41 Pb ppm 0.2	ME-MS41 Rb ppm 0.1
Sample Description															
Buffer pH6															
Buffer pH6															
Target Range - Lower Bound															
Upper Bound															
DS-1															
Target Range - Lower Bound															
Upper Bound															
GS313-8															
Target Range - Lower Bound															
Upper Bound															
KZK-1															
KZK-1															
Target Range - Lower Bound															
Upper Bound															
MA-2c															
Target Range - Lower Bound															
Upper Bound															
OGGeo08	0.74	0.46	1.430	1.06	29.4	31.9	0.91	375	864	0.29	1.04	8900	800	7250	121.0
Target Range - Lower Bound	0.72	0.41	1.335	0.94	27.7	28.4	0.84	350	811	0.26	0.97	7760	700	6520	109.5
Upper Bound	0.92	0.57	1.645	1.18	34.3	35.0	1.05	438	991	0.34	1.29	9480	880	7970	134.5
OREAS 920	0.57	<0.01	0.031	0.42	36.5	20.0	1.03	506	0.35	0.03	0.41	41.6	720	21.0	24.2
Target Range - Lower Bound	0.53	<0.01	0.019	0.39	33.3	19.0	0.98	472	0.29	<0.01	0.31	34.4		19.2	22.2
Upper Bound	0.69	0.02	0.043	0.50	41.1	23.4	1.22	588	0.53	0.02	0.55	42.4		23.9	27.4
UTS-1															
Target Range - Lower Bound															
Upper Bound															
UTS-1															
UTS-1															
Target Range - Lower Bound															
Upper Bound															
UTS-4															
Target Range - Lower Bound															
Upper Bound															
UTS-4															
UTS-4															
Target Range - Lower Bound															
Upper Bound															



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Sample Description	Method Analyte Units LOR	ME-MS41 Re ppm	ME-MS41 S %	ME-MS41 Sb ppm	ME-MS41 Sc ppm	ME-MS41 Se ppm	ME-MS41 Sn ppm	ME-MS41 Sr ppm	ME-MS41 Ta ppm	ME-MS41 Te ppm	ME-MS41 Th ppm	ME-MS41 Ti %	ME-MS41 Tl ppm	ME-MS41 U ppm	ME-MS41 V ppm	ME-MS41 W ppm
		0.001	0.01	0.05	0.1	0.2	0.2	0.2	0.01	0.01	0.2	0.005	0.02	0.05	1	0.05
STANDARDS																
Buffer pH6																
Buffer pH6																
Target Range - Lower Bound																
Upper Bound																
DS-1																
Target Range - Lower Bound																
Upper Bound																
GS313-8																
Target Range - Lower Bound																
Upper Bound																
KZK-1																
KZK-1																
Target Range - Lower Bound																
Upper Bound																
MA-2c																
Target Range - Lower Bound																
Upper Bound																
OGGeo08		1.360	2.73	19.65	6.2	11.1	12.4	62.7	0.01	0.15	16.9	0.307	1.39	4.76	77	2.89
Target Range - Lower Bound		1.295	2.51	17.70	6.0	9.7	12.0	59.6	<0.01	0.14	15.6	0.279	1.14	4.45	70	2.58
Upper Bound		1.585	3.09	24.1	7.6	12.3	15.1	73.2	0.03	0.20	19.6	0.353	1.58	5.55	88	3.60
OREAS 920		<0.001	0.03	0.60	2.8	0.4	1.0	17.1	0.02	0.01	16.0	0.127	0.15	2.05	24	0.44
Target Range - Lower Bound		<0.001	<0.01	0.45	2.5	<0.2	0.7	15.0	<0.01	<0.01	13.6	0.106	0.07	1.89	23	0.31
Upper Bound		0.002	0.05	0.77	3.3	0.7	1.7	18.8	0.02	0.04	17.0	0.140	0.18	2.42	30	0.61
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
UTS-4																
Target Range - Lower Bound																
Upper Bound																



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Sample Description	Method Analyte Units LOR	ME-MS41 Y ppm 0.05	ME-MS41 Zn ppm 2	ME-MS41 Zr ppm 0.5
STANDARDS				
Buffer pH6				
Buffer pH6				
Target Range - Lower Bound				
Upper Bound				
DS-1				
Target Range - Lower Bound				
Upper Bound				
GS313-8				
Target Range - Lower Bound				
Upper Bound				
KZK-1				
KZK-1				
Target Range - Lower Bound				
Upper Bound				
MA-2c				
Target Range - Lower Bound				
Upper Bound				
OGGeo08		16.45	7060	23.7
Target Range - Lower Bound		15.35	6500	19.5
Upper Bound		18.85	7950	27.5
OREAS 920		17.85	105	23.5
Target Range - Lower Bound		16.85	93	17.6
Upper Bound		20.7	119	25.0
UTS-1				
Target Range - Lower Bound				
Upper Bound				
UTS-1				
UTS-1				
Target Range - Lower Bound				
Upper Bound				
UTS-4				
Target Range - Lower Bound				
Upper Bound				
UTS-4				
UTS-4				
Target Range - Lower Bound				
Upper Bound				



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Method Analyte Units LOR	OA-VOL08m FIZZ RAT Unity	OA-VOL08m MPA tCaCO3/1Kt	OA-VOL08m NNP tCaCO3/1Kt	OA-VOL08m NP tCaCO3/1Kt	OA-VOL08m Ratio (N) Unity	OA-ELE07 pH Unity	S-IR08 S %	C-GAS05 C %	C-GAS05 CO2 %	S-GRA06a S %	C-IR07 C %	S-GRA06 S %	ME-MS41 Ag ppm	ME-MS41 Al %	ME-MS41 As ppm
Sample Description	1	0.3	1	1	0.01	0.1	0.01	0.05	0.2	0.01	0.01	0.01	0.01	0.01	0.1
BLANKS															
BLANK								<0.05	<0.2						
Target Range - Lower Bound								<0.05	<0.2						
Upper Bound								0.10	0.4						
BLANK													<0.01	<0.01	<0.1
Target Range - Lower Bound													<0.01	<0.01	<0.1
Upper Bound													0.02	0.02	0.2
BLANK						6.0									
Target Range - Lower Bound						5.5									
Upper Bound						6.9									
BLANK												<0.01			
Target Range - Lower Bound												<0.01			
Upper Bound												0.02			
BLANK															
BLANK															
Target Range - Lower Bound															
Upper Bound															
BLANK							<0.01								
Target Range - Lower Bound							<0.01					<0.01			
Upper Bound							0.02					0.02			
DUPLICATES															
ORIGINAL	2	8.8	20	29	3.31										
DUP	2	8.8	19	28	3.20										
Target Range - Lower Bound	<1	8.1	18	26	3.08										
Upper Bound	3	9.5	21	31	3.43										
ORIGINAL							3.84				0.13				
DUP							3.88				0.13				
Target Range - Lower Bound							3.75				0.12				
Upper Bound							3.97				0.14				
L2047740-2 146740													0.17	1.26	0.1
DUP													0.18	1.31	0.2
Target Range - Lower Bound													0.16	1.21	<0.1
Upper Bound													0.19	1.36	0.2



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Sample Description	Method Analyte Units LOR	ME-MS41 Au ppm 0.02	ME-MS41 B ppm 10	ME-MS41 Ba ppm 10	ME-MS41 Be ppm 0.05	ME-MS41 Bi ppm 0.01	ME-MS41 Ca % 0.01	ME-MS41 Cd ppm 0.01	ME-MS41 Ce ppm 0.02	ME-MS41 Co ppm 0.1	ME-MS41 Cr ppm 1	ME-MS41 Cs ppm 0.05	ME-MS41 Cu ppm 0.2	ME-MS41 Fe % 0.01	ME-MS41 Ga ppm 0.05	ME-MS41 Ge ppm 0.05
BLANKS																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK		<0.02	<10	<10	<0.05	0.01	<0.01	0.01	<0.02	<0.1	<1	<0.05	<0.2	<0.01	<0.05	<0.05
Target Range - Lower Bound		<0.02	<10	<10	<0.05	<0.01	<0.01	<0.01	<0.02	<0.1	<1	<0.05	<0.2	<0.01	<0.05	<0.05
Upper Bound		0.04	20	20	0.10	0.02	0.02	0.02	0.04	0.2	2	0.10	0.4	0.02	0.10	0.10
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
DUPLICATES																
ORIGINAL																
DUP																
Target Range - Lower Bound																
Upper Bound																
ORIGINAL																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2047740-2 146740		<0.02	<10	300	0.21	0.17	0.52	0.06	27.7	5.6	5	0.41	843	2.42	6.16	0.13
DUP		<0.02	<10	310	0.23	0.17	0.55	0.06	27.1	5.7	5	0.42	878	2.50	6.17	0.09
Target Range - Lower Bound		<0.02	<10	270	0.16	0.15	0.50	0.05	26.0	5.3	4	0.34	830	2.33	5.81	<0.05
Upper Bound		0.04	20	340	0.28	0.19	0.57	0.07	28.8	6.0	6	0.49	891	2.59	6.52	0.17



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Sample Description	Method Analyte Units LOR	ME-MS41 Hf ppm 0.02	ME-MS41 Hg ppm 0.01	ME-MS41 In ppm 0.005	ME-MS41 K % 0.01	ME-MS41 La ppm 0.2	ME-MS41 Li ppm 0.1	ME-MS41 Mg % 0.01	ME-MS41 Mn ppm 5	ME-MS41 Mo ppm 0.05	ME-MS41 Na % 0.01	ME-MS41 Nb ppm 0.05	ME-MS41 Ni ppm 0.2	ME-MS41 P ppm 10	ME-MS41 Pb ppm 0.2	ME-MS41 Rb ppm 0.1
BLANKS																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK		<0.02	<0.01	<0.005	<0.01	<0.2	0.1	<0.01	<5	<0.05	<0.01	<0.05	<0.2	<10	<0.2	<0.1
Target Range - Lower Bound		<0.02	<0.01	<0.005	<0.01	<0.2	<0.1	<0.01	<5	<0.05	<0.01	<0.05	<0.2	<10	<0.2	<0.1
Upper Bound		0.04	0.02	0.010	0.02	0.4	0.2	0.02	10	0.10	0.02	0.10	0.4	20	0.4	0.2
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
DUPLICATES																
ORIGINAL																
DUP																
Target Range - Lower Bound																
Upper Bound																
ORIGINAL																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2047740-2 146740		0.03	<0.01	0.029	0.76	14.3	5.9	0.62	533	0.88	0.10	0.29	2.6	580	1.9	36.0
DUP		0.03	<0.01	0.030	0.79	14.3	5.7	0.64	552	0.92	0.10	0.29	2.7	610	2.0	36.3
Target Range - Lower Bound		<0.02	<0.01	0.023	0.73	13.4	5.4	0.59	510	0.81	0.09	0.23	2.3	560	1.7	34.2
Upper Bound		0.04	0.02	0.036	0.82	15.2	6.2	0.67	575	1.00	0.12	0.35	3.0	630	2.2	38.1



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Sample Description	Method Analyte Units LOR	ME-MS41 Re ppm	ME-MS41 S %	ME-MS41 Sb ppm	ME-MS41 Sc ppm	ME-MS41 Se ppm	ME-MS41 Sn ppm	ME-MS41 Sr ppm	ME-MS41 Ta ppm	ME-MS41 Te ppm	ME-MS41 Th ppm	ME-MS41 Ti %	ME-MS41 Tl ppm	ME-MS41 U ppm	ME-MS41 V ppm	ME-MS41 W ppm
		0.001	0.01	0.05	0.1	0.2	0.2	0.2	0.01	0.01	0.2	0.005	0.02	0.05	1	0.05
BLANKS																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK		<0.001	<0.01	<0.05	<0.1	<0.2	<0.2	<0.2	<0.01	<0.01	<0.2	<0.005	<0.02	<0.05	<1	<0.05
Target Range - Lower Bound		<0.001	<0.01	<0.05	<0.1	<0.2	<0.2	<0.2	<0.01	<0.01	<0.2	<0.005	<0.02	<0.05	<1	<0.05
Upper Bound		0.002	0.02	0.10	0.2	0.4	0.4	0.4	0.02	0.02	0.4	0.010	0.04	0.10	2	0.10
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
DUPLICATES																
ORIGINAL																
DUP																
Target Range - Lower Bound																
Upper Bound																
ORIGINAL																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2047740-2 146740		<0.001	0.01	<0.05	8.2	0.4	0.5	44.0	<0.01	0.03	3.8	0.124	0.21	0.17	48	0.79
DUP		<0.001	0.01	<0.05	8.2	0.6	0.5	45.5	<0.01	0.03	3.7	0.128	0.22	0.17	50	1.04
Target Range - Lower Bound		<0.001	<0.01	<0.05	7.7	0.3	0.3	42.3	<0.01	0.02	3.4	0.115	0.18	0.11	46	0.80
Upper Bound		0.002	0.02	0.10	8.7	0.7	0.7	47.2	0.02	0.04	4.1	0.137	0.25	0.23	52	1.03



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Sample Description	Method Analyte Units LOR	ME-MS41 Y ppm 0.05	ME-MS41 Zn ppm 2	ME-MS41 Zr ppm 0.5
BLANKS				
BLANK				
Target Range - Lower Bound				
Upper Bound				
BLANK		<0.05	<2	<0.5
Target Range - Lower Bound		<0.05	<2	<0.5
Upper Bound		0.10	4	1.0
BLANK				
Target Range - Lower Bound				
Upper Bound				
BLANK				
Target Range - Lower Bound				
Upper Bound				
BLANK				
Target Range - Lower Bound				
Upper Bound				
BLANK				
Target Range - Lower Bound				
Upper Bound				
BLANK				
Target Range - Lower Bound				
Upper Bound				
DUPLICATES				
ORIGINAL				
DUP				
Target Range - Lower Bound				
Upper Bound				
ORIGINAL				
DUP				
Target Range - Lower Bound				
Upper Bound				
L2047740-2 146740		5.01	80	0.6
DUP		5.12	83	0.7
Target Range - Lower Bound		4.76	75	<0.5
Upper Bound		5.37	88	1.0



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Sample Description	Method Analyte Units LOR	OA-VOL08m FIZZ RAT Unity 1	OA-VOL08m MPA tCaCO3/1Kt 0.3	OA-VOL08m NNP tCaCO3/1Kt 1	OA-VOL08m NP tCaCO3/1Kt 1	OA-VOL08m Ratio (N) Unity 0.01	OA-ELE07 pH Unity 0.1	S-IR08 S % 0.01	C-GAS05 C % 0.05	C-GAS05 CO2 % 0.2	S-GRA06a S % 0.01	C-IR07 C % 0.01	S-GRA06 S % 0.01	ME-MS41 Ag ppm 0.01	ME-MS41 Al % 0.01	ME-MS41 As ppm 0.1
DUPLICATES																
L2047740-10 146749							9.5		0.08	0.3	<0.01		<0.01			
DUP							9.5		0.07	0.3	0.02		<0.01			
Target Range - Lower Bound							8.9		<0.05	<0.2	<0.01		<0.01			
Upper Bound							10.1		0.10	0.4	0.02		0.02			
L2047741-3 153305											<0.01					
DUP											<0.01					
Target Range - Lower Bound											<0.01					
Upper Bound											0.02					



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Page: 4 - B
Total # Pages: 4 (A - E)
Plus Appendix Pages
Finalized Date: 16 - FEB - 2018
Account: APN

Project: L2047740

QC CERTIFICATE OF ANALYSIS VA18016945

Sample Description	Method Analyte Units LOR	ME-MS41 Au ppm 0.02	ME-MS41 B ppm 10	ME-MS41 Ba ppm 10	ME-MS41 Be ppm 0.05	ME-MS41 Bi ppm 0.01	ME-MS41 Ca % 0.01	ME-MS41 Cd ppm 0.01	ME-MS41 Ce ppm 0.02	ME-MS41 Co ppm 0.1	ME-MS41 Cr ppm 1	ME-MS41 Cs ppm 0.05	ME-MS41 Cu ppm 0.2	ME-MS41 Fe % 0.01	ME-MS41 Ga ppm 0.05	ME-MS41 Ge ppm 0.05
L2047740-10 146749 DUP Target Range - Lower Bound Upper Bound		DUPLICATES														
L2047741-3 153305 DUP Target Range - Lower Bound Upper Bound																



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Page: 4 - C
Total # Pages: 4 (A - E)
Plus Appendix Pages
Finalized Date: 16-FEB-2018
Account: APN

Project: L2047740

QC CERTIFICATE OF ANALYSIS VA18016945

Sample Description	Method Analyte Units LOR	ME-MS41 Hf ppm 0.02	ME-MS41 Hg ppm 0.01	ME-MS41 In ppm 0.005	ME-MS41 K % 0.01	ME-MS41 La ppm 0.2	ME-MS41 Li ppm 0.1	ME-MS41 Mg % 0.01	ME-MS41 Mn ppm 5	ME-MS41 Mo ppm 0.05	ME-MS41 Na % 0.01	ME-MS41 Nb ppm 0.05	ME-MS41 Ni ppm 0.2	ME-MS41 P ppm 10	ME-MS41 Pb ppm 0.2	ME-MS41 Rb ppm 0.1
L2047740-10 146749 DUP Target Range - Lower Bound Upper Bound		DUPLICATES														
L2047741-3 153305 DUP Target Range - Lower Bound Upper Bound																



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Page: 4 - D
Total # Pages: 4 (A - E)
Plus Appendix Pages
Finalized Date: 16-FEB-2018
Account: APN

Project: L2047740

QC CERTIFICATE OF ANALYSIS VA18016945

Sample Description	Method Analyte Units LOR	ME-MS41 Re ppm 0.001	ME-MS41 S % 0.01	ME-MS41 Sb ppm 0.05	ME-MS41 Sc ppm 0.1	ME-MS41 Se ppm 0.2	ME-MS41 Sn ppm 0.2	ME-MS41 Sr ppm 0.2	ME-MS41 Ta ppm 0.01	ME-MS41 Te ppm 0.01	ME-MS41 Th ppm 0.2	ME-MS41 Ti % 0.005	ME-MS41 Tl ppm 0.02	ME-MS41 U ppm 0.05	ME-MS41 V ppm 1	ME-MS41 W ppm 0.05
L2047740-10 146749 DUP Target Range - Lower Bound Upper Bound		DUPLICATES														
L2047741-3 153305 DUP Target Range - Lower Bound Upper Bound																



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Page: 4 - E
Total # Pages: 4 (A - E)
Plus Appendix Pages
Finalized Date: 16 - FEB - 2018
Account: APN

Project: L2047740

QC CERTIFICATE OF ANALYSIS VA18016945

Sample Description	Method Analyte Units LOR	ME-MS41 Y ppm 0.05	ME-MS41 Zn ppm 2	ME-MS41 Zr ppm 0.5
L2047740-10 146749 DUP Target Range - Lower Bound Upper Bound		DUPLICATES		
L2047741-3 153305 DUP Target Range - Lower Bound Upper Bound				



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Page: Appendix 1
Total # Appendix Pages: 1
Finalized Date: 16-FEB-2018
Account: APN

Project: L2047740

QC CERTIFICATE OF ANALYSIS VA18016945

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

C-GAS05	C-IR07	LOG-22	ME-MS41
OA-ELE07	OA-VOL08m	PUL-31	S-CAL06a
S-GRA06	S-GRA06a	S-IR08	SPL-21
WEI-21			



Minto Explorations Ltd.
ATTN: Minto Environment
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 22-JAN-18
Report Date: 22-FEB-18 14:25 (MT)
Version: FINAL

Client Phone: 604-759-0860

Certificate of Analysis

Lab Work Order #: L2047741
Project P.O. #: PO#229850
Job Reference:
C of C Numbers: 18-01
Legal Site Desc:

Comments: Please note, the ALS Minerals version of the finalized report and QC can be found at the end of the attachment.

Shane Stack
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2047741-1 Waste 01-JAN-18 146737	L2047741-2 Waste 01-JAN-18 146738	L2047741-3 Waste 13-JAN-18 153305	L2047741-4 Waste 13-JAN-18 153306	L2047741-5 Waste 15-JAN-18 153307
Grouping	Analyte					
SOIL						
Physical Tests	pH (Unity)	8.9	8.9	8.8	8.9	8.6
Organic / Inorganic Carbon	Carbon (C) (%)	0.56	0.34	<0.05	0.05	<0.05
Acid Base Accounting	FIZZ RATING (Unity)	2	2	1	1	1
	MPA (tCaCO3/1Kt)	0.6	0.3	0.3	0.3	0.3
	Neutralization Potential (NP) (tCaCO3/1Kt)	45	32	9	11	8
	NNP (tCaCO3/1Kt)	44	32	9	11	8
	Ratio (NP/MPA) (Unity)	72.00	102.40	28.80	35.20	25.60
	Sulfate Sulfur (carbonate leach) (%)	<0.01	<0.01	<0.01	<0.01	<0.01
	Sulfate Sulfur (HCl leach) (%)	<0.01	<0.01	<0.01	<0.01	0.01
	Sulfide Sulfur (T minus HCl leach) (%)	0.02	0.01	0.01	0.01	<0.01
	Total Sulfur (combustion) (%)	0.02	0.01	0.01	0.01	0.01
Total Metals	Aluminum (Al) (%)	1.12	1.17	1.14	1.39	0.92
	Antimony (Sb) (ppm)	<0.05	<0.05	<0.05	<0.05	<0.05
	Arsenic (As) (ppm)	0.7	1.1	0.8	0.7	1.0
	Barium (Ba) (ppm)	250	120	370	280	270
	Beryllium (Be) (ppm)	0.28	0.49	0.28	0.30	0.32
	Bismuth (Bi) (ppm)	0.06	0.02	0.19	0.02	0.67
	Boron (B) (ppm)	<10	<10	<10	<10	<10
	Cadmium (Cd) (ppm)	0.03	0.04	0.17	0.09	0.29
	Calcium (Ca) (%)	1.52	1.28	0.35	0.60	0.32
	Cerium (Ce) (ppm)	25.1	26.4	22.3	26.0	21.8
	Cesium (Cs) (ppm)	0.43	0.36	0.53	0.36	0.37
	Chromium (Cr) (ppm)	6	6	5	6	5
	Cobalt (Co) (ppm)	6.2	5.6	6.2	6.7	6.8
	Copper (Cu) (ppm)	249	120.0	2460	178.0	3600
	Gallium (Ga) (ppm)	5.34	6.47	5.65	6.42	4.92
	Germanium (Ge) (ppm)	0.12	0.11	0.10	0.12	0.10
	Gold (Au) (ppm)	<0.02	<0.02	0.04	<0.02	0.14
	Hafnium (Hf) (ppm)	0.04	0.04	0.05	0.07	0.04
	Indium (In) (ppm)	0.022	0.030	0.062	0.031	0.043
	Iron (Fe) (%)	2.43	2.23	2.87	2.61	2.83
	Lanthanum (La) (ppm)	13.1	13.4	12.1	13.2	11.6
	Lead (Pb) (ppm)	2.3	4.2	2.4	2.3	4.5
	Lithium (Li) (ppm)	5.4	7.2	4.7	7.1	4.0
	Magnesium (Mg) (%)	0.75	0.69	0.48	0.69	0.31
	Manganese (Mn) (ppm)	596	558	607	692	589

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2047741-6 Waste 15-JAN-18 153308	L2047741-7 Waste 10-JAN-18 153301	L2047741-8 Waste 10-JAN-18 153302	L2047741-9 Waste 11-JAN-18 153303	L2047741-10 Waste 12-JAN-18 153304
Grouping	Analyte					
SOIL						
Physical Tests	pH (Unity)	9.0	9.0	9.0	9.0	8.8
Organic / Inorganic Carbon	Carbon (C) (%)	0.52	0.30	0.44	0.49	0.28
Acid Base Accounting	FIZZ RATING (Unity)	2	2	2	2	2
	MPA (tCaCO3/1Kt)	6.6	0.6	1.6	3.4	2.5
	Neutralization Potential (NP) (tCaCO3/1Kt)	35	25	33	36	29
	NNP (tCaCO3/1Kt)	28	24	31	33	27
	Ratio (NP/MPA) (Unity)	5.33	40.00	21.12	10.47	11.60
	Sulfate Sulfur (carbonate leach) (%)	<0.01	<0.01	<0.01	<0.01	<0.01
	Sulfate Sulfur (HCl leach) (%)	0.02	<0.01	0.02	<0.01	0.01
	Sulfide Sulfur (T minus HCl leach) (%)	0.19	0.02	0.03	0.11	0.07
	Total Sulfur (combustion) (%)	0.21	0.02	0.05	0.11	0.08
Total Metals	Aluminum (Al) (%)	1.26	1.06	1.04	1.07	1.10
	Antimony (Sb) (ppm)	<0.05	<0.05	<0.05	<0.05	<0.05
	Arsenic (As) (ppm)	0.5	0.4	0.8	0.9	0.9
	Barium (Ba) (ppm)	450	250	220	230	240
	Beryllium (Be) (ppm)	0.30	0.30	0.36	0.35	0.29
	Bismuth (Bi) (ppm)	0.22	0.05	0.04	0.11	0.12
	Boron (B) (ppm)	<10	<10	<10	<10	<10
	Cadmium (Cd) (ppm)	0.11	0.04	0.08	0.15	0.10
	Calcium (Ca) (%)	1.13	0.94	1.08	1.28	1.12
	Cerium (Ce) (ppm)	54.8	24.1	28.9	27.0	30.8
	Cesium (Cs) (ppm)	0.69	0.39	0.42	0.63	0.35
	Chromium (Cr) (ppm)	6	4	5	4	5
	Cobalt (Co) (ppm)	8.5	5.7	5.6	6.2	5.7
	Copper (Cu) (ppm)	1645	381	429	840	1320
	Gallium (Ga) (ppm)	5.85	5.26	5.24	5.32	5.57
	Germanium (Ge) (ppm)	0.12	0.09	0.11	0.11	0.12
	Gold (Au) (ppm)	0.02	<0.02	0.02	<0.02	0.02
	Hafnium (Hf) (ppm)	0.06	0.03	0.05	0.06	0.06
	Indium (In) (ppm)	0.064	0.027	0.045	0.077	0.036
	Iron (Fe) (%)	3.28	2.26	2.40	2.67	2.30
	Lanthanum (La) (ppm)	31.2	13.1	15.2	13.7	15.9
	Lead (Pb) (ppm)	3.2	2.5	3.6	3.6	2.6
	Lithium (Li) (ppm)	4.8	5.5	4.9	4.5	5.8
	Magnesium (Mg) (%)	0.86	0.58	0.59	0.65	0.58
	Manganese (Mn) (ppm)	579	497	534	718	580

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2047741-1 Waste 01-JAN-18 146737	L2047741-2 Waste 01-JAN-18 146738	L2047741-3 Waste 13-JAN-18 153305	L2047741-4 Waste 13-JAN-18 153306	L2047741-5 Waste 15-JAN-18 153307
Grouping	Analyte					
SOIL						
Total Metals	Mercury (Hg) (ppm)	<0.01	<0.01	0.01	<0.01	0.01
	Molybdenum (Mo) (ppm)	1.00	1.48	1.41	0.81	5.65
	Nickel (Ni) (ppm)	2.7	2.5	2.6	3.1	2.7
	Niobium (Nb) (ppm)	0.20	0.08	0.21	0.15	0.18
	Phosphorus (P) (ppm)	620	630	620	720	630
	Potassium (K) (%)	0.56	0.22	0.76	0.71	0.45
	Rhenium (Re) (ppm)	0.001	0.001	<0.001	<0.001	<0.001
	Rubidium (Rb) (ppm)	26.2	10.6	38.4	32.0	22.4
	Scandium (Sc) (ppm)	4.5	4.7	5.0	5.4	3.5
	Selenium (Se) (ppm)	0.2	0.2	0.8	0.3	2.0
	Silver (Ag) (ppm)	0.11	0.04	0.71	0.02	1.29
	Sodium (Na) (%)	0.09	0.08	0.08	0.11	0.08
	Strontium (Sr) (ppm)	173.5	98.1	39.7	52.8	55.4
	Sulfur (S) (%)	0.02	0.01	0.01	<0.01	0.01
	Tantalum (Ta) (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01
	Tellurium (Te) (ppm)	0.01	<0.01	0.20	<0.01	0.33
	Thallium (Tl) (ppm)	0.16	0.06	0.21	0.19	0.13
	Thorium (Th) (ppm)	2.9	2.8	2.7	2.8	2.6
	Tin (Sn) (ppm)	0.6	0.6	0.7	0.7	0.5
	Titanium (Ti) (%)	0.088	0.022	0.121	0.117	0.063
	Tungsten (W) (ppm)	0.42	0.30	0.54	0.51	0.42
	Uranium (U) (ppm)	0.38	0.31	0.25	0.25	0.36
	Vanadium (V) (ppm)	51	43	64	57	55
	Yttrium (Y) (ppm)	8.65	10.30	8.03	11.05	6.45
	Zinc (Zn) (ppm)	66	66	93	93	88
	Zirconium (Zr) (ppm)	1.0	0.8	1.1	1.0	1.2
Permanent Gases	Carbon Dioxide (CO2) (%)	2.1	1.3	0.2	0.2	<0.2
Miscellaneous	Carbon (C) (%)	0.67	0.46	0.09	0.09	0.09

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2047741-6 Waste 15-JAN-18 153308	L2047741-7 Waste 10-JAN-18 153301	L2047741-8 Waste 10-JAN-18 153302	L2047741-9 Waste 11-JAN-18 153303	L2047741-10 Waste 12-JAN-18 153304
Grouping	Analyte					
SOIL						
Total Metals	Mercury (Hg) (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01
	Molybdenum (Mo) (ppm)	6.12	2.37	2.11	4.48	25.0
	Nickel (Ni) (ppm)	3.4	2.2	2.6	2.3	2.5
	Niobium (Nb) (ppm)	0.25	0.15	0.17	0.20	0.13
	Phosphorus (P) (ppm)	930	510	600	690	700
	Potassium (K) (%)	0.83	0.49	0.45	0.57	0.51
	Rhenium (Re) (ppm)	0.010	0.006	0.006	0.018	0.103
	Rubidium (Rb) (ppm)	38.9	22.7	21.1	28.0	22.7
	Scandium (Sc) (ppm)	4.7	4.0	6.3	5.3	4.7
	Selenium (Se) (ppm)	1.2	0.4	0.5	0.8	1.0
	Silver (Ag) (ppm)	0.45	0.12	0.14	0.24	0.31
	Sodium (Na) (%)	0.09	0.10	0.10	0.10	0.10
	Strontium (Sr) (ppm)	120.5	76.2	95.9	109.5	89.2
	Sulfur (S) (%)	0.23	0.03	0.06	0.12	0.08
	Tantalum (Ta) (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01
	Tellurium (Te) (ppm)	0.04	0.01	0.01	0.03	0.03
	Thallium (Tl) (ppm)	0.24	0.14	0.13	0.20	0.14
	Thorium (Th) (ppm)	7.1	2.9	3.9	3.7	4.0
	Tin (Sn) (ppm)	0.8	0.5	0.7	0.8	0.7
	Titanium (Ti) (%)	0.131	0.075	0.062	0.083	0.076
	Tungsten (W) (ppm)	0.71	0.20	0.43	0.35	0.30
	Uranium (U) (ppm)	0.33	0.24	0.29	0.36	0.31
	Vanadium (V) (ppm)	75	47	49	55	50
	Yttrium (Y) (ppm)	7.81	6.30	8.78	10.55	10.65
	Zinc (Zn) (ppm)	87	64	63	81	71
	Zirconium (Zr) (ppm)	1.8	0.8	1.0	1.4	1.1
Permanent Gases	Carbon Dioxide (CO2) (%)	1.9	1.1	1.6	1.8	1.0
Miscellaneous	Carbon (C) (%)	0.62	0.41	0.50	0.56	0.34

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ABA-OA-VOL08-AX	Soil	Acid Base Accounting	OA-VOL08
CARBON-C-GAS05-AX	Soil	Carbon, TOC and CO ₂	C-GAS05
CARBON-C-IR07-AX	Soil	Carbon (C) using LECO analyzer	Total Carbon - Method Code C-IR07
Total Carbon & Sulfur - Method Codes C-IR07 & S-IR08			
A 0.1g sample is heated to approximately 1350°C in an induction furnace while passing a stream of oxygen through the sample. Carbon dioxide & sulfur dioxide released from the sample are measured by an IR detection system (Leco analyzer) and the total carbon & sulfur results are provided.			
ME-MS41-AX	Soil	Aqua Regia ICPMS	Aqua Regia ICPMS
A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences.			
PH-OA-ELE07-AX	Soil	pH	OA-ELE07
SULPHUR-S-CAL06A-AX	Soil	Sulfide Sulfur Calc from HCl Leach	ALS Minerals S-CAL06A
Sulfide Sulfur (as S) is calculated by subtracting the HCl Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion.			
SULPHUR-S-GRA06-AX	Soil	Sulfate Sulfur in Soil (Carbonate Leach)	ALS Minerals S-GRA06
A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).			
SULPHUR-S-GRA06A-AX	Soil	Sulfate Sulfur in Soil (HCl Leach)	ALS Minerals S-GRA06A
A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).			
SULPHUR-S-IR08-AX	Soil	Total Sulfur in Soil by Combustion	ALS Minerals S-IR08
The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
AX	ALS MINERALS - VANCOUVER, B.C., CANADA

Chain of Custody Numbers:

18-01

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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Page: 1
Total # Pages: 2 (A - E)
Plus Appendix Pages
Finalized Date: 16-FEB-2018
Account: APN

CERTIFICATE VA18016946

Project: L2047741

This report is for 10 Other samples submitted to our lab in Vancouver, BC, Canada on 24-JAN-2018.

The following have access to data associated with this certificate:

CASDG ALSE

ALSEV DATASUBLET

SHANE STACK

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI-21	Received Sample Weight
SPL-21	Split sample - riffle splitter
LOG-22	Sample login - Rcd w/o BarCode
PUL-31	Pulverize split to 85% <75 um

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	
C-GAS05	Inorganic Carbon (CO2)	
C-IR07	Total Carbon (Leco)	LECO
S-GRA06	Sulfate Sulfur - carbonate leach	WST-SEQ
ME-MS41	Ultra Trace Aqua Regia ICP-MS	
OA-VOL08m	Modified NP	
S-IR08	Total Sulphur (Leco)	LECO
OA-ELE07	Paste pH	
S-CAL06a	Sulfide Sulfur (calculated*)	
S-GRA06a	Sulfate Sulfur (HCl leachable)	WST-SEQ

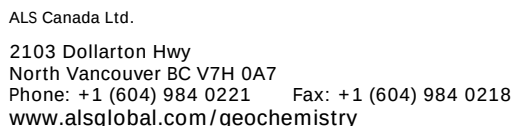
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***** See Appendix Page for comments regarding this certificate *****

Signature:

Colin Ramshaw, Vancouver Laboratory Manager



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CERTIFICATE OF ANALYSIS VA18016946

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CERTIFICATE OF ANALYSIS VA18016946

Sample Description	Method Analyte Units LOR	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
		Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu
		%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm
		0.01	0.1	0.02	10	10	0.05	0.01	0.01	0.01	0.02	0.1	1	0.05	0.2
L2047741-1 146737		1.12	0.7	<0.02	<10	250	0.28	0.06	1.52	0.03	25.1	6.2	6	0.43	249
L2047741-2 146738		1.17	1.1	<0.02	<10	120	0.49	0.02	1.28	0.04	26.4	5.6	6	0.36	120.0
L2047741-3 153305		1.14	0.8	0.04	<10	370	0.28	0.19	0.35	0.17	22.3	6.2	5	0.53	2460
L2047741-4 153306		1.39	0.7	<0.02	<10	280	0.30	0.02	0.60	0.09	26.0	6.7	6	0.36	178.0
L2047741-5 153307		0.92	1.0	0.14	<10	270	0.32	0.67	0.32	0.29	21.8	6.8	5	0.37	3600
L2047741-6 153308		1.26	0.5	0.02	<10	450	0.30	0.22	1.13	0.11	54.8	8.5	6	0.69	1645
L2047741-7 153301		1.06	0.4	<0.02	<10	250	0.30	0.05	0.94	0.04	24.1	5.7	4	0.39	381
L2047741-8 153302		1.04	0.8	0.02	<10	220	0.36	0.04	1.08	0.08	28.9	5.6	5	0.42	429
L2047741-9 153303		1.07	0.9	<0.02	<10	230	0.35	0.11	1.28	0.15	27.0	6.2	4	0.63	840
L2047741-10 153304		1.10	0.9	0.02	<10	240	0.29	0.12	1.12	0.10	30.8	5.7	5	0.35	1320



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CERTIFICATE OF ANALYSIS VA18016946

Sample Description	Method Analyte Units LOR	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
		Ga	Ge	Hf	Hg	In	K	La	Li	Mg	Mn	Mo	Na	Nb	Ni
		ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	ppm	%	ppm	ppm
		0.05	0.05	0.02	0.01	0.005	0.01	0.2	0.1	0.01	5	0.05	0.01	0.05	0.2
L2047741-1 146737		5.34	0.12	0.04	<0.01	0.022	0.56	13.1	5.4	0.75	596	1.00	0.09	0.20	2.7
L2047741-2 146738		6.47	0.11	0.04	<0.01	0.030	0.22	13.4	7.2	0.69	558	1.48	0.08	0.08	2.5
L2047741-3 153305		5.65	0.10	0.05	0.01	0.062	0.76	12.1	4.7	0.48	607	1.41	0.08	0.21	2.6
L2047741-4 153306		6.42	0.12	0.07	<0.01	0.031	0.71	13.2	7.1	0.69	692	0.81	0.11	0.15	3.1
L2047741-5 153307		4.92	0.10	0.04	0.01	0.043	0.45	11.6	4.0	0.31	589	5.65	0.08	0.18	2.7
L2047741-6 153308		5.85	0.12	0.06	<0.01	0.064	0.83	31.2	4.8	0.86	579	6.12	0.09	0.25	3.4
L2047741-7 153301		5.26	0.09	0.03	<0.01	0.027	0.49	13.1	5.5	0.58	497	2.37	0.10	0.15	2.2
L2047741-8 153302		5.24	0.11	0.05	<0.01	0.045	0.45	15.2	4.9	0.59	534	2.11	0.10	0.17	2.6
L2047741-9 153303		5.32	0.11	0.06	<0.01	0.077	0.57	13.7	4.5	0.65	718	4.48	0.10	0.20	2.3
L2047741-10 153304		5.57	0.12	0.06	<0.01	0.036	0.51	15.9	5.8	0.58	580	25.0	0.10	0.13	2.5



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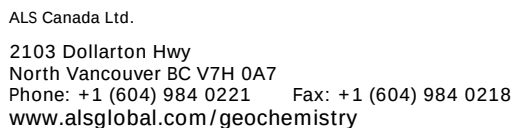
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CERTIFICATE OF ANALYSIS VA18016946

Sample Description	Method Analyte Units LOR	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
		Pb	Rb	Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl
		ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm
		0.2	0.1	0.001	0.01	0.05	0.1	0.2	0.2	0.2	0.01	0.01	0.2	0.005	0.02
L2047741-1 146737		2.3	26.2	0.001	0.02	<0.05	4.5	0.2	0.6	173.5	<0.01	0.01	2.9	0.088	0.16
L2047741-2 146738		4.2	10.6	0.001	0.01	<0.05	4.7	0.2	0.6	98.1	<0.01	<0.01	2.8	0.022	0.06
L2047741-3 153305		2.4	38.4	<0.001	0.01	<0.05	5.0	0.8	0.7	39.7	<0.01	0.20	2.7	0.121	0.21
L2047741-4 153306		2.3	32.0	<0.001	<0.01	<0.05	5.4	0.3	0.7	52.8	<0.01	<0.01	2.8	0.117	0.19
L2047741-5 153307		4.5	22.4	<0.001	0.01	<0.05	3.5	2.0	0.5	55.4	<0.01	0.33	2.6	0.063	0.13
L2047741-6 153308		3.2	38.9	0.010	0.23	<0.05	4.7	1.2	0.8	120.5	<0.01	0.04	7.1	0.131	0.24
L2047741-7 153301		2.5	22.7	0.006	0.03	<0.05	4.0	0.4	0.5	76.2	<0.01	0.01	2.9	0.075	0.14
L2047741-8 153302		3.6	21.1	0.006	0.06	<0.05	6.3	0.5	0.7	95.9	<0.01	0.01	3.9	0.062	0.13
L2047741-9 153303		3.6	28.0	0.018	0.12	<0.05	5.3	0.8	0.8	109.5	<0.01	0.03	3.7	0.083	0.20
L2047741-10 153304		2.6	22.7	0.103	0.08	<0.05	4.7	1.0	0.7	89.2	<0.01	0.03	4.0	0.076	0.14



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CERTIFICATE OF ANALYSIS VA18016946

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

C-GAS05	C-IR07	LOG-22	ME-MS41
OA-ELE07	OA-VOL08m	PUL-31	S-CAL06a
S-GRA06	S-GRA06a	S-IR08	SPL-21
WEI-21			



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QC CERTIFICATE VA18016946

Project: L2047741

This report is for 10 Other samples submitted to our lab in Vancouver, BC, Canada on 24-JAN-2018.

The following have access to data associated with this certificate:

CASDG ALSE

ALSEV DATASUBLET

SHANE STACK

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI-21	Received Sample Weight
SPL-21	Split sample - riffle splitter
LOG-22	Sample login - Rcd w/o BarCode
PUL-31	Pulverize split to 85% <75 um

ANALYTICAL PROCEDURES

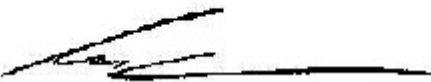
ALS CODE	DESCRIPTION	
C-GAS05	Inorganic Carbon (CO2)	
C-IR07	Total Carbon (Leco)	LECO
S-GRA06	Sulfate Sulfur - carbonate leach	WST-SEQ
ME-MS41	Ultra Trace Aqua Regia ICP-MS	
OA-VOL08m	Modified NP	
S-IR08	Total Sulphur (Leco)	LECO
OA-ELE07	Paste pH	
S-CAL06a	Sulfide Sulfur (calculated*)	
S-GRA06a	Sulfate Sulfur (HCl leachable)	WST-SEQ

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Signature:


Colin Ramshaw, Vancouver Laboratory Manager



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Project: L2047741

QC CERTIFICATE OF ANALYSIS VA18016946

Sample Description	Method Analyte Units LOR	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-ELE07	S-IR08	C-GAS05	C-GAS05	S-GRA06a	C-IR07	S-GRA06	ME-MS41	ME-MS41	ME-MS41
		FIZZ RAT	MPA	NNP	NP	Ratio (N	pH	S	C	CO2	S	C	S	Ag	Al	As
		Unity	tCaCO3/1Kt	tCaCO3/1Kt	tCaCO3/1Kt	Unity	Unity	%	%	%	%	%	%	ppm	%	ppm
		1	0.3	1	1	0.01	0.1	0.01	0.05	0.2	0.01	0.01	0.01	0.01	0.01	0.1
STANDARDS																
Buffer pH6							6.0									
Buffer pH6							6.0									
Target Range - Lower Bound							5.3									
Upper Bound							6.7									
DS-1								2.70				3.14				
Target Range - Lower Bound								2.51				3.01				
Upper Bound								2.71				3.25				
GS310-10								0.27				1.05				
Target Range - Lower Bound								0.25				1.03				
Upper Bound								0.29				1.13				
GS313-8								1.24				0.95				
Target Range - Lower Bound								1.19				0.90				
Upper Bound								1.29				0.98				
KZK-1		2	25.0	31	56	2.24										
KZK-1		2	25.0	31	56	2.24										
Target Range - Lower Bound		<1	22.9	30	54	2.18										
Upper Bound		>4	27.1	38	64	2.53										
MA-1b								1.16				2.41				
Target Range - Lower Bound								1.12				2.34				
Upper Bound								1.22				2.54				
MA-2c									1.52	5.6						
Target Range - Lower Bound									1.50	5.5						
Upper Bound									1.84	6.8						
OGGeo08														20.8	2.13	124.0
Target Range - Lower Bound														18.15	2.05	107.0
Upper Bound														22.2	2.53	131.0
OREAS 920														0.10	2.36	4.6
Target Range - Lower Bound														0.07	2.18	3.8
Upper Bound														0.12	2.68	4.9
UTS-1													0.83			
Target Range - Lower Bound													0.83			
Upper Bound													0.93			
UTS-1										0.88						
UTS-1										0.84						
Target Range - Lower Bound										0.81						
Upper Bound										0.95						
UTS-4													1.71			



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QC CERTIFICATE OF ANALYSIS VA18016946

Sample Description	Method Analyte Units LOR	ME-MS41 Au ppm 0.02	ME-MS41 B ppm 10	ME-MS41 Ba ppm 10	ME-MS41 Be ppm 0.05	ME-MS41 Bi ppm 0.01	ME-MS41 Ca % 0.01	ME-MS41 Cd ppm 0.01	ME-MS41 Ce ppm 0.02	ME-MS41 Co ppm 0.1	ME-MS41 Cr ppm 1	ME-MS41 Cs ppm 0.05	ME-MS41 Cu ppm 0.2	ME-MS41 Fe % 0.01	ME-MS41 Ga ppm 0.05	ME-MS41 Ge ppm 0.05
STANDARDS																
Buffer pH6																
Buffer pH6																
Target Range - Lower Bound																
Upper Bound																
DS-1																
Target Range - Lower Bound																
Upper Bound																
GS310-10																
Target Range - Lower Bound																
Upper Bound																
GS313-8																
Target Range - Lower Bound																
Upper Bound																
KZK-1																
KZK-1																
Target Range - Lower Bound																
Upper Bound																
MA-1b																
Target Range - Lower Bound																
Upper Bound																
MA-2c																
Target Range - Lower Bound																
Upper Bound																
OGGeo08		0.07	<10	100	0.69	10.35	0.83	17.60	60.8	95.0	79	9.36	8540	5.10	8.07	0.22
Target Range - Lower Bound		0.03	<10	60	0.61	9.44	0.82	16.75	56.7	87.2	75	8.68	7800	4.51	8.05	0.21
Upper Bound		0.11	30	110	0.89	11.55	1.02	20.5	69.3	107.0	93	10.70	8980	5.53	9.95	0.45
OREAS 920		<0.02	<10	80	0.71	0.61	0.31	0.05	73.0	14.7	41	2.07	112.0	3.66	6.43	0.15
Target Range - Lower Bound		<0.02	<10	50	0.59	0.60	0.28	0.04	64.8	13.4	37	1.84	102.0	3.26	6.12	<0.05
Upper Bound		0.04	20	110	0.87	0.76	0.37	0.09	79.2	16.6	48	2.36	118.0	4.00	7.60	0.22
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-4																



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QC CERTIFICATE OF ANALYSIS VA18016946

Sample Description	Method Analyte Units LOR	ME-MS41 Hf ppm 0.02	ME-MS41 Hg ppm 0.01	ME-MS41 In ppm 0.005	ME-MS41 K % 0.01	ME-MS41 La ppm 0.2	ME-MS41 Li ppm 0.1	ME-MS41 Mg % 0.01	ME-MS41 Mn ppm 5	ME-MS41 Mo ppm 0.05	ME-MS41 Na % 0.01	ME-MS41 Nb ppm 0.05	ME-MS41 Ni ppm 0.2	ME-MS41 P ppm 10	ME-MS41 Pb ppm 0.2	ME-MS41 Rb ppm 0.1
STANDARDS																
Buffer pH6																
Buffer pH6																
Target Range - Lower Bound																
Upper Bound																
DS-1																
Target Range - Lower Bound																
Upper Bound																
GS310-10																
Target Range - Lower Bound																
Upper Bound																
GS313-8																
Target Range - Lower Bound																
Upper Bound																
KZK-1																
KZK-1																
Target Range - Lower Bound																
Upper Bound																
MA-1b																
Target Range - Lower Bound																
Upper Bound																
MA-2c																
Target Range - Lower Bound																
Upper Bound																
OGGeo08		0.74	0.46	1.430	1.06	29.4	31.9	0.91	375	864	0.29	1.04	8900	800	7250	121.0
Target Range - Lower Bound		0.72	0.41	1.335	0.94	27.7	28.4	0.84	350	811	0.26	0.97	7760	700	6520	109.5
Upper Bound		0.92	0.57	1.645	1.18	34.3	35.0	1.05	438	991	0.34	1.29	9480	880	7970	134.5
OREAS 920		0.57	<0.01	0.031	0.42	36.5	20.0	1.03	506	0.35	0.03	0.41	41.6	720	21.0	24.2
Target Range - Lower Bound		0.53	<0.01	0.019	0.39	33.3	19.0	0.98	472	0.29	<0.01	0.31	34.4		19.2	22.2
Upper Bound		0.69	0.02	0.043	0.50	41.1	23.4	1.22	588	0.53	0.02	0.55	42.4		23.9	27.4
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-4																



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QC CERTIFICATE OF ANALYSIS VA18016946

Sample Description	Method Analyte Units LOR	ME-MS41 Re ppm	ME-MS41 S %	ME-MS41 Sb ppm	ME-MS41 Sc ppm	ME-MS41 Se ppm	ME-MS41 Sn ppm	ME-MS41 Sr ppm	ME-MS41 Ta ppm	ME-MS41 Te ppm	ME-MS41 Th ppm	ME-MS41 Ti %	ME-MS41 Tl ppm	ME-MS41 U ppm	ME-MS41 V ppm	ME-MS41 W ppm
		0.001	0.01	0.05	0.1	0.2	0.2	0.2	0.01	0.01	0.2	0.005	0.02	0.05	1	0.05
STANDARDS																
Buffer pH6																
Buffer pH6																
Target Range - Lower Bound																
Upper Bound																
DS-1																
Target Range - Lower Bound																
Upper Bound																
GS310-10																
Target Range - Lower Bound																
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GS313-8																
Target Range - Lower Bound																
Upper Bound																
KZK-1																
KZK-1																
Target Range - Lower Bound																
Upper Bound																
MA-1b																
Target Range - Lower Bound																
Upper Bound																
MA-2c																
Target Range - Lower Bound																
Upper Bound																
OGGeo08		1.360	2.73	19.65	6.2	11.1	12.4	62.7	0.01	0.15	16.9	0.307	1.39	4.76	77	2.89
Target Range - Lower Bound		1.295	2.51	17.70	6.0	9.7	12.0	59.6	<0.01	0.14	15.6	0.279	1.14	4.45	70	2.58
Upper Bound		1.585	3.09	24.1	7.6	12.3	15.1	73.2	0.03	0.20	19.6	0.353	1.58	5.55	88	3.60
OREAS 920		<0.001	0.03	0.60	2.8	0.4	1.0	17.1	0.02	0.01	16.0	0.127	0.15	2.05	24	0.44
Target Range - Lower Bound		<0.001	<0.01	0.45	2.5	<0.2	0.7	15.0	<0.01	<0.01	13.6	0.106	0.07	1.89	23	0.31
Upper Bound		0.002	0.05	0.77	3.3	0.7	1.7	18.8	0.02	0.04	17.0	0.140	0.18	2.42	30	0.61
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-4																



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QC CERTIFICATE OF ANALYSIS VA18016946

Sample Description	Method Analyte Units LOR	ME-MS41 Y ppm 0.05	ME-MS41 Zn ppm 2	ME-MS41 Zr ppm 0.5
STANDARDS				
Buffer pH6				
Buffer pH6				
Target Range - Lower Bound				
Upper Bound				
DS-1				
Target Range - Lower Bound				
Upper Bound				
GS310-10				
Target Range - Lower Bound				
Upper Bound				
GS313-8				
Target Range - Lower Bound				
Upper Bound				
KZK-1				
KZK-1				
Target Range - Lower Bound				
Upper Bound				
MA-1b				
Target Range - Lower Bound				
Upper Bound				
MA-2c				
Target Range - Lower Bound				
Upper Bound				
OGGeo08		16.45	7060	23.7
Target Range - Lower Bound		15.35	6500	19.5
Upper Bound		18.85	7950	27.5
OREAS 920		17.85	105	23.5
Target Range - Lower Bound		16.85	93	17.6
Upper Bound		20.7	119	25.0
UTS-1				
Target Range - Lower Bound				
Upper Bound				
UTS-1				
UTS-1				
Target Range - Lower Bound				
Upper Bound				
UTS-4				



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QC CERTIFICATE OF ANALYSIS VA18016946

Sample Description	Method Analyte Units LOR	OA -VOL08m FIZZ RAT Unity	OA -VOL08m MPA tCaCO3/1Kt	OA -VOL08m NNP tCaCO3/1Kt	OA -VOL08m NP tCaCO3/1Kt	OA -VOL08m Ratio (N) Unity	OA -ELE07 pH Unity	S -IR08 S %	C -GAS05 C %	C -GAS05 CO2 %	S -GRA06a S %	C -IR07 C %	S -GRA06 S %	ME -MS41 Ag ppm	ME -MS41 Al %	ME -MS41 As ppm
		1	0.3	1	1	0.01	0.1	0.01	0.05	0.2	0.01	0.01	0.01	0.01	0.01	0.1
STANDARDS																
Target Range - Lower Bound														1.64		
Upper Bound														1.84		
UTS-4											1.75					
UTS-4											1.63					
Target Range - Lower Bound											1.61					
Upper Bound											1.87					
BLANKS																
BLANK									<0.05	<0.2						
Target Range - Lower Bound									<0.05	<0.2						
Upper Bound									0.10	0.4						
BLANK														<0.01	<0.01	<0.1
Target Range - Lower Bound														<0.01	<0.01	<0.1
Upper Bound														0.02	0.02	0.2
BLANK							6.0									
Target Range - Lower Bound							5.5									
Upper Bound							6.9									
BLANK														<0.01		
Target Range - Lower Bound														<0.01		
Upper Bound														0.02		
BLANK											<0.01					
BLANK											<0.01					
Target Range - Lower Bound											<0.01					
Upper Bound											0.02					
BLANK								<0.01					<0.01			
BLANK								0.01					0.01			
Target Range - Lower Bound								<0.01					<0.01			
Upper Bound								0.02					0.02			



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QC CERTIFICATE OF ANALYSIS VA18016946

Sample Description	Method Analyte Units LOR	ME-MS41 Au ppm 0.02	ME-MS41 B ppm 10	ME-MS41 Ba ppm 10	ME-MS41 Be ppm 0.05	ME-MS41 Bi ppm 0.01	ME-MS41 Ca % 0.01	ME-MS41 Cd ppm 0.01	ME-MS41 Ce ppm 0.02	ME-MS41 Co ppm 0.1	ME-MS41 Cr ppm 1	ME-MS41 Cs ppm 0.05	ME-MS41 Cu ppm 0.2	ME-MS41 Fe % 0.01	ME-MS41 Ga ppm 0.05	ME-MS41 Ge ppm 0.05
STANDARDS																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
UTS-4																
Target Range - Lower Bound																
Upper Bound																
BLANKS																
BLANK		<0.02	<10	<10	<0.05	0.01	<0.01	0.01	<0.02	<0.1	<1	<0.05	<0.2	<0.01	<0.05	<0.05
Target Range - Lower Bound		<0.02	<10	<10	<0.05	<0.01	<0.01	<0.01	<0.02	<0.1	<1	<0.05	<0.2	<0.01	<0.05	<0.05
Upper Bound		0.04	20	20	0.10	0.02	0.02	0.02	0.04	0.2	2	0.10	0.4	0.02	0.10	0.10
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
BLANK																
Target Range - Lower Bound																
Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18016946

Sample Description	Method Analyte Units LOR	ME-MS41 Hf ppm 0.02	ME-MS41 Hg ppm 0.01	ME-MS41 In ppm 0.005	ME-MS41 K % 0.01	ME-MS41 La ppm 0.2	ME-MS41 Li ppm 0.1	ME-MS41 Mg % 0.01	ME-MS41 Mn ppm 5	ME-MS41 Mo ppm 0.05	ME-MS41 Na % 0.01	ME-MS41 Nb ppm 0.05	ME-MS41 Ni ppm 0.2	ME-MS41 P ppm 10	ME-MS41 Pb ppm 0.2	ME-MS41 Rb ppm 0.1
STANDARDS																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
UTS-4																
Target Range - Lower Bound																
Upper Bound																
BLANKS																
BLANK		<0.02	<0.01	<0.005	<0.01	<0.2	0.1	<0.01	<5	<0.05	<0.01	<0.05	<0.2	<10	<0.2	<0.1
Target Range - Lower Bound		<0.02	<0.01	<0.005	<0.01	<0.2	<0.1	<0.01	<5	<0.05	<0.01	<0.05	<0.2	<10	<0.2	<0.1
Upper Bound		0.04	0.02	0.010	0.02	0.4	0.2	0.02	10	0.10	0.02	0.10	0.4	20	0.4	0.2
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
BLANK																
Target Range - Lower Bound																
Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18016946

Sample Description	Method Analyte Units LOR	ME-MS41 Re ppm	ME-MS41 S %	ME-MS41 Sb ppm	ME-MS41 Sc ppm	ME-MS41 Se ppm	ME-MS41 Sn ppm	ME-MS41 Sr ppm	ME-MS41 Ta ppm	ME-MS41 Te ppm	ME-MS41 Th ppm	ME-MS41 Ti %	ME-MS41 Tl ppm	ME-MS41 U ppm	ME-MS41 V ppm	ME-MS41 W ppm
		0.001	0.01	0.05	0.1	0.2	0.2	0.2	0.01	0.01	0.2	0.005	0.02	0.05	1	0.05
STANDARDS																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
UTS-4																
Target Range - Lower Bound																
Upper Bound																
BLANKS																
BLANK		<0.001	<0.01	<0.05	<0.1	<0.2	<0.2	<0.2	<0.01	<0.01	<0.2	<0.005	<0.02	<0.05	<1	<0.05
Target Range - Lower Bound		<0.001	<0.01	<0.05	<0.1	<0.2	<0.2	<0.2	<0.01	<0.01	<0.2	<0.005	<0.02	<0.05	<1	<0.05
Upper Bound		0.002	0.02	0.10	0.2	0.4	0.4	0.4	0.02	0.02	0.4	0.010	0.04	0.10	2	0.10
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
BLANK																
Target Range - Lower Bound																
Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18016946

Sample Description	Method Analyte Units LOR	ME-MS41 Y ppm 0.05	ME-MS41 Zn ppm 2	ME-MS41 Zr ppm 0.5
STANDARDS				
Target Range - Lower Bound				
Upper Bound				
UTS-4				
UTS-4				
Target Range - Lower Bound				
Upper Bound				
BLANKS				
BLANK				
Target Range - Lower Bound				
Upper Bound				
BLANK		<0.05	<2	<0.5
Target Range - Lower Bound		<0.05	<2	<0.5
Upper Bound		0.10	4	1.0
BLANK				
Target Range - Lower Bound				
Upper Bound				
BLANK				
Target Range - Lower Bound				
Upper Bound				
BLANK				
BLANK				
Target Range - Lower Bound				
Upper Bound				
BLANK				
BLANK				
Target Range - Lower Bound				
Upper Bound				



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QC CERTIFICATE OF ANALYSIS VA18016946

Sample Description	Method Analyte Units LOR	OA-VOL08m FIZZ RAT Unity	OA-VOL08m MPA tCaCO3/1Kt	OA-VOL08m NNP tCaCO3/1Kt	OA-VOL08m NP tCaCO3/1Kt	OA-VOL08m Ratio (N) Unity	OA-ELE07 pH Unity	S-IR08 S %	C-GAS05 C %	C-GAS05 CO2 %	S-GRA06a S %	C-IR07 C %	S-GRA06 S %	ME-MS41 Ag ppm	ME-MS41 Al %	ME-MS41 As ppm
		1	0.3	1	1	0.01	0.1	0.01	0.05	0.2	0.01	0.01	0.01	0.01	0.01	0.1
ORIGINAL								0.10				0.02				
DUP								0.09				0.02				
Target Range - Lower Bound								0.08				<0.01				
Upper Bound								0.11				0.03				
ORIGINAL		2	8.8	20	29	3.31										
DUP		2	8.8	19	28	3.20										
Target Range - Lower Bound		<1	8.1	18	26	3.08										
Upper Bound		3	9.5	21	31	3.43										
ORIGINAL								3.84				0.13				
DUP								3.88				0.13				
Target Range - Lower Bound								3.75				0.12				
Upper Bound								3.97				0.14				
L2047740-2 146740														0.17	1.26	0.1
DUP														0.18	1.31	0.2
Target Range - Lower Bound														0.16	1.21	<0.1
Upper Bound														0.19	1.36	0.2
L2047740-10 146749							9.5	0.08	0.3	<0.01		<0.01				
DUP							9.5	0.07	0.3	0.02		<0.01				
Target Range - Lower Bound							8.9	<0.05	<0.2	<0.01		<0.01				
Upper Bound							10.1	0.10	0.4	0.02		0.02				
L2047741-3 153305											<0.01					
DUP											<0.01					
Target Range - Lower Bound											<0.01					
Upper Bound											0.02					



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Sample Description	Method Analyte Units LOR	ME-MS41 Au ppm 0.02	ME-MS41 B ppm 10	ME-MS41 Ba ppm 10	ME-MS41 Be ppm 0.05	ME-MS41 Bi ppm 0.01	ME-MS41 Ca % 0.01	ME-MS41 Cd ppm 0.01	ME-MS41 Ce ppm 0.02	ME-MS41 Co ppm 0.1	ME-MS41 Cr ppm 1	ME-MS41 Cs ppm 0.05	ME-MS41 Cu ppm 0.2	ME-MS41 Fe % 0.01	ME-MS41 Ga ppm 0.05	ME-MS41 Ge ppm 0.05
ORIGINAL DUP Target Range - Lower Bound Upper Bound		DUPLICATES														
ORIGINAL DUP Target Range - Lower Bound Upper Bound																
ORIGINAL DUP Target Range - Lower Bound Upper Bound																
L2047740-2 146740 DUP Target Range - Lower Bound Upper Bound		<0.02 <0.02 <0.02 0.04	<10 <10 <10 20	300 310 270 340	0.21 0.23 0.16 0.28	0.17 0.17 0.15 0.19	0.52 0.55 0.50 0.57	0.06 0.06 0.05 0.07	27.7 27.1 26.0 28.8	5.6 5.7 5.3 6.0	5 5 4 6	0.41 0.42 0.34 0.49	843 878 830 891	2.42 2.50 2.33 2.59	6.16 6.17 5.81 6.52	0.13 0.09 <0.05 0.17
L2047740-10 146749 DUP Target Range - Lower Bound Upper Bound																
L2047741-3 153305 DUP Target Range - Lower Bound Upper Bound																



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Method Analyte Units LOR	ME-MS41 Hf ppm 0.02	ME-MS41 Hg ppm 0.01	ME-MS41 In ppm 0.005	ME-MS41 K % 0.01	ME-MS41 La ppm 0.2	ME-MS41 Li ppm 0.1	ME-MS41 Mg % 0.01	ME-MS41 Mn ppm 5	ME-MS41 Mo ppm 0.05	ME-MS41 Na % 0.01	ME-MS41 Nb ppm 0.05	ME-MS41 Ni ppm 0.2	ME-MS41 P ppm 10	ME-MS41 Pb ppm 0.2	ME-MS41 Rb ppm 0.1
Sample Description															
ORIGINAL DUP Target Range - Lower Bound Upper Bound	DUPLICATES														
ORIGINAL DUP Target Range - Lower Bound Upper Bound															
ORIGINAL DUP Target Range - Lower Bound Upper Bound															
L2047740-2 146740 DUP Target Range - Lower Bound Upper Bound	0.03 0.03 <0.02 0.04	<0.01 <0.01 <0.01 0.02	0.029 0.030 0.023 0.036	0.76 0.79 0.73 0.82	14.3 14.3 13.4 15.2	5.9 5.7 5.4 6.2	0.62 0.64 0.59 0.67	533 552 510 575	0.88 0.92 0.81 1.00	0.10 0.10 0.09 0.12	0.29 0.29 0.23 0.35	2.6 2.7 2.3 3.0	580 610 560 630	1.9 2.0 1.7 2.2	36.0 36.3 34.2 38.1
L2047740-10 146749 DUP Target Range - Lower Bound Upper Bound															
L2047741-3 153305 DUP Target Range - Lower Bound Upper Bound															



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Sample Description	Method Analyte Units LOR	ME-MS41 Re ppm	ME-MS41 S %	ME-MS41 Sb ppm	ME-MS41 Sc ppm	ME-MS41 Se ppm	ME-MS41 Sn ppm	ME-MS41 Sr ppm	ME-MS41 Ta ppm	ME-MS41 Te ppm	ME-MS41 Th ppm	ME-MS41 Ti %	ME-MS41 Tl ppm	ME-MS41 U ppm	ME-MS41 V ppm	ME-MS41 W ppm
		0.001	0.01	0.05	0.1	0.2	0.2	0.2	0.01	0.01	0.2	0.005	0.02	0.05	1	0.05
ORIGINAL DUP Target Range - Lower Bound Upper Bound		DUPLICATES														
ORIGINAL DUP Target Range - Lower Bound Upper Bound																
ORIGINAL DUP Target Range - Lower Bound Upper Bound																
L2047740-2 146740 DUP Target Range - Lower Bound Upper Bound		<0.001 <0.001 <0.001 0.002	0.01 0.01 <0.01 0.02	<0.05 <0.05 <0.05 0.10	8.2 8.2 7.7 8.7	0.4 0.6 0.3 0.7	0.5 0.5 0.3 0.7	44.0 45.5 42.3 47.2	<0.01 <0.01 <0.01 0.02	0.03 0.03 0.02 0.04	3.8 3.7 3.4 4.1	0.124 0.128 0.115 0.137	0.21 0.22 0.18 0.25	0.17 0.17 0.11 0.23	48 50 46 52	0.79 1.04 0.80 1.03
L2047740-10 146749 DUP Target Range - Lower Bound Upper Bound																
L2047741-3 153305 DUP Target Range - Lower Bound Upper Bound																



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Sample Description	Method Analyte Units LOR	ME-MS41 Y ppm 0.05	ME-MS41 Zn ppm 2	ME-MS41 Zr ppm 0.5
ORIGINAL DUP Target Range - Lower Bound Upper Bound	DUPLICATES			
ORIGINAL DUP Target Range - Lower Bound Upper Bound				
ORIGINAL DUP Target Range - Lower Bound Upper Bound				
L2047740-2 146740 DUP Target Range - Lower Bound Upper Bound		5.01 5.12 4.76 5.37	80 83 75 88	0.6 0.7 <0.5 1.0
L2047740-10 146749 DUP Target Range - Lower Bound Upper Bound				
L2047741-3 153305 DUP Target Range - Lower Bound Upper Bound				



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CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

C-GAS05	C-IR07	LOG-22	ME-MS41
OA-ELE07	OA-VOL08m	PUL-31	S-CAL06a
S-GRA06	S-GRA06a	S-IR08	SPL-21
WEI-21			



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Postal Code:	V6B 0M3			For tests that can not be performed according to the service level selected, you will be contacted.	
Invoice To	Same as Report To ☐ YES ☒ NO	Invoice Distribution		Analysis Request	
	Copy of Invoice with Report ☐ YES ☒ NO	Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below	
Company:	Minto Explorations Ltd.	Email 1 or Fax ap@mintomine.com			
Contact:	Ruth Cayetano	Email 2			
Project Information		Oil and Gas Required Fields (client use)			
ALS Account # / Quote #:		AFE/Cost Center:			
Job #:		Major/Minor Code:			
PO / AFE:	TBD	Requisitioner:			
LSD:		Location:			
ALS Lab Work Order # (lab use only)		ALS Contact:		Sampler:	
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	
				Composite	
	146737	01-01-18		WASTE	
	146738	01-01-18		WASTE	
	153305	13-JAN-18		WASTE	
	153306	13-JAN-18		WASTE	
	153307	15-JAN-18		WASTE	
	153308	15-JAN-18		WASTE	
	153301	10-JAN-18		WASTE	
	153302	10-JAN-18		WASTE	
	153303	11-JAN-18		WASTE	
	153304	12-JAN-18		WASTE	
Drinking Water (DW) Samples ¹ (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)		SAMPLE CONDITION AS RECEIVED (lab use only)	
Are samples taken from a Regulated DW System? ☐ YES ☒ NO				Frozen ☐ SIF Observations Yes ☐ No ☐	
Are samples for human drinking water use? ☐ YES ☒ NO				Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐	
				Cooling Initiated ☐	
				INITIAL COOLER TEMPERATURES °C 13°C	
				FINAL COOLER TEMPERATURES °C 15.4°C	
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)		FINAL SHIPMENT RECEPTION (lab use only)	
Released by: SH.	Date:	Time:	Received by: AW	Date: JAN 22/17	Time: 13:20
				Received by: TP	Date: Jan 23
					Time: 15:40

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

OCTOBER 2015 FRONT



Minto Explorations Ltd.
ATTN: Minto Environment
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 29-JAN-18
Report Date: 02-MAR-18 16:40 (MT)
Version: FINAL

Client Phone: 604-759-0860

Certificate of Analysis

Lab Work Order #: L2050182
Project P.O. #: PO#229850
Job Reference:
C of C Numbers: 18-3
Legal Site Desc:

Comments: Please note, the ALS Minerals version of the finalized report and QC can be found at the end of the attachment.

Shane Stack
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2050182-1 Waste 09-JAN-18 146750	L2050182-2 Waste 17-JAN-18 153309	L2050182-3 Waste 17-JAN-18 153310	L2050182-4 Waste 18-JAN-18 153311	L2050182-5 Waste 18-JAN-18 153312
Grouping	Analyte					
SOIL						
Physical Tests	pH (Unity)	8.8	8.7	8.6	8.8	9.0
Organic / Inorganic Carbon	Carbon (C) (%)	<0.05	0.33	0.33	0.25	0.10
Acid Base Accounting	FIZZ RATING (Unity)	1	2	2	2	2
	MPA (tCaCO3/1Kt)	0.3	0.6	0.6	0.6	0.6
	Neutralization Potential (NP) (tCaCO3/1Kt)	8	34	32	28	17
	NNP (tCaCO3/1Kt)	8	33	31	27	16
	Ratio (NP/MPA) (Unity)	25.60	54.40	51.20	44.80	27.20
	Sulfate Sulfur (carbonate leach) (%)	0.02	0.01	<0.01	0.01	0.01
	Sulfate Sulfur (HCl leach) (%)	0.01	<0.01	0.03	0.03	<0.01
	Sulfide Sulfur (T minus HCl leach) (%)	<0.01	0.02	<0.01	<0.01	0.02
	Total Sulfur (combustion) (%)	0.01	0.02	0.02	0.02	0.02
Total Metals	Aluminum (Al) (%)	0.89	0.88	0.77	0.98	1.15
	Antimony (Sb) (ppm)	0.32	0.14	0.10	0.21	0.10
	Arsenic (As) (ppm)	2.4	1.4	0.7	1.9	0.7
	Barium (Ba) (ppm)	200	150	140	240	250
	Beryllium (Be) (ppm)	0.22	0.30	0.27	0.31	0.28
	Bismuth (Bi) (ppm)	0.21	0.07	0.62	0.10	0.07
	Boron (B) (ppm)	<10	<10	<10	<10	<10
	Cadmium (Cd) (ppm)	0.13	0.05	0.12	0.10	0.07
	Calcium (Ca) (%)	0.29	1.28	1.24	1.04	0.69
	Cerium (Ce) (ppm)	13.10	19.05	21.0	22.0	26.8
	Cesium (Cs) (ppm)	0.25	0.26	0.21	0.31	0.39
	Chromium (Cr) (ppm)	4	3	3	4	6
	Cobalt (Co) (ppm)	4.8	6.1	5.0	6.1	6.3
	Copper (Cu) (ppm)	1350	88.5	1790	257	375
	Gallium (Ga) (ppm)	5.06	5.13	4.95	5.41	6.08
	Germanium (Ge) (ppm)	0.05	0.05	<0.05	0.06	0.07
	Gold (Au) (ppm)	0.03	<0.02	0.08	<0.02	<0.02
	Hafnium (Hf) (ppm)	0.03	0.03	<0.02	0.05	0.06
	Indium (In) (ppm)	0.021	0.024	0.019	0.028	0.028
	Iron (Fe) (%)	1.78	1.99	1.95	2.13	2.23
	Lanthanum (La) (ppm)	6.4	9.7	11.7	11.3	13.8
	Lead (Pb) (ppm)	3.5	2.8	3.9	3.2	2.3
	Lithium (Li) (ppm)	6.2	6.7	5.6	6.0	6.1
	Magnesium (Mg) (%)	0.47	0.57	0.38	0.59	0.59
	Manganese (Mn) (ppm)	470	586	453	628	599

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2050182-6 Waste 18-JAN-18 153313	L2050182-7 Waste 18-JAN-18 153314	L2050182-8 Waste 18-JAN-18 153315	L2050182-9 Waste 20-JAN-18 153316	L2050182-10 Waste 20-JAN-18 153317
Grouping	Analyte					
SOIL						
Physical Tests	pH (Unity)	8.6	9.2	9.0	8.9	9.0
Organic / Inorganic Carbon	Carbon (C) (%)	0.25	0.12	0.29	0.21	0.06
Acid Base Accounting	FIZZ RATING (Unity)	2	2	2	2	1
	MPA (tCaCO3/1Kt)	0.6	0.6	2.5	0.3	0.6
	Neutralization Potential (NP) (tCaCO3/1Kt)	28	19	28	27	15
	NNP (tCaCO3/1Kt)	27	18	26	27	14
	Ratio (NP/MPA) (Unity)	44.80	30.40	11.20	86.40	24.00
	Sulfate Sulfur (carbonate leach) (%)	0.01	0.01	<0.01	0.03	0.02
	Sulfate Sulfur (HCl leach) (%)	<0.01	<0.01	0.02	<0.01	0.02
	Sulfide Sulfur (T minus HCl leach) (%)	0.02	0.02	0.06	0.01	<0.01
	Total Sulfur (combustion) (%)	0.02	0.02	0.08	0.01	0.02
Total Metals	Aluminum (Al) (%)	1.18	1.23	1.33	0.91	1.22
	Antimony (Sb) (ppm)	0.10	0.07	0.05	0.05	<0.05
	Arsenic (As) (ppm)	2.2	0.6	0.8	0.9	0.8
	Barium (Ba) (ppm)	140	270	320	310	280
	Beryllium (Be) (ppm)	0.55	0.29	0.25	0.28	0.27
	Bismuth (Bi) (ppm)	0.03	0.05	0.12	0.02	0.13
	Boron (B) (ppm)	<10	<10	<10	<10	<10
	Cadmium (Cd) (ppm)	0.05	0.03	0.09	0.12	0.09
	Calcium (Ca) (%)	1.02	0.77	0.97	1.04	0.57
	Cerium (Ce) (ppm)	24.8	28.2	48.6	23.2	27.8
	Cesium (Cs) (ppm)	0.59	0.37	0.52	0.35	0.38
	Chromium (Cr) (ppm)	4	5	5	4	4
	Cobalt (Co) (ppm)	6.2	6.6	7.6	6.3	6.7
	Copper (Cu) (ppm)	41.1	169.0	1180	66.2	583
	Gallium (Ga) (ppm)	6.87	6.19	7.16	5.01	6.41
	Germanium (Ge) (ppm)	0.07	0.07	0.07	0.05	0.07
	Gold (Au) (ppm)	<0.02	<0.02	<0.02	<0.02	<0.02
	Hafnium (Hf) (ppm)	0.06	0.05	0.04	0.06	0.05
	Indium (In) (ppm)	0.035	0.020	0.055	0.027	0.027
	Iron (Fe) (%)	2.19	2.21	2.66	2.21	2.34
	Lanthanum (La) (ppm)	11.8	14.9	26.6	12.2	14.5
	Lead (Pb) (ppm)	4.0	2.2	3.0	2.3	2.2
	Lithium (Li) (ppm)	9.3	7.8	7.1	4.6	7.0
	Magnesium (Mg) (%)	0.60	0.68	0.81	0.41	0.67
	Manganese (Mn) (ppm)	593	544	526	830	659

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2050182-1 Waste 09-JAN-18 146750	L2050182-2 Waste 17-JAN-18 153309	L2050182-3 Waste 17-JAN-18 153310	L2050182-4 Waste 18-JAN-18 153311	L2050182-5 Waste 18-JAN-18 153312
Grouping	Analyte					
SOIL						
Total Metals	Mercury (Hg) (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01
	Molybdenum (Mo) (ppm)	0.73	0.79	1.22	1.92	0.69
	Nickel (Ni) (ppm)	2.3	2.8	2.4	2.8	5.0
	Niobium (Nb) (ppm)	0.14	0.12	<0.05	0.15	0.17
	Phosphorus (P) (ppm)	420	540	570	650	620
	Potassium (K) (%)	0.44	0.30	0.17	0.45	0.64
	Rhenium (Re) (ppm)	<0.001	<0.001	<0.001	0.001	<0.001
	Rubidium (Rb) (ppm)	21.8	14.4	9.7	21.3	31.8
	Scandium (Sc) (ppm)	3.5	6.4	1.9	4.8	6.0
	Selenium (Se) (ppm)	0.3	0.2	0.7	0.2	0.2
	Silver (Ag) (ppm)	0.17	0.03	1.24	0.06	0.06
	Sodium (Na) (%)	0.06	0.02	0.04	0.06	0.09
	Strontium (Sr) (ppm)	29.6	102.5	55.1	70.8	57.1
	Sulfur (S) (%)	0.01	0.01	0.01	0.01	0.01
	Tantalum (Ta) (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01
	Tellurium (Te) (ppm)	0.03	0.01	0.22	0.02	0.02
	Thallium (Tl) (ppm)	0.13	0.08	0.05	0.12	0.18
	Thorium (Th) (ppm)	1.5	2.1	2.2	2.2	3.3
	Tin (Sn) (ppm)	0.5	0.4	0.3	0.5	0.6
	Titanium (Ti) (%)	0.068	0.046	0.018	0.073	0.105
	Tungsten (W) (ppm)	1.83	0.65	0.40	1.18	1.38
	Uranium (U) (ppm)	0.16	0.20	0.24	0.31	0.23
	Vanadium (V) (ppm)	37	37	32	43	48
	Yttrium (Y) (ppm)	5.51	7.79	3.99	9.98	8.62
	Zinc (Zn) (ppm)	61	61	60	70	76
	Zirconium (Zr) (ppm)	0.7	0.5	<0.5	0.8	1.1
Permanent Gases	Carbon Dioxide (CO2) (%)	<0.2	1.2	1.2	0.9	0.4
Miscellaneous	Carbon (C) (%)	0.07	0.38	0.39	0.33	0.17

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2050182-6 Waste 18-JAN-18 153313	L2050182-7 Waste 18-JAN-18 153314	L2050182-8 Waste 18-JAN-18 153315	L2050182-9 Waste 20-JAN-18 153316	L2050182-10 Waste 20-JAN-18 153317
Grouping	Analyte					
SOIL						
Total Metals	Mercury (Hg) (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01
	Molybdenum (Mo) (ppm)	0.83	1.42	22.1	1.84	0.63
	Nickel (Ni) (ppm)	2.7	3.0	3.2	3.0	2.8
	Niobium (Nb) (ppm)	0.05	0.23	0.33	0.12	0.18
	Phosphorus (P) (ppm)	600	650	880	530	630
	Potassium (K) (%)	0.39	0.65	0.93	0.52	0.72
	Rhenium (Re) (ppm)	<0.001	0.003	0.067	<0.001	<0.001
	Rubidium (Rb) (ppm)	19.4	30.4	47.1	26.2	34.9
	Scandium (Sc) (ppm)	7.2	5.4	8.1	5.6	5.4
	Selenium (Se) (ppm)	<0.2	0.3	0.6	0.2	0.5
	Silver (Ag) (ppm)	0.01	0.07	0.40	0.02	0.20
	Sodium (Na) (%)	0.05	0.09	0.07	0.07	0.08
	Strontium (Sr) (ppm)	99.2	56.7	47.2	71.5	45.1
	Sulfur (S) (%)	0.01	0.02	0.09	0.01	0.01
	Tantalum (Ta) (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01
	Tellurium (Te) (ppm)	0.01	0.01	0.04	0.01	0.06
	Thallium (Tl) (ppm)	0.11	0.18	0.32	0.13	0.20
	Thorium (Th) (ppm)	2.4	3.7	7.6	2.3	3.1
	Tin (Sn) (ppm)	0.6	0.5	0.9	0.5	0.6
	Titanium (Ti) (%)	0.042	0.113	0.153	0.078	0.124
	Tungsten (W) (ppm)	0.57	0.94	1.05	0.65	0.45
	Uranium (U) (ppm)	0.30	0.28	0.33	0.39	0.22
	Vanadium (V) (ppm)	42	49	67	45	53
	Yttrium (Y) (ppm)	12.35	7.64	9.65	9.56	8.31
	Zinc (Zn) (ppm)	66	59	73	70	81
	Zirconium (Zr) (ppm)	1.0	0.8	0.9	1.1	0.7
Permanent Gases	Carbon Dioxide (CO2) (%)	0.9	0.4	1.1	0.8	0.2
Miscellaneous	Carbon (C) (%)	0.31	0.19	0.45	0.29	0.14

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ABA-OA-VOL08-AX	Soil	Acid Base Accounting	OA-VOL08
CARBON-C-GAS05-AX	Soil	Carbon, TOC and CO ₂	C-GAS05
CARBON-C-IR07-AX	Soil	Carbon (C) using LECO analyzer	Total Carbon - Method Code C-IR07
Total Carbon & Sulfur - Method Codes C-IR07 & S-IR08			
A 0.1g sample is heated to approximately 1350°C in an induction furnace while passing a stream of oxygen through the sample. Carbon dioxide & sulfur dioxide released from the sample are measured by an IR detection system (Leco analyzer) and the total carbon & sulfur results are provided.			
ME-MS41-AX	Soil	Aqua Regia ICPMS	Aqua Regia ICPMS
A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences.			
PH-OA-ELE07-AX	Soil	pH	OA-ELE07
SULPHUR-S-CAL06A-AX	Soil	Sulfide Sulfur Calc from HCl Leach	ALS Minerals S-CAL06A
Sulfide Sulfur (as S) is calculated by subtracting the HCl Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion.			
SULPHUR-S-GRA06-AX	Soil	Sulfate Sulfur in Soil (Carbonate Leach)	ALS Minerals S-GRA06
A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).			
SULPHUR-S-GRA06A-AX	Soil	Sulfate Sulfur in Soil (HCl Leach)	ALS Minerals S-GRA06A
A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).			
SULPHUR-S-IR08-AX	Soil	Total Sulfur in Soil by Combustion	ALS Minerals S-IR08
The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
AX	ALS MINERALS - VANCOUVER, B.C., CANADA

Chain of Custody Numbers:

18-3

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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To: **ALS ENVIRONMENTAL**
100 - 8081 LOUGHEED HWY.
BURNABY BC V5A 1W9

Page: **1**
Total # Pages: **2 (A - E)**
Plus Appendix Pages
Finalized Date: **2 - MAR - 2018**
Account: **APN**

CERTIFICATE VA18024484

Project: L2050182

This report is for 10 Crushed Rock samples submitted to our lab in Vancouver, BC, Canada on 1-FEB-2018.

The following have access to data associated with this certificate:

CASDG ALSE

ALSEV DATASUBLET

SHANE STACK

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI-21	Received Sample Weight
SPL-21	Split sample - riffle splitter
LOG-22	Sample login - Rcd w/o BarCode
PUL-31	Pulverize split to 85% <75 um

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	
C-GAS05	Inorganic Carbon (CO2)	
C-IR07	Total Carbon (Leco)	LECO
S-GRA06	Sulfate Sulfur - carbonate leach	WST-SEQ
ME-MS41	Ultra Trace Aqua Regia ICP-MS	
OA-VOL08m	Modified NP	
S-IR08	Total Sulphur (Leco)	LECO
OA-ELE07	Paste pH	
S-CAL06a	Sulfide Sulfur (calculated*)	
S-GRA06a	Sulfate Sulfur (HCl leachable)	WST-SEQ

To: **ALS ENVIRONMENTAL**
ATTN: ALSEV DATASUBLET
100 - 8081 LOUGHEED HWY.
BURNABY BC V5A 1W9

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature:

Colin Ramshaw, Vancouver Laboratory Manager



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Page: 2 - A
Total # Pages: 2 (A - E)
Plus Appendix Pages
Finalized Date: 2 - MAR - 2018
Account: APN

Project: L2050182

CERTIFICATE OF ANALYSIS VA18024484

Sample Description	Method Analyte Units LOR	WEI-21	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-ELE07	S-IR08	S-CAL06a	C-GAS05	C-GAS05	S-GRA06a	C-IR07	S-GRA06	ME-MS41
		Recvd Wt.	FIZZ RAT	MPA	NNP	NP	Ratio (N	pH	S	S	C	CO2	S	C	S	Ag
		kg	Unity	tCaCO3/1Kt	tCaCO3/1Kt	tCaCO3/1Kt	Unity	Unity	%	%	%	%	%	%	%	ppm
		0.02	1	0.3	1	1	0.01	0.1	0.01	0.01	0.05	0.2	0.01	0.01	0.01	0.01
L2050182-1 146750		1.04	1	0.3	8	8	25.60	8.8	0.01	<0.01	<0.05	<0.2	0.01	0.07	0.02	0.17
L2050182-2 153309		1.06	2	0.6	33	34	54.40	8.7	0.02	0.02	0.33	1.2	<0.01	0.38	0.01	0.03
L2050182-3 153310		1.08	2	0.6	31	32	51.20	8.6	0.02	<0.01	0.33	1.2	0.03	0.39	<0.01	1.24
L2050182-4 153311		1.06	2	0.6	27	28	44.80	8.8	0.02	<0.01	0.25	0.9	0.03	0.33	0.01	0.06
L2050182-5 153312		1.04	2	0.6	16	17	27.20	9.0	0.02	0.02	0.10	0.4	<0.01	0.17	0.01	0.06
L2050182-6 153313		1.04	2	0.6	27	28	44.80	8.6	0.02	0.02	0.25	0.9	<0.01	0.31	0.01	0.01
L2050182-7 153314		1.10	2	0.6	18	19	30.40	9.2	0.02	0.02	0.12	0.4	<0.01	0.19	0.01	0.07
L2050182-8 153315		0.98	2	2.5	26	28	11.20	9.0	0.08	0.06	0.29	1.1	0.02	0.45	<0.01	0.40
L2050182-9 153316		1.06	2	0.3	27	27	86.40	8.9	0.01	0.01	0.21	0.8	<0.01	0.29	0.03	0.02
L2050182-10 153317		1.04	1	0.6	14	15	24.00	9.0	0.02	<0.01	0.06	0.2	0.02	0.14	0.02	0.20

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CERTIFICATE OF ANALYSIS VA18024484

Sample Description	Method Analyte Units LOR	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
		Ga	Ge	Hf	Hg	In	K	La	Li	Mg	Mn	Mo	Na	Nb	Ni
		ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	ppm	%	ppm	ppm
		0.05	0.05	0.02	0.01	0.005	0.01	0.2	0.1	0.01	5	0.05	0.01	0.05	0.2
L2050182-1 146750		5.06	0.05	0.03	<0.01	0.021	0.44	6.4	6.2	0.47	470	0.73	0.06	0.14	2.3
L2050182-2 153309		5.13	0.05	0.03	<0.01	0.024	0.30	9.7	6.7	0.57	586	0.79	0.02	0.12	2.8
L2050182-3 153310		4.95	<0.05	<0.02	<0.01	0.019	0.17	11.7	5.6	0.38	453	1.22	0.04	<0.05	2.4
L2050182-4 153311		5.41	0.06	0.05	<0.01	0.028	0.45	11.3	6.0	0.59	628	1.92	0.06	0.15	2.8
L2050182-5 153312		6.08	0.07	0.06	<0.01	0.028	0.64	13.8	6.1	0.59	599	0.69	0.09	0.17	5.0
L2050182-6 153313		6.87	0.07	0.06	<0.01	0.035	0.39	11.8	9.3	0.60	593	0.83	0.05	0.05	2.7
L2050182-7 153314		6.19	0.07	0.05	<0.01	0.020	0.65	14.9	7.8	0.68	544	1.42	0.09	0.23	3.0
L2050182-8 153315		7.16	0.07	0.04	<0.01	0.055	0.93	26.6	7.1	0.81	526	22.1	0.07	0.33	3.2
L2050182-9 153316		5.01	0.05	0.06	<0.01	0.027	0.52	12.2	4.6	0.41	830	1.84	0.07	0.12	3.0
L2050182-10 153317		6.41	0.07	0.05	<0.01	0.027	0.72	14.5	7.0	0.67	659	0.63	0.08	0.18	2.8



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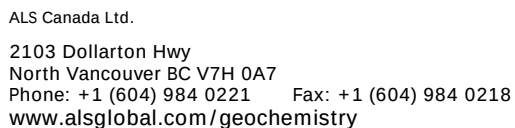
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Sample Description	Method Analyte Units LOR	ME-MS41 Pb ppm 0.2	ME-MS41 Rb ppm 0.1	ME-MS41 Re ppm 0.001	ME-MS41 S % 0.01	ME-MS41 Sb ppm 0.05	ME-MS41 Sc ppm 0.1	ME-MS41 Se ppm 0.2	ME-MS41 Sn ppm 0.2	ME-MS41 Sr ppm 0.2	ME-MS41 Ta ppm 0.01	ME-MS41 Te ppm 0.01	ME-MS41 Th ppm 0.2	ME-MS41 Ti % 0.005	ME-MS41 Tl ppm 0.02	ME-MS41 U ppm 0.05
L2050182-1 146750		3.5	21.8	<0.001	0.01	0.32	3.5	0.3	0.5	29.6	<0.01	0.03	1.5	0.068	0.13	0.16
L2050182-2 153309		2.8	14.4	<0.001	0.01	0.14	6.4	0.2	0.4	102.5	<0.01	0.01	2.1	0.046	0.08	0.20
L2050182-3 153310		3.9	9.7	<0.001	0.01	0.10	1.9	0.7	0.3	55.1	<0.01	0.22	2.2	0.018	0.05	0.24
L2050182-4 153311		3.2	21.3	0.001	0.01	0.21	4.8	0.2	0.5	70.8	<0.01	0.02	2.2	0.073	0.12	0.31
L2050182-5 153312		2.3	31.8	<0.001	0.01	0.10	6.0	0.2	0.6	57.1	<0.01	0.02	3.3	0.105	0.18	0.23
L2050182-6 153313		4.0	19.4	<0.001	0.01	0.10	7.2	<0.2	0.6	99.2	<0.01	0.01	2.4	0.042	0.11	0.30
L2050182-7 153314		2.2	30.4	0.003	0.02	0.07	5.4	0.3	0.5	56.7	<0.01	0.01	3.7	0.113	0.18	0.28
L2050182-8 153315		3.0	47.1	0.067	0.09	0.05	8.1	0.6	0.9	47.2	<0.01	0.04	7.6	0.153	0.32	0.33
L2050182-9 153316		2.3	26.2	<0.001	0.01	0.05	5.6	0.2	0.5	71.5	<0.01	0.01	2.3	0.078	0.13	0.39
L2050182-10 153317		2.2	34.9	<0.001	0.01	<0.05	5.4	0.5	0.6	45.1	<0.01	0.06	3.1	0.124	0.20	0.22



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CERTIFICATE OF ANALYSIS VA18024484

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

C-GAS05	C-IR07	LOG-22	ME-MS41
OA-ELE07	OA-VOL08m	PUL-31	S-CAL06a
S-GRA06	S-GRA06a	S-IR08	SPL-21
WEI-21			



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QC CERTIFICATE VA18024484

Project: L2050182

This report is for 10 Crushed Rock samples submitted to our lab in Vancouver, BC, Canada on 1-FEB-2018.

The following have access to data associated with this certificate:

CASDG ALSE

ALSEV DATASUBLET

SHANE STACK

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI-21	Received Sample Weight
SPL-21	Split sample - riffle splitter
LOG-22	Sample login - Rcd w/o BarCode
PUL-31	Pulverize split to 85% <75 um

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	
C-GAS05	Inorganic Carbon (CO2)	
C-IR07	Total Carbon (Leco)	LECO
S-GRA06	Sulfate Sulfur - carbonate leach	WST-SEQ
ME-MS41	Ultra Trace Aqua Regia ICP-MS	
OA-VOL08m	Modified NP	
S-IR08	Total Sulphur (Leco)	LECO
OA-ELE07	Paste pH	
S-CAL06a	Sulfide Sulfur (calculated*)	
S-GRA06a	Sulfate Sulfur (HCl leachable)	WST-SEQ

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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature:

Colin Ramshaw, Vancouver Laboratory Manager



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Sample Description	Method Analyte Units LOR	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-ELE07	S-IR08	C-GAS05	C-GAS05	S-GRA06a	C-IR07	S-GRA06	ME-MS41	ME-MS41	ME-MS41
		FIZZ RAT	MPA	NNP	NP	Ratio (N	pH	S	C	CO2	S	C	S	Ag	Al	As
		Unity	tCaCO3/1Kt	tCaCO3/1Kt	tCaCO3/1Kt	Unity	Unity	%	%	%	%	%	%	ppm	%	ppm
		1	0.3	1	1	0.01	0.1	0.01	0.05	0.2	0.01	0.01	0.01	0.01	0.01	0.1
STANDARDS																
Buffer pH6							6.0									
Buffer pH6							6.0									
Target Range - Lower Bound							5.3									
Upper Bound							6.7									
DS-1								2.60				3.13				
Target Range - Lower Bound								2.51				3.01				
Upper Bound								2.71				3.25				
GS313-8								1.25				0.94				
Target Range - Lower Bound								1.19				0.90				
Upper Bound								1.29				0.98				
KZK-1		2	25.0	31	56	2.24										
KZK-1		2	25.0	31	56	2.24										
Target Range - Lower Bound		<1	22.9	30	54	2.18										
Upper Bound		>4	27.1	38	64	2.53										
MA-3a									2.37	8.7						
Target Range - Lower Bound									2.31	8.4						
Upper Bound									2.77	10.2						
MRGeo08														4.26	2.63	32.4
Target Range - Lower Bound														4.00	2.44	29.6
Upper Bound														4.92	3.00	36.4
OREAS 905														0.48	0.77	33.0
Target Range - Lower Bound														0.45	0.73	28.4
Upper Bound														0.58	0.91	35.0
SY-4									0.85	3.1						
Target Range - Lower Bound									0.84	3.0						
Upper Bound									1.08	4.0						
UTS-1													0.85			
Target Range - Lower Bound													0.83			
Upper Bound													0.93			
UTS-1											0.93					
UTS-1											0.97					
UTS-1											0.94					
Target Range - Lower Bound											0.81					
Upper Bound											0.95					
UTS-4													1.66			
Target Range - Lower Bound													1.64			
Upper Bound													1.84			
UTS-4											1.86					



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Sample Description	Method Analyte Units LOR	ME-MS41 Au ppm 0.02	ME-MS41 B ppm 10	ME-MS41 Ba ppm 10	ME-MS41 Be ppm 0.05	ME-MS41 Bi ppm 0.01	ME-MS41 Ca % 0.01	ME-MS41 Cd ppm 0.01	ME-MS41 Ce ppm 0.02	ME-MS41 Co ppm 0.1	ME-MS41 Cr ppm 1	ME-MS41 Cs ppm 0.05	ME-MS41 Cu ppm 0.2	ME-MS41 Fe % 0.01	ME-MS41 Ga ppm 0.05	ME-MS41 Ge ppm 0.05
STANDARDS																
Buffer pH6																
Buffer pH6																
Target Range - Lower Bound																
Upper Bound																
DS-1																
Target Range - Lower Bound																
Upper Bound																
GS313-8																
Target Range - Lower Bound																
Upper Bound																
KZK-1																
KZK-1																
Target Range - Lower Bound																
Upper Bound																
MA-3a																
Target Range - Lower Bound																
Upper Bound																
MRGeo08		<0.02	<10	430	0.87	0.67	1.07	2.09	74.1	19.2	89	11.20	639	3.51	9.70	0.11
Target Range - Lower Bound		<0.02	<10	370	0.67	0.60	1.00	2.01	66.2	17.0	81	9.40	587	3.22	8.73	0.07
Upper Bound		0.04	20	530	0.95	0.76	1.24	2.47	81.0	21.0	102	11.60	675	3.96	10.80	0.29
OREAS 905		0.38	<10	230	0.93	5.80	0.32	0.31	76.8	14.7	16	1.21	1530	3.29	6.26	0.07
Target Range - Lower Bound		0.33	<10	200	0.78	5.16	0.29	0.30	72.0	12.4	15	1.14	1450	3.14	5.74	<0.05
Upper Bound		0.45	20	300	1.08	6.32	0.38	0.38	88.0	15.4	20	1.50	1670	3.86	7.12	0.22
SY-4																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
UTS-1																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																
UTS-4																



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Sample Description	Method Analyte Units LOR	ME-MS41 Hf ppm 0.02	ME-MS41 Hg ppm 0.01	ME-MS41 In ppm 0.005	ME-MS41 K % 0.01	ME-MS41 La ppm 0.2	ME-MS41 Li ppm 0.1	ME-MS41 Mg % 0.01	ME-MS41 Mn ppm 5	ME-MS41 Mo ppm 0.05	ME-MS41 Na % 0.01	ME-MS41 Nb ppm 0.05	ME-MS41 Ni ppm 0.2	ME-MS41 P ppm 10	ME-MS41 Pb ppm 0.2	ME-MS41 Rb ppm 0.1
STANDARDS																
Buffer pH6																
Buffer pH6																
Target Range - Lower Bound																
Upper Bound																
DS-1																
Target Range - Lower Bound																
Upper Bound																
GS313-8																
Target Range - Lower Bound																
Upper Bound																
KZK-1																
KZK-1																
Target Range - Lower Bound																
Upper Bound																
MA-3a																
Target Range - Lower Bound																
Upper Bound																
MRGeo08		0.69	0.05	0.154	1.25	36.6	36.3	1.13	411	13.60	0.34	0.98	701	990	1060	142.5
Target Range - Lower Bound		0.64	0.04	0.137	1.12	33.2	29.6	1.03	378	13.10	0.30	0.79	622	900	959	132.0
Upper Bound		0.83	0.10	0.179	1.40	41.0	36.4	1.29	473	16.10	0.39	1.09	760	1130	1175	162.0
OREAS 905		1.12	0.01	0.575	0.30	38.1	4.5	0.14	332	2.75	0.09	0.34	9.0	230	16.3	18.5
Target Range - Lower Bound		1.08	<0.01	0.517	0.28	35.6	4.3	0.13	310	2.65	0.07	0.19	7.8		15.2	17.3
Upper Bound		1.36	0.04	0.643	0.36	44.0	5.5	0.19	390	3.35	0.12	0.43	10.0		19.0	21.3
SY-4																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
UTS-1																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																
UTS-4																



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Sample Description	Method Analyte Units LOR	ME-MS41 Re ppm	ME-MS41 S %	ME-MS41 Sb ppm	ME-MS41 Sc ppm	ME-MS41 Se ppm	ME-MS41 Sn ppm	ME-MS41 Sr ppm	ME-MS41 Ta ppm	ME-MS41 Te ppm	ME-MS41 Th ppm	ME-MS41 Ti %	ME-MS41 Tl ppm	ME-MS41 U ppm	ME-MS41 V ppm	ME-MS41 W ppm
		0.001	0.01	0.05	0.1	0.2	0.2	0.2	0.01	0.01	0.2	0.005	0.02	0.05	1	0.05
STANDARDS																
Buffer pH6																
Buffer pH6																
Target Range - Lower Bound																
Upper Bound																
DS-1																
Target Range - Lower Bound																
Upper Bound																
GS313-8																
Target Range - Lower Bound																
Upper Bound																
KZK-1																
KZK-1																
Target Range - Lower Bound																
Upper Bound																
MA-3a																
Target Range - Lower Bound																
Upper Bound																
MRGeo08		0.008	0.31	3.20	8.0	0.8	3.3	79.4	0.01	0.02	22.0	0.377	0.80	5.95	98	2.62
Target Range - Lower Bound		0.006	0.27	2.80	6.7	0.9	2.8	72.1	<0.01	<0.01	19.1	0.338	0.64	4.93	90	2.44
Upper Bound		0.010	0.35	3.90	8.4	1.9	4.0	88.5	0.03	0.04	23.7	0.424	0.92	6.13	112	3.42
OREAS 905		<0.001	0.07	1.06	1.8	2.3	1.2	12.5	<0.01	0.06	8.8	0.019	0.10	2.32	5	0.60
Target Range - Lower Bound		<0.001	0.04	0.90	1.6	1.8	0.8	10.9	<0.01	0.04	7.8	0.008	0.06	2.08	4	0.44
Upper Bound		0.002	0.09	1.34	2.2	2.8	1.7	13.7	0.02	0.09	10.0	0.030	0.16	2.66	8	0.76
SY-4																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
UTS-1																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																
UTS-4																



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Sample Description	Method Analyte Units LOR	ME-MS41 Y ppm 0.05	ME-MS41 Zn ppm 2	ME-MS41 Zr ppm 0.5
STANDARDS				
Buffer pH6				
Buffer pH6				
Target Range - Lower Bound				
Upper Bound				
DS-1				
Target Range - Lower Bound				
Upper Bound				
GS313-8				
Target Range - Lower Bound				
Upper Bound				
KZK-1				
KZK-1				
Target Range - Lower Bound				
Upper Bound				
MA-3a				
Target Range - Lower Bound				
Upper Bound				
MRGeo08		20.2	764	21.6
Target Range - Lower Bound		17.50	708	18.1
Upper Bound		21.5	870	25.7
OREAS 905		7.52	62	46.0
Target Range - Lower Bound		6.32	58	39.9
Upper Bound		7.84	76	55.1
SY-4				
Target Range - Lower Bound				
Upper Bound				
UTS-1				
Target Range - Lower Bound				
Upper Bound				
UTS-1				
UTS-1				
UTS-1				
Target Range - Lower Bound				
Upper Bound				
UTS-4				
Target Range - Lower Bound				
Upper Bound				
UTS-4				



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QC CERTIFICATE OF ANALYSIS VA18024484

Sample Description	Method Analyte Units LOR	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-ELE07	S-IR08	C-GAS05	C-GAS05	S-GRA06a	C-IR07	S-GRA06	ME-MS41	ME-MS41	ME-MS41
		FIZZ RAT	MPA	NNP	NP	Ratio (N	pH	S	C	CO2	S	C	S	Ag	Al	As
		Unity	tCaCO3/1Kt	tCaCO3/1Kt	tCaCO3/1Kt	Unity	Unity	%	%	%	%	%	%	ppm	%	ppm
		1	0.3	1	1	0.01	0.1	0.01	0.05	0.2	0.01	0.01	0.01	0.01	0.01	0.1
STANDARDS																
UTS-4											1.81					
UTS-4											1.83					
Target Range - Lower Bound											1.61					
Upper Bound											1.87					
BLANKS																
BLANK									<0.05	<0.2						
Target Range - Lower Bound									<0.05	<0.2						
Upper Bound									0.10	0.4						
BLANK														<0.01	<0.01	<0.1
Target Range - Lower Bound														<0.01	<0.01	<0.1
Upper Bound														0.02	0.02	0.2
BLANK							6.0									
Target Range - Lower Bound							5.5									
Upper Bound							6.9									
BLANK													<0.01			
Target Range - Lower Bound													<0.01			
Upper Bound													0.02			
BLANK											<0.01					
BLANK											<0.01					
BLANK											<0.01					
Target Range - Lower Bound											<0.01					
Upper Bound											0.02					
BLANK								<0.01				<0.01				
Target Range - Lower Bound								<0.01				<0.01				
Upper Bound								0.02				0.02				



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QC CERTIFICATE OF ANALYSIS VA18024484

Sample Description	Method Analyte Units LOR	ME-MS41 Au ppm 0.02	ME-MS41 B ppm 10	ME-MS41 Ba ppm 10	ME-MS41 Be ppm 0.05	ME-MS41 Bi ppm 0.01	ME-MS41 Ca % 0.01	ME-MS41 Cd ppm 0.01	ME-MS41 Ce ppm 0.02	ME-MS41 Co ppm 0.1	ME-MS41 Cr ppm 1	ME-MS41 Cs ppm 0.05	ME-MS41 Cu ppm 0.2	ME-MS41 Fe % 0.01	ME-MS41 Ga ppm 0.05	ME-MS41 Ge ppm 0.05
STANDARDS																
UTS-4																
UTS-4																
Target Range - Lower Bound																
Upper Bound																
BLANKS																
BLANK		<0.02	<10	<10	<0.05	<0.01	<0.01	<0.01	<0.02	<0.1	<1	<0.05	<0.2	<0.01	<0.05	<0.05
Target Range - Lower Bound		<0.02	<10	<10	<0.05	<0.01	<0.01	<0.01	<0.02	<0.1	<1	<0.05	<0.2	<0.01	<0.05	<0.05
Upper Bound		0.04	20	20	0.10	0.02	0.02	0.02	0.04	0.2	2	0.10	0.4	0.02	0.10	0.10
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
BLANK																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18024484

Sample Description	Method Analyte Units LOR	ME-MS41 Hf ppm 0.02	ME-MS41 Hg ppm 0.01	ME-MS41 In ppm 0.005	ME-MS41 K % 0.01	ME-MS41 La ppm 0.2	ME-MS41 Li ppm 0.1	ME-MS41 Mg % 0.01	ME-MS41 Mn ppm 5	ME-MS41 Mo ppm 0.05	ME-MS41 Na % 0.01	ME-MS41 Nb ppm 0.05	ME-MS41 Ni ppm 0.2	ME-MS41 P ppm 10	ME-MS41 Pb ppm 0.2	ME-MS41 Rb ppm 0.1
STANDARDS																
UTS-4																
UTS-4																
Target Range - Lower Bound																
Upper Bound																
BLANKS																
BLANK		<0.02	<0.01	<0.005	<0.01	<0.2	<0.1	<0.01	<5	<0.05	<0.01	<0.05	<0.2	<10	<0.2	<0.1
Target Range - Lower Bound		<0.02	<0.01	<0.005	<0.01	<0.2	<0.1	<0.01	<5	<0.05	<0.01	<0.05	<0.2	<10	<0.2	<0.1
Upper Bound		0.04	0.02	0.010	0.02	0.4	0.2	0.02	10	0.10	0.02	0.10	0.4	20	0.4	0.2
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
BLANK																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18024484

Sample Description	Method Analyte Units LOR	ME-MS41 Re ppm	ME-MS41 S %	ME-MS41 Sb ppm	ME-MS41 Sc ppm	ME-MS41 Se ppm	ME-MS41 Sn ppm	ME-MS41 Sr ppm	ME-MS41 Ta ppm	ME-MS41 Te ppm	ME-MS41 Th ppm	ME-MS41 Ti %	ME-MS41 Tl ppm	ME-MS41 U ppm	ME-MS41 V ppm	ME-MS41 W ppm
		0.001	0.01	0.05	0.1	0.2	0.2	0.2	0.01	0.01	0.2	0.005	0.02	0.05	1	0.05
STANDARDS																
UTS-4																
UTS-4																
Target Range - Lower Bound																
Upper Bound																
BLANKS																
BLANK		<0.001	<0.01	<0.05	<0.1	<0.2	<0.2	<0.2	<0.01	<0.01	<0.2	<0.005	<0.02	<0.05	<1	<0.05
Target Range - Lower Bound		<0.001	<0.01	<0.05	<0.1	<0.2	<0.2	<0.2	<0.01	<0.01	<0.2	<0.005	<0.02	<0.05	<1	<0.05
Upper Bound		0.002	0.02	0.10	0.2	0.4	0.4	0.4	0.02	0.02	0.4	0.010	0.04	0.10	2	0.10
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
BLANK																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18024484

Sample Description	Method Analyte Units LOR	ME-MS41 Y ppm 0.05	ME-MS41 Zn ppm 2	ME-MS41 Zr ppm 0.5
STANDARDS				
UTS-4				
UTS-4				
Target Range - Lower Bound				
Upper Bound				
BLANKS				
BLANK				
Target Range - Lower Bound				
Upper Bound				
BLANK		<0.05	<2	<0.5
Target Range - Lower Bound		<0.05	<2	<0.5
Upper Bound		0.10	4	1.0
BLANK				
Target Range - Lower Bound				
Upper Bound				
BLANK				
Target Range - Lower Bound				
Upper Bound				
BLANK				
BLANK				
BLANK				
Target Range - Lower Bound				
Upper Bound				
BLANK				
Target Range - Lower Bound				
Upper Bound				



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Sample Description	Method Analyte Units LOR	OA -VOL08m FIZZ RAT Unity	OA -VOL08m MPA tCaCO3/1Kt	OA -VOL08m NNP tCaCO3/1Kt	OA -VOL08m NP tCaCO3/1Kt	OA -VOL08m Ratio (N) Unity	OA -ELE07 pH Unity	S -IR08 S %	C -GAS05 C %	C -GAS05 CO2 %	S -GRA06a S %	C -IR07 C %	S -GRA06 S %	ME -MS41 Ag ppm	ME -MS41 Al %	ME -MS41 As ppm
		1	0.3	1	1	0.01	0.1	0.01	0.05	0.2	0.01	0.01	0.01	0.01	0.01	0.1
ORIGINAL DUP Target Range - Lower Bound Upper Bound														0.01 0.02 <0.01 0.02	0.12 0.12 0.10 0.14	16.2 15.5 15.0 16.7
ORIGINAL DUP Target Range - Lower Bound Upper Bound								37.9 37.9 36.9 38.9				0.21 0.21 0.19 0.23				
L2050182-3 153310 DUP Target Range - Lower Bound Upper Bound											0.03 0.04 0.02 0.05					
L2050182-7 153314 DUP Target Range - Lower Bound Upper Bound											<0.01 0.02 <0.01 0.02					
L2050182-10 153317 DUP Target Range - Lower Bound Upper Bound		1 1 <1 2	0.6 0.6 <0.3 0.9	14 14 12 16	15 15 13 17	24.00 24.00 22.79 25.21			0.06 0.06 <0.05 0.10	0.2 0.2 <0.2 0.4						
ORIGINAL DUP Target Range - Lower Bound Upper Bound							8.3 8.4 7.8 8.9									
ORIGINAL DUP Target Range - Lower Bound Upper Bound											<0.01 <0.01 <0.01 0.02					
ORIGINAL DUP Target Range - Lower Bound Upper Bound													0.03 0.02 <0.01 0.04			



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QC CERTIFICATE OF ANALYSIS VA18024484

Sample Description	Method Analyte Units LOR	ME-MS41 Au ppm 0.02	ME-MS41 B ppm 10	ME-MS41 Ba ppm 10	ME-MS41 Be ppm 0.05	ME-MS41 Bi ppm 0.01	ME-MS41 Ca % 0.01	ME-MS41 Cd ppm 0.01	ME-MS41 Ce ppm 0.02	ME-MS41 Co ppm 0.1	ME-MS41 Cr ppm 1	ME-MS41 Cs ppm 0.05	ME-MS41 Cu ppm 0.2	ME-MS41 Fe % 0.01	ME-MS41 Ga ppm 0.05	ME-MS41 Ge ppm 0.05
DUPLICATES																
ORIGINAL		<0.02	<10	10	0.25	0.01	>25.0	0.05	7.08	1.8	4	0.63	3.5	0.32	0.37	<0.05
DUP		<0.02	<10	10	0.23	0.02	>25.0	0.06	7.79	1.6	4	0.67	3.1	0.34	0.35	<0.05
Target Range - Lower Bound		<0.02	<10	<10	0.18	<0.01	23.7	0.04	7.04	1.5	3	0.57	3.0	0.30	0.29	<0.05
Upper Bound		0.04	20	20	0.30	0.02	>25.0	0.07	7.83	1.9	5	0.73	3.6	0.36	0.43	0.10
ORIGINAL																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2050182-3 153310																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2050182-7 153314																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2050182-10 153317																
DUP																
Target Range - Lower Bound																
Upper Bound																
ORIGINAL																
DUP																
Target Range - Lower Bound																
Upper Bound																
ORIGINAL																
DUP																
Target Range - Lower Bound																
Upper Bound																



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Sample Description	Method Analyte Units LOR	ME-MS41 Hf ppm 0.02	ME-MS41 Hg ppm 0.01	ME-MS41 In ppm 0.005	ME-MS41 K % 0.01	ME-MS41 La ppm 0.2	ME-MS41 Li ppm 0.1	ME-MS41 Mg % 0.01	ME-MS41 Mn ppm 5	ME-MS41 Mo ppm 0.05	ME-MS41 Na % 0.01	ME-MS41 Nb ppm 0.05	ME-MS41 Ni ppm 0.2	ME-MS41 P ppm 10	ME-MS41 Pb ppm 0.2	ME-MS41 Rb ppm 0.1
DUPLICATES																
ORIGINAL		0.02	0.20	<0.005	0.06	4.1	1.6	1.26	101	0.67	0.01	<0.05	6.1	80	2.5	2.7
DUP		0.03	0.21	0.005	0.07	4.6	1.4	1.27	104	0.67	0.02	<0.05	5.7	70	2.5	2.8
Target Range - Lower Bound		<0.02	0.18	<0.005	0.05	3.9	1.3	1.19	92	0.59	<0.01	<0.05	5.4	60	2.2	2.5
Upper Bound		0.04	0.23	0.010	0.08	4.8	1.7	1.34	113	0.75	0.02	0.10	6.4	90	2.8	3.0
ORIGINAL																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2050182-3 153310																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2050182-7 153314																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2050182-10 153317																
DUP																
Target Range - Lower Bound																
Upper Bound																
ORIGINAL																
DUP																
Target Range - Lower Bound																
Upper Bound																
ORIGINAL																
DUP																
Target Range - Lower Bound																
Upper Bound																



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Sample Description	Method Analyte Units LOR	ME-MS41 Re ppm	ME-MS41 S %	ME-MS41 Sb ppm	ME-MS41 Sc ppm	ME-MS41 Se ppm	ME-MS41 Sn ppm	ME-MS41 Sr ppm	ME-MS41 Ta ppm	ME-MS41 Te ppm	ME-MS41 Th ppm	ME-MS41 Ti %	ME-MS41 Tl ppm	ME-MS41 U ppm	ME-MS41 V ppm	ME-MS41 W ppm
		0.001	0.01	0.05	0.1	0.2	0.2	0.2	0.01	0.01	0.2	0.005	0.02	0.05	1	0.05
DUPLICATES																
ORIGINAL		0.001	0.02	3.09	1.2	1.6	<0.2	684	<0.01	0.02	0.8	<0.005	0.17	0.39	5	0.25
DUP		0.001	0.03	3.32	1.0	1.6	<0.2	698	<0.01	0.01	0.8	<0.005	0.18	0.39	5	0.25
Target Range - Lower Bound		<0.001	<0.01	2.91	0.9	1.3	<0.2	656	<0.01	<0.01	0.6	<0.005	0.14	0.32	4	0.18
Upper Bound		0.002	0.04	3.50	1.3	1.9	0.4	726	0.02	0.02	1.0	0.010	0.21	0.46	6	0.32
ORIGINAL																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2050182-3 153310																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2050182-7 153314																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2050182-10 153317																
DUP																
Target Range - Lower Bound																
Upper Bound																
ORIGINAL																
DUP																
Target Range - Lower Bound																
Upper Bound																
ORIGINAL																
DUP																
Target Range - Lower Bound																
Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18024484

Sample Description	Method Analyte Units LOR	ME-MS41 Y ppm 0.05	ME-MS41 Zn ppm 2	ME-MS41 Zr ppm 0.5
ORIGINAL DUP Target Range - Lower Bound Upper Bound		5.34 5.38 5.04 5.68	18 17 15 20	1.0 1.0 <0.5 1.6
ORIGINAL DUP Target Range - Lower Bound Upper Bound				
L2050182-3 153310 DUP Target Range - Lower Bound Upper Bound				
L2050182-7 153314 DUP Target Range - Lower Bound Upper Bound				
L2050182-10 153317 DUP Target Range - Lower Bound Upper Bound				
ORIGINAL DUP Target Range - Lower Bound Upper Bound				
ORIGINAL DUP Target Range - Lower Bound Upper Bound				
ORIGINAL DUP Target Range - Lower Bound Upper Bound				



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QC CERTIFICATE OF ANALYSIS VA18024484

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

C-GAS05	C-IR07	LOG-22	ME-MS41
OA-ELE07	OA-VOL08m	PUL-31	S-CAL06a
S-GRA06	S-GRA06a	S-IR08	SPL-21
WEI-21			



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Report To Contact and company name below will appear on the final report		Report Format / Distribution		Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply											
Company: Minto Explorations Ltd.		Select Report Format: ☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)		Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply											
Contact: Minto Environment - Coordinator		Quality Control (QC) Report with Report ☒ YES ☐ NO		PRIORITY (Business Days)		4 day [P4] ☐				EMERGENCY		1 Business day [E1] ☐			
Phone: 1-604-759-4659		☒ Compare Results to Criteria on Report - provide details below if box checked				3 day [P3] ☐						Same Day, Weekend or Statutory holiday [E0] ☐			
Company address below will appear on the final report		Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX													
Street: 2100-510 West Georgia St.		Email 1 or Fax minto_environment@mintomine.com		Date and Time Required for all E&P TATs:											
City/Province: Vancouver, British Columbia		Email 2		For tests that can not be performed according to the service level selected, you will be contacted.											
Postal Code: V6B 0M3		Email 3		Analysis Request											
Invoice To Same as Report To ☐ YES ☒ NO		Invoice Distribution		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below											
Copy of Invoice with Report ☐ YES ☒ NO		Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX													
Company: Minto Explorations Ltd.		Email 1 or Fax ap@mintomine.com													
Contact: Ruth Cayetano		Email 2													
Project Information		Oil and Gas Required Fields (client use)													
ALS Account # / Quote #:		AFE/Cost Center:		PO#		Total Metals- Aqua regia digestion (ICP) Total Carbon/Sulphur (Leco) AP - determination by % sulphide sulphur Modified NP - (MEND 1991)				Number of Containers					
Job #:		Major/Minor Code:		Routing Code:											
PO / AFE: TBD		Requisitioner:													
LSD:		Location:													
ALS Lab Work Order # (lab use only)		ALS Contact:		Sampler:											
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Total Metals- Aqua regia digestion (ICP)	Paste pH	% Inorganic Carbonate	Total Carbon/Sulphur (Leco)	AP - determination by % sulphide sulphur	Modified NP - (MEND 1991)					
				Composite	R	R	R	R	R	R					
	146750	09-JAN-18		WASTE	X	X	X	X	X	X					
	153309	17-Jan-18		WASTE	X	X	X	X	X	X					
	153310	17-Jan-18		WASTE	X	X	X	X	X	X					
	153311	18-Jan-18		WASTE	X	X	X	X	X	X					
	153312	18-Jan-18		WASTE	X	X	X	X	X	X					
	153313	18-Jan-18		WASTE	X	X	X	X	X	X					
	153314	18-Jan-18		WASTE	X	X	X	X	X	X					
	153315	18-Jan-18		WASTE	X	X	X	X	X	X					
	153316	20-Jan-18		WASTE	X	X	X	X	X	X					
	153317	20-Jan-18		WASTE	X	X	X	X	X	X					
Drinking Water (DW) Samples¹ (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)		SAMPLE CONDITION AS RECEIVED (lab use only)											
Are samples taken from a Regulated DW System? ☐ YES ☒ NO				Frozen ☐ SIF Observations Yes ☐ No ☐											
Are samples for human drinking water use? ☐ YES ☒ NO				Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐											
				Cooling Initiated ☐											
				INITIAL COOLER TEMPERATURES °C: 8°C FINAL COOLER TEMPERATURES °C: 11											
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)		FINAL SHIPMENT RECEPTION (lab use only)											
Released by: Kala S... Jutta H.		Received by: (Signature)		Received by: JC											
Date: ...		Date: JAN 29 / 18		Date: 1 / 30 / 18											
Time: ...		Time: 09:45		Time: 12:35											

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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OCTOBER 2015 FRONT



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 07-FEB-18
Report Date: 05-MAR-18 17:51 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2054140
Project P.O. #: PO#229850
Job Reference:
C of C Numbers: 18-4
Legal Site Desc:

Comments: Please note, the ALS Minerals version of the finalized report and QC can be found at the end of the attachment.

Shane Stack
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2054140-1 Waste 22-JAN-18 153318	L2054140-2 Waste 22-JAN-18 153319	L2054140-3 Waste 22-JAN-18 153320	L2054140-4 Waste 22-JAN-18 153323	L2054140-5 Waste 23-JAN-18 153324
Grouping	Analyte					
SOIL						
Physical Tests	pH (Unity)	9.0	9.0	9.2	8.9	8.7
Organic / Inorganic Carbon	Carbon (C) (%)	0.57	0.52	0.23	0.33	0.32
Acid Base Accounting	FIZZ RATING (Unity)	2	2	2	2	2
	MPA (tCaCO3/1Kt)	0.3	2.2	2.5	1.6	<0.3
	Neutralization Potential (NP) (tCaCO3/1Kt)	37	40	22	25	27
	NNP (tCaCO3/1Kt)	37	38	20	23	27
	Ratio (NP/MPA) (Unity)	118.40	18.29	8.80	16.00	172.80
	Sulfate Sulfur (carbonate leach) (%)	0.01	0.02	0.02	0.01	0.01
	Sulfate Sulfur (HCl leach) (%)	0.01	<0.01	<0.01	0.02	<0.01
	Sulfide Sulfur (T minus HCl leach) (%)	<0.01	0.07	0.08	0.03	<0.01
	Total Sulfur (combustion) (%)	0.01	0.07	0.08	0.05	<0.01
Total Metals	Aluminum (Al) (%)	0.73	1.25	1.08	1.12	1.16
	Antimony (Sb) (ppm)	<0.05	<0.05	<0.05	<0.05	<0.05
	Arsenic (As) (ppm)	1.2	1.0	0.7	1.0	1.0
	Barium (Ba) (ppm)	130	550	230	250	130
	Beryllium (Be) (ppm)	0.34	0.25	0.23	0.27	0.45
	Bismuth (Bi) (ppm)	0.02	0.14	0.04	0.11	0.01
	Boron (B) (ppm)	<10	<10	<10	<10	<10
	Cadmium (Cd) (ppm)	0.02	0.10	0.07	0.08	0.06
	Calcium (Ca) (%)	1.38	1.70	0.94	1.00	1.16
	Cerium (Ce) (ppm)	21.3	35.4	25.5	27.4	25.1
	Cesium (Cs) (ppm)	0.33	0.45	0.36	0.56	0.24
	Chromium (Cr) (ppm)	4	5	6	5	5
	Cobalt (Co) (ppm)	4.8	5.5	5.4	6.3	5.8
	Copper (Cu) (ppm)	79.9	1220	366	883	83.8
	Gallium (Ga) (ppm)	4.00	6.13	5.45	5.79	6.57
	Germanium (Ge) (ppm)	0.06	0.08	0.06	0.07	0.06
	Gold (Au) (ppm)	<0.02	0.04	<0.02	<0.02	<0.02
	Hafnium (Hf) (ppm)	0.04	0.06	0.06	0.07	0.06
	Indium (In) (ppm)	0.023	0.041	0.031	0.043	0.025
	Iron (Fe) (%)	2.11	2.39	2.35	2.83	2.26
	Lanthanum (La) (ppm)	9.1	19.3	13.4	14.5	12.6
	Lead (Pb) (ppm)	3.3	2.4	2.1	2.4	2.9
	Lithium (Li) (ppm)	3.6	7.1	5.2	5.2	9.9
	Magnesium (Mg) (%)	0.56	0.82	0.64	0.67	0.66
	Manganese (Mn) (ppm)	551	637	488	659	638

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2054140-6 Waste 23-JAN-18 153325	L2054140-7 Waste 24-JAN-18 153326	L2054140-8 Waste 24-JAN-18 153327	L2054140-9 Waste 25-JAN-18 153328	L2054140-10 Waste 26-JAN-18 153329
Grouping	Analyte					
SOIL						
Physical Tests	pH (Unity)	8.7	9.0	9.2	8.9	8.9
Organic / Inorganic Carbon	Carbon (C) (%)	0.09	0.13	0.13	0.45	0.63
Acid Base Accounting	FIZZ RATING (Unity)	1	1	2	2	2
	MPA (tCaCO3/1Kt)	<0.3	2.2	<0.3	6.6	<0.3
	Neutralization Potential (NP) (tCaCO3/1Kt)	10	11	14	25	35
	NNP (tCaCO3/1Kt)	10	9	14	18	35
	Ratio (NP/MPA) (Unity)	64.00	5.03	89.60	3.81	224.00
	Sulfate Sulfur (carbonate leach) (%)	<0.01	0.01	0.01	0.02	0.01
	Sulfate Sulfur (HCl leach) (%)	<0.01	0.01	<0.01	0.01	<0.01
	Sulfide Sulfur (T minus HCl leach) (%)	<0.01	0.06	<0.01	0.20	<0.01
	Total Sulfur (combustion) (%)	<0.01	0.07	<0.01	0.21	<0.01
Total Metals	Aluminum (Al) (%)	1.01	1.02	1.05	0.99	0.50
	Antimony (Sb) (ppm)	<0.05	<0.05	<0.05	<0.05	<0.05
	Arsenic (As) (ppm)	0.9	0.5	0.4	0.5	1.2
	Barium (Ba) (ppm)	150	230	280	210	60
	Beryllium (Be) (ppm)	0.30	0.16	0.19	0.24	0.29
	Bismuth (Bi) (ppm)	0.01	0.38	0.01	0.07	0.01
	Boron (B) (ppm)	<10	<10	<10	<10	<10
	Cadmium (Cd) (ppm)	0.14	0.10	0.08	0.10	0.02
	Calcium (Ca) (%)	0.53	0.40	0.60	0.90	1.18
	Cerium (Ce) (ppm)	21.3	20.1	22.1	28.7	23.8
	Cesium (Cs) (ppm)	0.28	0.41	0.34	0.35	0.36
	Chromium (Cr) (ppm)	4	4	5	5	4
	Cobalt (Co) (ppm)	5.5	4.5	5.0	5.9	3.9
	Copper (Cu) (ppm)	180.5	2290	149.5	1060	11.9
	Gallium (Ga) (ppm)	5.87	5.33	5.10	5.46	3.14
	Germanium (Ge) (ppm)	0.07	0.06	0.08	0.06	0.05
	Gold (Au) (ppm)	<0.02	0.05	<0.02	0.02	<0.02
	Hafnium (Hf) (ppm)	0.07	0.04	0.06	0.04	0.03
	Indium (In) (ppm)	0.031	0.055	0.024	0.047	0.031
	Iron (Fe) (%)	2.23	2.22	2.09	2.51	1.75
	Lanthanum (La) (ppm)	10.5	10.2	10.7	15.0	12.0
	Lead (Pb) (ppm)	2.5	2.6	1.3	2.6	3.0
	Lithium (Li) (ppm)	6.5	4.8	5.4	5.6	2.8
	Magnesium (Mg) (%)	0.50	0.54	0.54	0.65	0.36
	Manganese (Mn) (ppm)	503	535	585	477	434

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2054140-1 Waste 22-JAN-18 153318	L2054140-2 Waste 22-JAN-18 153319	L2054140-3 Waste 22-JAN-18 153320	L2054140-4 Waste 22-JAN-18 153323	L2054140-5 Waste 23-JAN-18 153324
Grouping	Analyte					
SOIL						
Total Metals	Mercury (Hg) (ppm)	<0.01	0.01	<0.01	<0.01	<0.01
	Molybdenum (Mo) (ppm)	0.61	37.9	1.33	0.68	1.62
	Nickel (Ni) (ppm)	2.2	2.5	2.6	2.2	2.6
	Niobium (Nb) (ppm)	0.14	0.14	0.20	0.19	0.07
	Phosphorus (P) (ppm)	560	830	650	740	650
	Potassium (K) (%)	0.26	0.62	0.57	0.63	0.22
	Rhenium (Re) (ppm)	0.001	0.141	0.003	<0.001	<0.001
	Rubidium (Rb) (ppm)	11.9	31.5	29.2	32.8	10.7
	Scandium (Sc) (ppm)	3.3	3.8	4.2	6.9	4.8
	Selenium (Se) (ppm)	0.2	0.9	0.2	0.8	<0.2
	Silver (Ag) (ppm)	0.04	0.52	0.13	0.24	0.02
	Sodium (Na) (%)	0.06	0.06	0.07	0.06	0.04
	Strontium (Sr) (ppm)	117.5	71.8	56.0	77.9	53.6
	Sulfur (S) (%)	0.01	0.08	0.09	0.06	<0.01
	Tantalum (Ta) (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01
	Tellurium (Te) (ppm)	<0.01	0.11	0.02	0.04	<0.01
	Thallium (Tl) (ppm)	0.07	0.18	0.17	0.19	0.06
	Thorium (Th) (ppm)	1.9	3.2	2.9	3.7	2.3
	Tin (Sn) (ppm)	0.5	0.9	0.6	0.7	0.6
	Titanium (Ti) (%)	0.041	0.114	0.100	0.105	0.030
	Tungsten (W) (ppm)	0.86	0.86	0.92	0.71	0.41
	Uranium (U) (ppm)	0.28	0.71	0.31	0.22	0.22
	Vanadium (V) (ppm)	38	59	50	57	41
	Yttrium (Y) (ppm)	7.53	7.00	6.94	8.50	9.43
	Zinc (Zn) (ppm)	61	74	64	77	74
	Zirconium (Zr) (ppm)	0.8	0.9	0.9	1.4	0.8
Permanent Gases	Carbon Dioxide (CO2) (%)	2.1	1.9	0.9	1.2	1.2
Miscellaneous	Carbon (C) (%)	0.63	0.52	0.29	0.42	0.30

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2054140-6 Waste 23-JAN-18 153325	L2054140-7 Waste 24-JAN-18 153326	L2054140-8 Waste 24-JAN-18 153327	L2054140-9 Waste 25-JAN-18 153328	L2054140-10 Waste 26-JAN-18 153329
Grouping	Analyte					
SOIL						
Total Metals	Mercury (Hg) (ppm)	<0.01	0.01	<0.01	<0.01	<0.01
	Molybdenum (Mo) (ppm)	1.26	0.90	0.90	1.77	0.64
	Nickel (Ni) (ppm)	2.3	5.3	2.4	2.5	2.1
	Niobium (Nb) (ppm)	0.10	0.22	0.13	0.19	<0.05
	Phosphorus (P) (ppm)	620	500	500	670	380
	Potassium (K) (%)	0.33	0.69	0.67	0.47	0.12
	Rhenium (Re) (ppm)	<0.001	<0.001	<0.001	0.003	<0.001
	Rubidium (Rb) (ppm)	15.7	36.8	34.0	24.1	6.1
	Scandium (Sc) (ppm)	4.3	3.2	3.7	4.1	4.2
	Selenium (Se) (ppm)	<0.2	1.3	<0.2	0.9	<0.2
	Silver (Ag) (ppm)	0.02	0.71	0.02	0.34	0.02
	Sodium (Na) (%)	0.06	0.06	0.08	0.05	0.05
	Strontium (Sr) (ppm)	43.7	34.0	46.1	67.5	116.5
	Sulfur (S) (%)	<0.01	0.07	<0.01	0.21	<0.01
	Tantalum (Ta) (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01
	Tellurium (Te) (ppm)	<0.01	0.16	<0.01	0.05	<0.01
	Thallium (Tl) (ppm)	0.09	0.23	0.18	0.15	0.03
	Thorium (Th) (ppm)	1.9	3.3	2.6	3.8	2.8
	Tin (Sn) (ppm)	0.6	0.5	0.6	0.7	0.5
	Titanium (Ti) (%)	0.050	0.114	0.114	0.070	0.010
	Tungsten (W) (ppm)	0.37	2.58	0.98	0.96	0.45
	Uranium (U) (ppm)	0.26	0.17	0.15	0.22	0.14
	Vanadium (V) (ppm)	44	43	46	48	30
	Yttrium (Y) (ppm)	9.11	4.69	8.30	6.34	7.61
	Zinc (Zn) (ppm)	76	79	67	67	44
	Zirconium (Zr) (ppm)	1.0	0.7	0.7	0.7	0.6
Permanent Gases	Carbon Dioxide (CO2) (%)	0.3	0.5	0.5	1.6	2.3
Miscellaneous	Carbon (C) (%)	0.07	0.12	0.15	0.46	0.68
		</				

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ABA-OA-VOL08-AX	Soil	Acid Base Accounting	OA-VOL08
CARBON-C-GAS05-AX	Soil	Carbon, TOC and CO2	C-GAS05
CARBON-C-IR07-AX	Soil	Carbon (C) using LECO analyzer	Total Carbon - Method Code C-IR07
Total Carbon & Sulfur - Method Codes C-IR07 & S-IR08			
A 0.1g sample is heated to approximately 1350°C in an induction furnace while passing a stream of oxygen through the sample. Carbon dioxide & sulfur dioxide released from the sample are measured by an IR detection system (Leco analyzer) and the total carbon & sulfur results are provided.			
ME-MS41-AX	Soil	Aqua Regia ICPMS	Aqua Regia ICPMS
A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences.			
PH-OA-ELE07-AX	Soil	pH	OA-ELE07
SULPHUR-S-CAL06A-AX	Soil	Sulfide Sulfur Calc from HCl Leach	ALS Minerals S-CAL06A
Sulfide Sulfur (as S) is calculated by subtracting the HCl Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion.			
SULPHUR-S-GRA06-AX	Soil	Sulfate Sulfur in Soil (Carbonate Leach)	ALS Minerals S-GRA06
A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).			
SULPHUR-S-GRA06A-AX	Soil	Sulfate Sulfur in Soil (HCl Leach)	ALS Minerals S-GRA06A
A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).			
SULPHUR-S-IR08-AX	Soil	Total Sulfur in Soil by Combustion	ALS Minerals S-IR08
The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
AX	ALS MINERALS - VANCOUVER, B.C., CANADA

Chain of Custody Numbers:

18-4

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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100 - 8081 LOUGHEED HWY.
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Page: 1
Total # Pages: 2 (A - E)
Plus Appendix Pages
Finalized Date: 4 - MAR - 2018
Account: APN

CERTIFICATE VA18030190

Project: L2054140

This report is for 10 Other samples submitted to our lab in Vancouver, BC, Canada on 9-FEB-2018.

The following have access to data associated with this certificate:

CASDG ALSE

ALSEV DATASUBLET

SHANE STACK

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI-21	Received Sample Weight
SPL-21	Split sample - riffle splitter
LOG-22	Sample login - Rcd w/o BarCode
PUL-31	Pulverize split to 85% <75 um

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	
C-GAS05	Inorganic Carbon (CO2)	
C-IR07	Total Carbon (Leco)	LECO
S-GRA06	Sulfate Sulfur - carbonate leach	WST-SEQ
ME-MS41	Ultra Trace Aqua Regia ICP-MS	
OA-VOL08m	Modified NP	
S-IR08	Total Sulphur (Leco)	LECO
OA-ELE07	Paste pH	
S-CAL06a	Sulfide Sulfur (calculated*)	
S-GRA06a	Sulfate Sulfur (HCl leachable)	WST-SEQ

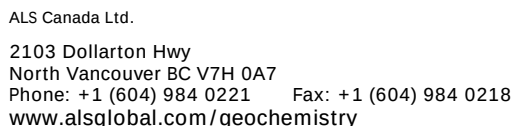
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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature:

Colin Ramshaw, Vancouver Laboratory Manager



Page: 2 - A
Total # Pages: 2 (A - E)
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Finalized Date: 4-MAR-2018
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CERTIFICATE OF ANALYSIS VA18030190

***** See Appendix Page for comments regarding this certificate *****



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Total # Pages: 2 (A - E)
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Finalized Date: 4 - MAR - 2018
Account: APN

Project: L2054140

CERTIFICATE OF ANALYSIS VA18030190

Sample Description	Method Analyte Units LOR	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
		Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu
		%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm
		0.01	0.1	0.02	10	10	0.05	0.01	0.01	0.01	0.02	0.1	1	0.05	0.2
L2054140-1 153318		0.73	1.2	<0.02	<10	130	0.34	0.02	1.38	0.02	21.3	4.8	4	0.33	79.9
L2054140-2 153319		1.25	1.0	0.04	<10	550	0.25	0.14	1.70	0.10	35.4	5.5	5	0.45	1220
L2054140-3 153320		1.08	0.7	<0.02	<10	230	0.23	0.04	0.94	0.07	25.5	5.4	6	0.36	366
L2054140-4 153323		1.12	1.0	<0.02	<10	250	0.27	0.11	1.00	0.08	27.4	6.3	5	0.56	883
L2054140-5 153324		1.16	1.0	<0.02	<10	130	0.45	0.01	1.16	0.06	25.1	5.8	5	0.24	83.8
L2054140-6 153325		1.01	0.9	<0.02	<10	150	0.30	0.01	0.53	0.14	21.3	5.5	4	0.28	180.5
L2054140-7 153326		1.02	0.5	0.05	<10	230	0.16	0.38	0.40	0.10	20.1	4.5	4	0.41	2290
L2054140-8 153327		1.05	0.4	<0.02	<10	280	0.19	0.01	0.60	0.08	22.1	5.0	5	0.34	149.5
L2054140-9 153328		0.99	0.5	0.02	<10	210	0.24	0.07	0.90	0.10	28.7	5.9	5	0.35	1060
L2054140-10 153329		0.50	1.2	<0.02	<10	60	0.29	0.01	1.18	0.02	23.8	3.9	4	0.36	11.9



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Page: 2 - C
Total # Pages: 2 (A - E)
Plus Appendix Pages
Finalized Date: 4 - MAR - 2018
Account: APN

Project: L2054140

CERTIFICATE OF ANALYSIS VA18030190

Sample Description	Method Analyte Units LOR	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
		Ga	Ge	Hf	Hg	In	K	La	Li	Mg	Mn	Mo	Na	Nb	Ni
		ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	ppm	%	ppm	ppm
		0.05	0.05	0.02	0.01	0.005	0.01	0.2	0.1	0.01	5	0.05	0.01	0.05	0.2
L2054140-1 153318		4.00	0.06	0.04	<0.01	0.023	0.26	9.1	3.6	0.56	551	0.61	0.06	0.14	2.2
L2054140-2 153319		6.13	0.08	0.06	0.01	0.041	0.62	19.3	7.1	0.82	637	37.9	0.06	0.14	2.5
L2054140-3 153320		5.45	0.06	0.06	<0.01	0.031	0.57	13.4	5.2	0.64	488	1.33	0.07	0.20	2.6
L2054140-4 153323		5.79	0.07	0.07	<0.01	0.043	0.63	14.5	5.2	0.67	659	0.68	0.06	0.19	2.2
L2054140-5 153324		6.57	0.06	0.06	<0.01	0.025	0.22	12.6	9.9	0.66	638	1.62	0.04	0.07	2.6
L2054140-6 153325		5.87	0.07	0.07	<0.01	0.031	0.33	10.5	6.5	0.50	503	1.26	0.06	0.10	2.3
L2054140-7 153326		5.33	0.06	0.04	0.01	0.055	0.69	10.2	4.8	0.54	535	0.90	0.06	0.22	5.3
L2054140-8 153327		5.10	0.08	0.06	<0.01	0.024	0.67	10.7	5.4	0.54	585	0.90	0.08	0.13	2.4
L2054140-9 153328		5.46	0.06	0.04	<0.01	0.047	0.47	15.0	5.6	0.65	477	1.77	0.05	0.19	2.5
L2054140-10 153329		3.14	0.05	0.03	<0.01	0.031	0.12	12.0	2.8	0.36	434	0.64	0.05	<0.05	2.1



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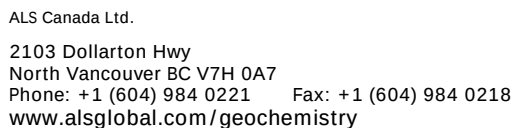
To: **ALS ENVIRONMENTAL**
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Page: 2 - D
Total # Pages: 2 (A - E)
Plus Appendix Pages
Finalized Date: 4 - MAR - 2018
Account: APN

Project: L2054140

CERTIFICATE OF ANALYSIS VA18030190

Sample Description	Method Analyte Units LOR	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
		Pb	Rb	Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl
		ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm
		0.2	0.1	0.001	0.01	0.05	0.1	0.2	0.2	0.2	0.01	0.01	0.2	0.005	0.02
L2054140-1 153318		3.3	11.9	0.001	0.01	<0.05	3.3	0.2	0.5	117.5	<0.01	<0.01	1.9	0.041	0.07
L2054140-2 153319		2.4	31.5	0.141	0.08	<0.05	3.8	0.9	0.9	71.8	<0.01	0.11	3.2	0.114	0.18
L2054140-3 153320		2.1	29.2	0.003	0.09	<0.05	4.2	0.2	0.6	56.0	<0.01	0.02	2.9	0.100	0.17
L2054140-4 153323		2.4	32.8	<0.001	0.06	<0.05	6.9	0.8	0.7	77.9	<0.01	0.04	3.7	0.105	0.19
L2054140-5 153324		2.9	10.7	<0.001	<0.01	<0.05	4.8	<0.2	0.6	53.6	<0.01	<0.01	2.3	0.030	0.06
L2054140-6 153325		2.5	15.7	<0.001	<0.01	<0.05	4.3	<0.2	0.6	43.7	<0.01	<0.01	1.9	0.050	0.09
L2054140-7 153326		2.6	36.8	<0.001	0.07	<0.05	3.2	1.3	0.5	34.0	<0.01	0.16	3.3	0.114	0.23
L2054140-8 153327		1.3	34.0	<0.001	<0.01	<0.05	3.7	<0.2	0.6	46.1	<0.01	<0.01	2.6	0.114	0.18
L2054140-9 153328		2.6	24.1	0.003	0.21	<0.05	4.1	0.9	0.7	67.5	<0.01	0.05	3.8	0.070	0.15
L2054140-10 153329		3.0	6.1	<0.001	<0.01	<0.05	4.2	<0.2	0.5	116.5	<0.01	<0.01	2.8	0.010	0.03



Page: 2 - E
Total # Pages: 2 (A - E)
Plus Appendix Pages
Finalized Date: 4-MAR-2018
Account: APN

CERTIFICATE OF ANALYSIS VA18030190

***** See Appendix Page for comments regarding this certificate *****



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Page: Appendix 1
Total # Appendix Pages: 1
Finalized Date: 4 - MAR - 2018
Account: APN

Project: L2054140

CERTIFICATE OF ANALYSIS VA18030190

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

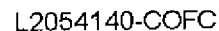
LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

C-GAS05	C-IR07	LOG-22	ME-MS41
OA-ELE07	OA-VOL08m	PUL-31	S-CAL06a
S-GRA06	S-GRA06a	S-IR08	SPL-21
WEI-21			



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OCTOBER 2014 PROCEEDINGS



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 07-FEB-18
Report Date: 05-MAR-18 18:02 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2054143
Project P.O. #: PO#229850
Job Reference:
C of C Numbers: 18-5
Legal Site Desc:

Comments: Please note, the ALS Minerals version of the finalized report and QC can be found at the end of the attachment.

Shane Stack
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2054143-1 Waste 26-JAN-18 153330	L2054143-2 Waste 26-JAN-18 153331	L2054143-3 Waste 26-JAN-18 153332	L2054143-4 Waste 27-JAN-18 153333	L2054143-5 Waste 28-JAN-18 153334
Grouping	Analyte					
SOIL						
Physical Tests	pH (Unity)	8.8	9.0	8.8	9.2	8.8
Organic / Inorganic Carbon	Carbon (C) (%)	0.54	0.31	0.64	0.25	0.35
Acid Base Accounting	FIZZ RATING (Unity)	2	2	2	2	2
	MPA (tCaCO3/1Kt)	7.8	17.2	19.4	<0.3	5.3
	Neutralization Potential (NP) (tCaCO3/1Kt)	33	22	35	21	26
	NNP (tCaCO3/1Kt)	25	5	16	21	21
	Ratio (NP/MPA) (Unity)	4.22	1.28	1.81	134.40	4.89
	Sulfate Sulfur (carbonate leach) (%)	0.02	0.01	0.02	0.01	0.02
	Sulfate Sulfur (HCl leach) (%)	<0.01	<0.01	<0.01	<0.01	<0.01
	Sulfide Sulfur (T minus HCl leach) (%)	0.25	0.55	0.62	<0.01	0.17
	Total Sulfur (combustion) (%)	0.25	0.55	0.62	<0.01	0.17
Total Metals	Aluminum (Al) (%)	1.08	1.28	0.81	1.07	1.13
	Antimony (Sb) (ppm)	<0.05	<0.05	<0.05	<0.05	<0.05
	Arsenic (As) (ppm)	0.8	0.7	1.4	0.8	0.7
	Barium (Ba) (ppm)	200	190	200	250	160
	Beryllium (Be) (ppm)	0.28	0.28	0.20	0.18	0.23
	Bismuth (Bi) (ppm)	0.18	0.08	0.14	0.02	0.20
	Boron (B) (ppm)	<10	<10	<10	<10	<10
	Cadmium (Cd) (ppm)	0.15	0.11	0.53	0.06	0.07
	Calcium (Ca) (%)	1.31	0.85	1.08	0.87	1.00
	Cerium (Ce) (ppm)	31.5	31.9	30.1	27.5	28.8
	Cesium (Cs) (ppm)	0.28	0.53	0.39	0.32	0.27
	Chromium (Cr) (ppm)	4	5	4	5	4
	Cobalt (Co) (ppm)	6.5	7.1	5.9	5.2	6.1
	Copper (Cu) (ppm)	1690	1095	3630	86.9	2020
	Gallium (Ga) (ppm)	6.55	6.77	4.81	5.56	7.10
	Germanium (Ge) (ppm)	0.06	0.07	0.06	0.07	0.06
	Gold (Au) (ppm)	0.02	<0.02	0.05	<0.02	0.09
	Hafnium (Hf) (ppm)	0.07	0.05	0.04	0.05	0.03
	Indium (In) (ppm)	0.102	0.080	0.197	0.021	0.046
	Iron (Fe) (%)	3.08	2.99	2.66	2.17	2.64
	Lanthanum (La) (ppm)	17.0	17.6	16.4	14.0	15.4
	Lead (Pb) (ppm)	3.7	2.9	3.0	2.3	3.7
	Lithium (Li) (ppm)	6.5	7.0	4.0	5.4	7.3
	Magnesium (Mg) (%)	0.70	0.85	0.65	0.61	0.65
	Manganese (Mn) (ppm)	420	412	520	565	503

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2054143-6 Waste 28-JAN-18 153335	L2054143-7 Waste 28-JAN-18 153336	L2054143-8 Waste 29-JAN-18 153337	L2054143-9 Waste 29-JAN-18 153338	L2054143-10 Waste 30-JAN-18 153339
Grouping	Analyte					
SOIL						
Physical Tests	pH (Unity)	8.7	9.0	8.8	9.0	9.1
Organic / Inorganic Carbon	Carbon (C) (%)	0.24	0.24	0.55	0.10	0.43
Acid Base Accounting	FIZZ RATING (Unity)	2	2	2	1	2
	MPA (tCaCO3/1Kt)	10.9	0.3	2.5	<0.3	<0.3
	Neutralization Potential (NP) (tCaCO3/1Kt)	22	23	36	13	37
	NNP (tCaCO3/1Kt)	11	23	34	13	37
	Ratio (NP/MPA) (Unity)	2.01	73.60	14.40	83.20	236.80
	Sulfate Sulfur (carbonate leach) (%)	0.03	0.02	0.02	<0.01	0.02
	Sulfate Sulfur (HCl leach) (%)	<0.01	<0.01	<0.01	<0.01	0.01
	Sulfide Sulfur (T minus HCl leach) (%)	0.35	0.01	0.08	<0.01	<0.01
	Total Sulfur (combustion) (%)	0.35	0.01	0.08	<0.01	<0.01
Total Metals	Aluminum (Al) (%)	1.22	1.28	0.84	1.03	1.24
	Antimony (Sb) (ppm)	<0.05	<0.05	<0.05	<0.05	<0.05
	Arsenic (As) (ppm)	0.8	0.8	1.3	1.5	0.5
	Barium (Ba) (ppm)	220	190	220	200	220
	Beryllium (Be) (ppm)	0.32	0.38	0.32	0.23	0.34
	Bismuth (Bi) (ppm)	0.17	0.02	0.07	0.01	0.01
	Boron (B) (ppm)	<10	<10	<10	<10	<10
	Cadmium (Cd) (ppm)	0.16	0.02	0.10	0.13	0.04
	Calcium (Ca) (%)	0.91	1.01	1.27	0.58	1.56
	Cerium (Ce) (ppm)	36.1	33.0	26.8	22.0	24.0
	Cesium (Cs) (ppm)	0.39	0.30	0.65	0.34	0.31
	Chromium (Cr) (ppm)	4	5	4	5	5
	Cobalt (Co) (ppm)	5.8	6.3	5.7	5.7	6.0
	Copper (Cu) (ppm)	3470	84.9	1130	185.0	28.2
	Gallium (Ga) (ppm)	7.54	6.55	5.06	5.81	6.35
	Germanium (Ge) (ppm)	0.08	0.07	0.05	0.08	0.06
	Gold (Au) (ppm)	0.09	<0.02	<0.02	<0.02	<0.02
	Hafnium (Hf) (ppm)	0.02	0.06	0.06	0.08	0.06
	Indium (In) (ppm)	0.148	0.014	0.046	0.019	0.027
	Iron (Fe) (%)	2.70	2.48	2.34	2.18	2.44
	Lanthanum (La) (ppm)	19.1	17.5	13.6	11.4	12.3
	Lead (Pb) (ppm)	3.7	2.5	3.0	2.3	2.1
	Lithium (Li) (ppm)	7.4	8.7	3.9	6.1	8.1
	Magnesium (Mg) (%)	0.59	0.75	0.61	0.55	0.74
	Manganese (Mn) (ppm)	387	551	598	644	634

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2054143-1 Waste 26-JAN-18 153330	L2054143-2 Waste 26-JAN-18 153331	L2054143-3 Waste 26-JAN-18 153332	L2054143-4 Waste 27-JAN-18 153333	L2054143-5 Waste 28-JAN-18 153334
Grouping	Analyte					
SOIL						
Total Metals	Mercury (Hg) (ppm)	<0.01	0.01	<0.01	<0.01	0.01
	Molybdenum (Mo) (ppm)	1.84	5.66	20.2	0.66	2.79
	Nickel (Ni) (ppm)	2.2	2.8	2.5	3.9	2.5
	Niobium (Nb) (ppm)	0.15	0.29	0.23	0.18	0.13
	Phosphorus (P) (ppm)	940	780	720	510	750
	Potassium (K) (%)	0.37	0.70	0.48	0.61	0.38
	Rhenium (Re) (ppm)	0.003	0.020	0.060	<0.001	0.004
	Rubidium (Rb) (ppm)	17.4	39.6	27.6	30.8	19.1
	Scandium (Sc) (ppm)	5.2	5.7	3.9	5.1	4.1
	Selenium (Se) (ppm)	1.4	0.7	2.0	0.2	2.1
	Silver (Ag) (ppm)	0.52	0.23	0.87	0.02	0.53
	Sodium (Na) (%)	0.05	0.06	0.05	0.06	0.05
	Strontium (Sr) (ppm)	63.1	68.6	83.6	57.3	47.6
	Sulfur (S) (%)	0.25	0.54	0.56	0.01	0.16
	Tantalum (Ta) (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01
	Tellurium (Te) (ppm)	0.10	0.10	0.10	<0.01	0.11
	Thallium (Tl) (ppm)	0.14	0.32	0.16	0.17	0.14
	Thorium (Th) (ppm)	4.4	3.9	4.4	3.5	4.5
	Tin (Sn) (ppm)	1.0	1.3	0.9	0.5	0.9
	Titanium (Ti) (%)	0.051	0.112	0.075	0.099	0.057
	Tungsten (W) (ppm)	0.74	1.29	0.93	0.63	0.60
	Uranium (U) (ppm)	0.39	0.44	0.32	0.23	0.23
	Vanadium (V) (ppm)	49	56	53	47	47
	Yttrium (Y) (ppm)	11.90	9.21	6.62	5.80	7.25
	Zinc (Zn) (ppm)	75	89	102	77	67
	Zirconium (Zr) (ppm)	1.7	1.1	1.0	0.7	0.9
Permanent Gases	Carbon Dioxide (CO2) (%)	2.0	1.2	2.3	0.9	1.3
Miscellaneous	Carbon (C) (%)	0.56	0.30	0.66	0.31	0.35
</						

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2054143-6 Waste 28-JAN-18 153335	L2054143-7 Waste 28-JAN-18 153336	L2054143-8 Waste 29-JAN-18 153337	L2054143-9 Waste 29-JAN-18 153338	L2054143-10 Waste 30-JAN-18 153339
Grouping	Analyte					
SOIL						
Total Metals	Mercury (Hg) (ppm)	0.01	<0.01	<0.01	<0.01	<0.01
	Molybdenum (Mo) (ppm)	3.15	0.91	17.50	1.10	0.47
	Nickel (Ni) (ppm)	2.8	2.7	2.6	2.6	2.7
	Niobium (Nb) (ppm)	0.21	0.15	0.11	0.15	0.10
	Phosphorus (P) (ppm)	740	750	770	570	700
	Potassium (K) (%)	0.53	0.43	0.41	0.47	0.39
	Rhenium (Re) (ppm)	0.004	0.001	0.046	<0.001	<0.001
	Rubidium (Rb) (ppm)	28.8	22.2	24.3	25.5	17.4
	Scandium (Sc) (ppm)	4.4	3.8	5.0	3.7	4.5
	Selenium (Se) (ppm)	2.3	0.4	0.7	<0.2	<0.2
	Silver (Ag) (ppm)	0.62	0.03	0.32	0.02	0.01
	Sodium (Na) (%)	0.04	0.07	0.05	0.07	0.06
	Strontium (Sr) (ppm)	46.3	62.4	116.5	44.5	91.4
	Sulfur (S) (%)	0.35	0.01	0.09	0.01	0.01
	Tantalum (Ta) (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01
	Tellurium (Te) (ppm)	0.12	<0.01	0.03	<0.01	<0.01
	Thallium (Tl) (ppm)	0.22	0.14	0.13	0.12	0.11
	Thorium (Th) (ppm)	6.5	4.2	2.8	2.1	2.5
	Tin (Sn) (ppm)	1.3	0.5	0.8	0.6	0.6
	Titanium (Ti) (%)	0.076	0.075	0.056	0.087	0.062
	Tungsten (W) (ppm)	0.76	0.75	0.66	1.05	0.68
	Uranium (U) (ppm)	0.26	0.27	0.39	0.38	0.27
	Vanadium (V) (ppm)	54	46	53	44	45
	Yttrium (Y) (ppm)	7.60	5.98	11.10	8.71	9.47
	Zinc (Zn) (ppm)	73	62	69	79	68
	Zirconium (Zr) (ppm)	0.7	1.4	1.2	1.1	1.0
Permanent Gases	Carbon Dioxide (CO2) (%)	0.9	0.9	2.0	0.4	1.6
Miscellaneous	Carbon (C) (%)	0.25	0.27	0.58	0.13	0.47

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ABA-OA-VOL08-AX	Soil	Acid Base Accounting	OA-VOL08
CARBON-C-GAS05-AX	Soil	Carbon, TOC and CO2	C-GAS05
CARBON-C-IR07-AX	Soil	Carbon (C) using LECO analyzer	Total Carbon - Method Code C-IR07
Total Carbon & Sulfur - Method Codes C-IR07 & S-IR08			
A 0.1g sample is heated to approximately 1350°C in an induction furnace while passing a stream of oxygen through the sample. Carbon dioxide & sulfur dioxide released from the sample are measured by an IR detection system (Leco analyzer) and the total carbon & sulfur results are provided.			
ME-MS41-AX	Soil	Aqua Regia ICPMS	Aqua Regia ICPMS
A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences.			
PH-OA-ELE07-AX	Soil	pH	OA-ELE07
SULPHUR-S-CAL06A-AX	Soil	Sulfide Sulfur Calc from HCl Leach	ALS Minerals S-CAL06A
Sulfide Sulfur (as S) is calculated by subtracting the HCl Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion.			
SULPHUR-S-GRA06-AX	Soil	Sulfate Sulfur in Soil (Carbonate Leach)	ALS Minerals S-GRA06
A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).			
SULPHUR-S-GRA06A-AX	Soil	Sulfate Sulfur in Soil (HCl Leach)	ALS Minerals S-GRA06A
A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).			
SULPHUR-S-IR08-AX	Soil	Total Sulfur in Soil by Combustion	ALS Minerals S-IR08
The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
AX	ALS MINERALS - VANCOUVER, B.C., CANADA

Chain of Custody Numbers:

18-5

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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100 - 8081 LOUGHEED HWY.
BURNABY BC V5A 1W9

Page: 1
Total # Pages: 2 (A - E)
Plus Appendix Pages
Finalized Date: 4 - MAR - 2018
Account: APN

CERTIFICATE VA18030191

Project: L2054143

This report is for 10 Other samples submitted to our lab in Vancouver, BC, Canada on 9-FEB-2018.

The following have access to data associated with this certificate:

CASDG ALSE

ALSEV DATASUBLET

SHANE STACK

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI-21	Received Sample Weight
SPL-21	Split sample - riffle splitter
LOG-22	Sample login - Rcd w/o BarCode
PUL-31	Pulverize split to 85% <75 um

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	
C-GAS05	Inorganic Carbon (CO2)	
C-IR07	Total Carbon (Leco)	LECO
S-GRA06	Sulfate Sulfur - carbonate leach	WST-SEQ
ME-MS41	Ultra Trace Aqua Regia ICP-MS	
OA-VOL08m	Modified NP	
S-IR08	Total Sulphur (Leco)	LECO
OA-ELE07	Paste pH	
S-CAL06a	Sulfide Sulfur (calculated*)	
S-GRA06a	Sulfate Sulfur (HCl leachable)	WST-SEQ

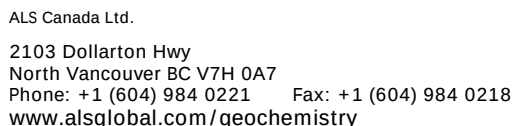
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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature:

Colin Ramshaw, Vancouver Laboratory Manager



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CERTIFICATE OF ANALYSIS VA18030191

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Project: L2054143

CERTIFICATE OF ANALYSIS VA18030191

Sample Description	Method Analyte Units LOR	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
		Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu
		%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm
		0.01	0.1	0.02	10	10	0.05	0.01	0.01	0.01	0.02	0.1	1	0.05	0.2
L2054143-1 153330		1.08	0.8	0.02	<10	200	0.28	0.18	1.31	0.15	31.5	6.5	4	0.28	1690
L2054143-2 153331		1.28	0.7	<0.02	<10	190	0.28	0.08	0.85	0.11	31.9	7.1	5	0.53	1095
L2054143-3 153332		0.81	1.4	0.05	<10	200	0.20	0.14	1.08	0.53	30.1	5.9	4	0.39	3630
L2054143-4 153333		1.07	0.8	<0.02	<10	250	0.18	0.02	0.87	0.06	27.5	5.2	5	0.32	86.9
L2054143-5 153334		1.13	0.7	0.09	<10	160	0.23	0.20	1.00	0.07	28.8	6.1	4	0.27	2020
L2054143-6 153335		1.22	0.8	0.09	<10	220	0.32	0.17	0.91	0.16	36.1	5.8	4	0.39	3470
L2054143-7 153336		1.28	0.8	<0.02	<10	190	0.38	0.02	1.01	0.02	33.0	6.3	5	0.30	84.9
L2054143-8 153337		0.84	1.3	<0.02	<10	220	0.32	0.07	1.27	0.10	26.8	5.7	4	0.65	1130
L2054143-9 153338		1.03	1.5	<0.02	<10	200	0.23	0.01	0.58	0.13	22.0	5.7	5	0.34	185.0
L2054143-10 153339		1.24	0.5	<0.02	<10	220	0.34	0.01	1.56	0.04	24.0	6.0	5	0.31	28.2



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Total # Pages: 2 (A - E)
Plus Appendix Pages
Finalized Date: 4 - MAR - 2018
Account: APN

Project: L2054143

CERTIFICATE OF ANALYSIS VA18030191

Sample Description	Method Analyte Units LOR	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
		Ga	Ge	Hf	Hg	In	K	La	Li	Mg	Mn	Mo	Na	Nb	Ni
		ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	ppm	%	ppm	ppm
		0.05	0.05	0.02	0.01	0.005	0.01	0.2	0.1	0.01	5	0.05	0.01	0.05	0.2
L2054143-1 153330		6.55	0.06	0.07	<0.01	0.102	0.37	17.0	6.5	0.70	420	1.84	0.05	0.15	2.2
L2054143-2 153331		6.77	0.07	0.05	0.01	0.080	0.70	17.6	7.0	0.85	412	5.66	0.06	0.29	2.8
L2054143-3 153332		4.81	0.06	0.04	<0.01	0.197	0.48	16.4	4.0	0.65	520	20.2	0.05	0.23	2.5
L2054143-4 153333		5.56	0.07	0.05	<0.01	0.021	0.61	14.0	5.4	0.61	565	0.66	0.06	0.18	3.9
L2054143-5 153334		7.10	0.06	0.03	0.01	0.046	0.38	15.4	7.3	0.65	503	2.79	0.05	0.13	2.5
L2054143-6 153335		7.54	0.08	0.02	0.01	0.148	0.53	19.1	7.4	0.59	387	3.15	0.04	0.21	2.8
L2054143-7 153336		6.55	0.07	0.06	<0.01	0.014	0.43	17.5	8.7	0.75	551	0.91	0.07	0.15	2.7
L2054143-8 153337		5.06	0.05	0.06	<0.01	0.046	0.41	13.6	3.9	0.61	598	17.50	0.05	0.11	2.6
L2054143-9 153338		5.81	0.08	0.08	<0.01	0.019	0.47	11.4	6.1	0.55	644	1.10	0.07	0.15	2.6
L2054143-10 153339		6.35	0.06	0.06	<0.01	0.027	0.39	12.3	8.1	0.74	634	0.47	0.06	0.10	2.7



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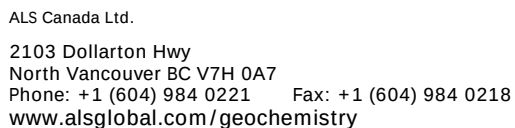
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CERTIFICATE OF ANALYSIS VA18030191

Sample Description	Method Analyte Units LOR	ME-MS41 Pb ppm 0.2	ME-MS41 Rb ppm 0.1	ME-MS41 Re ppm 0.001	ME-MS41 S % 0.01	ME-MS41 Sb ppm 0.05	ME-MS41 Sc ppm 0.1	ME-MS41 Se ppm 0.2	ME-MS41 Sn ppm 0.2	ME-MS41 Sr ppm 0.2	ME-MS41 Ta ppm 0.01	ME-MS41 Te ppm 0.01	ME-MS41 Th ppm 0.2	ME-MS41 Ti % 0.005	ME-MS41 Tl ppm 0.02	ME-MS41 U ppm 0.05
L2054143-1 153330		3.7	17.4	0.003	0.25	<0.05	5.2	1.4	1.0	63.1	<0.01	0.10	4.4	0.051	0.14	0.39
L2054143-2 153331		2.9	39.6	0.020	0.54	<0.05	5.7	0.7	1.3	68.6	<0.01	0.10	3.9	0.112	0.32	0.44
L2054143-3 153332		3.0	27.6	0.060	0.56	<0.05	3.9	2.0	0.9	83.6	<0.01	0.10	4.4	0.075	0.16	0.32
L2054143-4 153333		2.3	30.8	<0.001	0.01	<0.05	5.1	0.2	0.5	57.3	<0.01	<0.01	3.5	0.099	0.17	0.23
L2054143-5 153334		3.7	19.1	0.004	0.16	<0.05	4.1	2.1	0.9	47.6	<0.01	0.11	4.5	0.057	0.14	0.23
L2054143-6 153335		3.7	28.8	0.004	0.35	<0.05	4.4	2.3	1.3	46.3	<0.01	0.12	6.5	0.076	0.22	0.26
L2054143-7 153336		2.5	22.2	0.001	0.01	<0.05	3.8	0.4	0.5	62.4	<0.01	<0.01	4.2	0.075	0.14	0.27
L2054143-8 153337		3.0	24.3	0.046	0.09	<0.05	5.0	0.7	0.8	116.5	<0.01	0.03	2.8	0.056	0.13	0.39
L2054143-9 153338		2.3	25.5	<0.001	0.01	<0.05	3.7	<0.2	0.6	44.5	<0.01	<0.01	2.1	0.087	0.12	0.38
L2054143-10 153339		2.1	17.4	<0.001	0.01	<0.05	4.5	<0.2	0.6	91.4	<0.01	<0.01	2.5	0.062	0.11	0.27



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CERTIFICATE OF ANALYSIS VA18030191

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Project: L2054143

CERTIFICATE OF ANALYSIS VA18030191

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

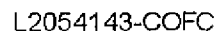
LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

C-GAS05	C-IR07	LOG-22	ME-MS41
OA-ELE07	OA-VOL08m	PUL-31	S-CAL06a
S-GRA06	S-GRA06a	S-IR08	SPL-21
WEI-21			



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Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 21-FEB-18
Report Date: 14-MAR-18 13:55 (MT)
Version: FINAL

Client Phone: 604-759-0860

Certificate of Analysis

Lab Work Order #: L2059205

Project P.O. #: 229850

Job Reference:

C of C Numbers: 18-6

Legal Site Desc:

Comments: Please note, the ALS Minerals version of the finalized report and QC can be found at the end of the attachment.

Shane Stack
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2059205-1 Waste 30-JAN-18 153340	L2059205-2 Waste 31-JAN-18 153341	L2059205-3 Waste 01-FEB-18 153342	L2059205-4 Waste 01-FEB-18 153343	L2059205-5 Waste 02-FEB-18 153344
Grouping	Analyte					
SOIL						
Physical Tests	pH (Unity)	9.2	8.8	9.1	9.0	8.9
Organic / Inorganic Carbon	Carbon (C) (%)	0.22	0.21	0.33	0.40	0.42
Acid Base Accounting	FIZZ RATING (Unity)	2	2	2	2	2
	MPA (tCaCO3/1Kt)	0.9	<0.3	0.6	5.6	4.1
	Neutralization Potential (NP) (tCaCO3/1Kt)	28	27	33	28	34
	NNP (tCaCO3/1Kt)	27	27	32	22	30
	Ratio (NP/MPA) (Unity)	29.87	172.80	52.80	4.98	8.37
	Sulfate Sulfur (carbonate leach) (%)	<0.01	0.02	<0.01	<0.01	0.01
	Sulfate Sulfur (HCl leach) (%)	0.01	0.01	0.01	0.02	0.02
	Sulfide Sulfur (T minus HCl leach) (%)	0.02	<0.01	0.01	0.16	0.11
	Total Sulfur (combustion) (%)	0.03	<0.01	0.02	0.18	0.13
Total Metals	Aluminum (Al) (%)	1.38	0.95	1.40	1.19	1.01
	Antimony (Sb) (ppm)	<0.05	<0.05	<0.05	<0.05	<0.05
	Arsenic (As) (ppm)	1.1	0.7	0.7	0.5	1.6
	Barium (Ba) (ppm)	220	150	310	270	200
	Beryllium (Be) (ppm)	0.40	0.38	0.39	0.25	0.36
	Bismuth (Bi) (ppm)	0.02	0.01	0.01	0.10	0.15
	Boron (B) (ppm)	<10	<10	<10	<10	<10
	Cadmium (Cd) (ppm)	0.09	0.11	0.07	0.13	0.10
	Calcium (Ca) (%)	1.28	1.10	1.38	0.98	1.24
	Cerium (Ce) (ppm)	18.70	20.8	22.4	29.0	29.0
	Cesium (Cs) (ppm)	0.41	0.33	0.56	0.55	0.40
	Chromium (Cr) (ppm)	5	4	6	5	4
	Cobalt (Co) (ppm)	7.0	4.8	6.6	6.2	6.6
	Copper (Cu) (ppm)	93.0	66.3	140.5	1830	1400
	Gallium (Ga) (ppm)	6.61	5.21	6.82	6.00	5.51
	Germanium (Ge) (ppm)	0.07	0.05	0.08	0.08	0.06
	Gold (Au) (ppm)	<0.02	<0.02	<0.02	<0.02	<0.02
	Hafnium (Hf) (ppm)	0.06	0.06	0.06	0.03	0.05
	Indium (In) (ppm)	0.018	0.025	0.032	0.076	0.053
	Iron (Fe) (%)	2.45	2.04	2.79	2.77	2.80
	Lanthanum (La) (ppm)	8.8	9.7	11.1	15.5	15.4
	Lead (Pb) (ppm)	6.6	3.4	3.7	2.8	4.5
	Lithium (Li) (ppm)	6.9	5.0	6.6	4.9	4.7
	Magnesium (Mg) (%)	0.77	0.44	0.76	0.74	0.62
	Manganese (Mn) (ppm)	576	594	660	606	584

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2059205-6 Waste 02-FEB-18 153345	L2059205-7 Waste 02-FEB-18 153346	L2059205-8 Waste 07-FEB-18 153347	L2059205-9 Waste 09-FEB-18 153348	L2059205-10 Tails 16-FEB-18 JAN TAL 2018
Grouping	Analyte					
SOIL						
Physical Tests	pH (Unity)	9.0	8.9	9.4	9.0	8.2
Organic / Inorganic Carbon	Carbon (C) (%)	0.47	0.81	0.11	0.19	0.23
Acid Base Accounting	FIZZ RATING (Unity)	2	2	1	2	2
	MPA (tCaCO3/1Kt)	0.3	44.1	<0.3	<0.3	3.8
	Neutralization Potential (NP) (tCaCO3/1Kt)	41	45	15	23	21
	NNP (tCaCO3/1Kt)	41	1	15	23	17
	Ratio (NP/MPA) (Unity)	131.20	1.02	96.00	147.20	5.60
	Sulfate Sulfur (carbonate leach) (%)	<0.01	<0.01	<0.01	<0.01	0.06
	Sulfate Sulfur (HCl leach) (%)	<0.01	0.01	0.01	<0.01	0.07
	Sulfide Sulfur (T minus HCl leach) (%)	0.01	1.40	<0.01	<0.01	0.05
	Total Sulfur (combustion) (%)	0.01	1.41	<0.01	<0.01	0.12
Total Metals	Aluminum (Al) (%)	1.29	1.03	1.22	1.27	1.12
	Antimony (Sb) (ppm)	<0.05	<0.05	<0.05	<0.05	<0.05
	Arsenic (As) (ppm)	1.0	0.7	0.8	0.6	1.0
	Barium (Ba) (ppm)	190	160	170	170	250
	Beryllium (Be) (ppm)	0.39	0.27	0.37	0.45	0.26
	Bismuth (Bi) (ppm)	0.01	0.03	0.03	0.01	0.42
	Boron (B) (ppm)	<10	<10	<10	<10	<10
	Cadmium (Cd) (ppm)	0.04	0.11	0.04	0.09	0.32
	Calcium (Ca) (%)	1.65	1.38	0.91	1.03	0.84
	Cerium (Ce) (ppm)	29.0	34.0	26.0	20.5	18.75
	Cesium (Cs) (ppm)	0.57	0.66	0.24	0.24	0.54
	Chromium (Cr) (ppm)	4	4	5	4	6
	Cobalt (Co) (ppm)	6.4	19.1	5.7	5.6	7.1
	Copper (Cu) (ppm)	50.4	846	91.0	42.2	2300
	Gallium (Ga) (ppm)	6.24	6.16	5.89	6.64	7.79
	Germanium (Ge) (ppm)	0.08	0.07	0.07	0.06	0.07
	Gold (Au) (ppm)	<0.02	<0.02	<0.02	<0.02	0.15
	Hafnium (Hf) (ppm)	0.09	0.06	0.08	0.05	0.05
	Indium (In) (ppm)	0.023	0.164	0.018	0.018	0.080
	Iron (Fe) (%)	2.50	4.18	2.36	2.34	4.21
	Lanthanum (La) (ppm)	15.5	17.6	13.6	10.1	9.2
	Lead (Pb) (ppm)	3.5	4.3	2.9	3.6	3.4
	Lithium (Li) (ppm)	6.7	3.9	5.8	8.7	4.3
	Magnesium (Mg) (%)	0.77	0.91	0.72	0.72	0.63
	Manganese (Mn) (ppm)	699	594	608	602	693

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2059205-1 Waste 30-JAN-18 153340	L2059205-2 Waste 31-JAN-18 153341	L2059205-3 Waste 01-FEB-18 153342	L2059205-4 Waste 01-FEB-18 153343	L2059205-5 Waste 02-FEB-18 153344
Grouping	Analyte					
SOIL						
Total Metals	Mercury (Hg) (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01
	Molybdenum (Mo) (ppm)	0.56	1.07	0.71	1.40	28.0
	Nickel (Ni) (ppm)	3.2	2.3	3.2	3.1	2.7
	Niobium (Nb) (ppm)	0.15	0.07	0.16	0.19	0.15
	Phosphorus (P) (ppm)	710	540	840	750	860
	Potassium (K) (%)	0.42	0.34	0.71	0.74	0.44
	Rhenium (Re) (ppm)	0.001	<0.001	0.001	0.003	0.096
	Rubidium (Rb) (ppm)	17.2	14.9	33.8	35.7	20.5
	Scandium (Sc) (ppm)	3.4	4.1	4.6	3.9	4.9
	Selenium (Se) (ppm)	<0.2	0.2	0.2	1.3	1.2
	Silver (Ag) (ppm)	0.06	0.05	0.07	0.39	0.31
	Sodium (Na) (%)	0.14	0.08	0.11	0.10	0.09
	Strontium (Sr) (ppm)	99.6	71.6	70.3	82.0	87.4
	Sulfur (S) (%)	0.06	0.01	0.04	0.21	0.17
	Tantalum (Ta) (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01
	Tellurium (Te) (ppm)	0.01	<0.01	<0.01	0.04	0.03
	Thallium (Tl) (ppm)	0.11	0.09	0.20	0.25	0.14
	Thorium (Th) (ppm)	1.8	1.9	2.1	3.7	3.3
	Tin (Sn) (ppm)	0.4	0.5	0.8	0.7	0.8
	Titanium (Ti) (%)	0.100	0.042	0.125	0.119	0.061
	Tungsten (W) (ppm)	0.67	0.50	0.61	0.87	0.46
	Uranium (U) (ppm)	0.33	0.26	0.48	0.21	0.32
	Vanadium (V) (ppm)	48	38	59	57	58
	Yttrium (Y) (ppm)	6.71	10.40	8.21	6.60	8.58
	Zinc (Zn) (ppm)	83	65	86	85	72
	Zirconium (Zr) (ppm)	1.3	0.9	1.0	0.8	1.0
Permanent Gases	Carbon Dioxide (CO2) (%)	0.8	0.8	1.2	1.5	1.5
Miscellaneous	Carbon (C) (%)	0.33	0.32	0.38	0.49	0.53

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2059205-6 Waste 02-FEB-18 153345	L2059205-7 Waste 02-FEB-18 153346	L2059205-8 Waste 07-FEB-18 153347	L2059205-9 Waste 09-FEB-18 153348	L2059205-10 Tails 16-FEB-18 JAN TAL 2018
Grouping	Analyte					
SOIL						
Total Metals	Mercury (Hg) (ppm)	<0.01	0.01	<0.01	<0.01	0.02
	Molybdenum (Mo) (ppm)	0.69	8.55	0.52	0.54	4.38
	Nickel (Ni) (ppm)	2.2	2.5	4.0	2.1	3.2
	Niobium (Nb) (ppm)	0.10	0.34	0.20	0.10	0.23
	Phosphorus (P) (ppm)	750	920	750	610	680
	Potassium (K) (%)	0.41	0.72	0.42	0.29	0.70
	Rhenium (Re) (ppm)	<0.001	0.027	<0.001	<0.001	0.005
	Rubidium (Rb) (ppm)	17.4	39.8	18.5	11.9	35.8
	Scandium (Sc) (ppm)	4.7	7.2	3.2	3.8	4.4
	Selenium (Se) (ppm)	0.2	1.9	0.3	<0.2	2.2
	Silver (Ag) (ppm)	0.03	0.15	0.10	0.02	0.73
	Sodium (Na) (%)	0.15	0.09	0.13	0.09	0.08
	Strontium (Sr) (ppm)	124.0	84.7	75.1	65.5	69.8
	Sulfur (S) (%)	0.03	1.43	0.02	0.02	0.15
	Tantalum (Ta) (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01
	Tellurium (Te) (ppm)	<0.01	0.10	0.01	<0.01	0.22
	Thallium (Tl) (ppm)	0.13	0.41	0.11	0.07	0.27
	Thorium (Th) (ppm)	3.3	4.8	4.1	2.0	2.9
	Tin (Sn) (ppm)	0.6	3.0	0.5	0.6	1.0
	Titanium (Ti) (%)	0.066	0.112	0.117	0.057	0.119
	Tungsten (W) (ppm)	0.31	0.83	0.88	0.22	0.12
	Uranium (U) (ppm)	0.43	0.48	0.29	0.24	0.28
	Vanadium (V) (ppm)	49	80	49	45	73
	Yttrium (Y) (ppm)	11.35	10.30	6.54	7.52	5.87
	Zinc (Zn) (ppm)	59	72	80	71	108
	Zirconium (Zr) (ppm)	1.8	1.6	1.1	0.9	1.2
Permanent Gases	Carbon Dioxide (CO2) (%)	1.7	3.0	0.4	0.7	0.8
Miscellaneous	Carbon (C) (%)	0.56	0.94	0.20	0.25	0.30

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ABA-OA-VOL08-AX	Soil	Acid Base Accounting	OA-VOL08
CARBON-C-GAS05-AX	Soil	Carbon, TOC and CO ₂	C-GAS05
CARBON-C-IR07-AX	Soil	Carbon (C) using LECO analyzer	Total Carbon - Method Code C-IR07
Total Carbon & Sulfur - Method Codes C-IR07 & S-IR08			
A 0.1g sample is heated to approximately 1350°C in an induction furnace while passing a stream of oxygen through the sample. Carbon dioxide & sulfur dioxide released from the sample are measured by an IR detection system (Leco analyzer) and the total carbon & sulfur results are provided.			
ME-MS41-AX	Soil	Aqua Regia ICPMS	Aqua Regia ICPMS
A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences.			
PH-OA-ELE07-AX	Soil	pH	OA-ELE07
SULPHUR-S-CAL06A-AX	Soil	Sulfide Sulfur Calc from HCl Leach	ALS Minerals S-CAL06A
Sulfide Sulfur (as S) is calculated by subtracting the HCl Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion.			
SULPHUR-S-GRA06-AX	Soil	Sulfate Sulfur in Soil (Carbonate Leach)	ALS Minerals S-GRA06
A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).			
SULPHUR-S-GRA06A-AX	Soil	Sulfate Sulfur in Soil (HCl Leach)	ALS Minerals S-GRA06A
A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).			
SULPHUR-S-IR08-AX	Soil	Total Sulfur in Soil by Combustion	ALS Minerals S-IR08
The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
AX	ALS MINERALS - VANCOUVER, B.C., CANADA

Chain of Custody Numbers:

18-6

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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Plus Appendix Pages
Finalized Date: 13 - MAR - 2018
Account: APN

CERTIFICATE VA18042881

Project: L2059205

This report is for 10 Other samples submitted to our lab in Vancouver, BC, Canada on 26-FEB-2018.

The following have access to data associated with this certificate:

CASDG ALSE

ALSEV DATASUBLET

SHANE STACK

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI - 21	Received Sample Weight
SPL - 21	Split sample - riffle splitter
LOG - 22	Sample login - Rcd w/o BarCode
PUL - 31	Pulverize split to 85% <75 um

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	
C - GAS05	Inorganic Carbon (CO2)	
C - IR07	Total Carbon (Leco)	LECO
S - GRA06	Sulfate Sulfur - carbonate leach	WST - SEQ
ME - MS41	Ultra Trace Aqua Regia ICP - MS	
OA - VOL08m	Modified NP	
S - IR08	Total Sulphur (Leco)	LECO
OA - ELE07	Paste pH	
S - CAL06a	Sulfide Sulfur (calculated*)	
S - GRA06a	Sulfate Sulfur (HCl leachable)	WST - SEQ

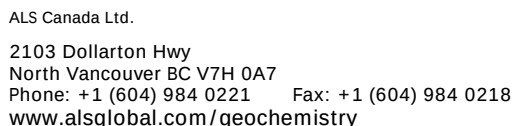
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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature:

Colin Ramshaw, Vancouver Laboratory Manager



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CERTIFICATE OF ANALYSIS VA18042881

Sample Description	Method Analyte Units LOR	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
		Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu
		%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm
		0.01	0.1	0.02	10	10	0.05	0.01	0.01	0.01	0.02	0.1	1	0.05	0.2
L2059205-1 153340		1.38	1.1	<0.02	<10	220	0.40	0.02	1.28	0.09	18.70	7.0	5	0.41	93.0
L2059205-2 153341		0.95	0.7	<0.02	<10	150	0.38	0.01	1.10	0.11	20.8	4.8	4	0.33	66.3
L2059205-3 153342		1.40	0.7	<0.02	<10	310	0.39	0.01	1.38	0.07	22.4	6.6	6	0.56	140.5
L2059205-4 153343		1.19	0.5	<0.02	<10	270	0.25	0.10	0.98	0.13	29.0	6.2	5	0.55	1830
L2059205-5 153344		1.01	1.6	<0.02	<10	200	0.36	0.15	1.24	0.10	29.0	6.6	4	0.40	1400
L2059205-6 153345		1.29	1.0	<0.02	<10	190	0.39	0.01	1.65	0.04	29.0	6.4	4	0.57	50.4
L2059205-7 153346		1.03	0.7	<0.02	<10	160	0.27	0.03	1.38	0.11	34.0	19.1	4	0.66	846
L2059205-8 153347		1.22	0.8	<0.02	<10	170	0.37	0.03	0.91	0.04	26.0	5.7	5	0.24	91.0
L2059205-9 153348		1.27	0.6	<0.02	<10	170	0.45	0.01	1.03	0.09	20.5	5.6	4	0.24	42.2
L2059205-10 JAN TAL 2018		1.12	1.0	0.15	<10	250	0.26	0.42	0.84	0.32	18.75	7.1	6	0.54	2300



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Account: APN

Project: L2059205

CERTIFICATE OF ANALYSIS VA18042881

Sample Description	Method Analyte Units LOR	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
		Ga	Ge	Hf	Hg	In	K	La	Li	Mg	Mn	Mo	Na	Nb	Ni
		ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	ppm	%	ppm	ppm
		0.05	0.05	0.02	0.01	0.005	0.01	0.2	0.1	0.01	5	0.05	0.01	0.05	0.2
L2059205-1 153340		6.61	0.07	0.06	<0.01	0.018	0.42	8.8	6.9	0.77	576	0.56	0.14	0.15	3.2
L2059205-2 153341		5.21	0.05	0.06	<0.01	0.025	0.34	9.7	5.0	0.44	594	1.07	0.08	0.07	2.3
L2059205-3 153342		6.82	0.08	0.06	<0.01	0.032	0.71	11.1	6.6	0.76	660	0.71	0.11	0.16	3.2
L2059205-4 153343		6.00	0.08	0.03	<0.01	0.076	0.74	15.5	4.9	0.74	606	1.40	0.10	0.19	3.1
L2059205-5 153344		5.51	0.06	0.05	<0.01	0.053	0.44	15.4	4.7	0.62	584	28.0	0.09	0.15	2.7
L2059205-6 153345		6.24	0.08	0.09	<0.01	0.023	0.41	15.5	6.7	0.77	699	0.69	0.15	0.10	2.2
L2059205-7 153346		6.16	0.07	0.06	0.01	0.164	0.72	17.6	3.9	0.91	594	8.55	0.09	0.34	2.5
L2059205-8 153347		5.89	0.07	0.08	<0.01	0.018	0.42	13.6	5.8	0.72	608	0.52	0.13	0.20	4.0
L2059205-9 153348		6.64	0.06	0.05	<0.01	0.018	0.29	10.1	8.7	0.72	602	0.54	0.09	0.10	2.1
L2059205-10 JAN TAL 2018		7.79	0.07	0.05	0.02	0.080	0.70	9.2	4.3	0.63	693	4.38	0.08	0.23	3.2



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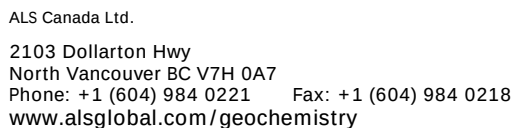
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Project: L2059205

CERTIFICATE OF ANALYSIS VA18042881

Sample Description	Method Analyte Units LOR	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
		Pb	Rb	Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl
		ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm
		0.2	0.1	0.001	0.01	0.05	0.1	0.2	0.2	0.2	0.01	0.01	0.2	0.005	0.02
L2059205-1 153340		6.6	17.2	0.001	0.06	<0.05	3.4	<0.2	0.4	99.6	<0.01	0.01	1.8	0.100	0.11
L2059205-2 153341		3.4	14.9	<0.001	0.01	<0.05	4.1	0.2	0.5	71.6	<0.01	<0.01	1.9	0.042	0.09
L2059205-3 153342		3.7	33.8	0.001	0.04	<0.05	4.6	0.2	0.8	70.3	<0.01	<0.01	2.1	0.125	0.20
L2059205-4 153343		2.8	35.7	0.003	0.21	<0.05	3.9	1.3	0.7	82.0	<0.01	0.04	3.7	0.119	0.25
L2059205-5 153344		4.5	20.5	0.096	0.17	<0.05	4.9	1.2	0.8	87.4	<0.01	0.03	3.3	0.061	0.14
L2059205-6 153345		3.5	17.4	<0.001	0.03	<0.05	4.7	0.2	0.6	124.0	<0.01	<0.01	3.3	0.066	0.13
L2059205-7 153346		4.3	39.8	0.027	1.43	<0.05	7.2	1.9	3.0	84.7	<0.01	0.10	4.8	0.112	0.41
L2059205-8 153347		2.9	18.5	<0.001	0.02	<0.05	3.2	0.3	0.5	75.1	<0.01	0.01	4.1	0.117	0.11
L2059205-9 153348		3.6	11.9	<0.001	0.02	<0.05	3.8	<0.2	0.6	65.5	<0.01	<0.01	2.0	0.057	0.07
L2059205-10 JAN TAL 2018		3.4	35.8	0.005	0.15	<0.05	4.4	2.2	1.0	69.8	<0.01	0.22	2.9	0.119	0.27



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CERTIFICATE OF ANALYSIS VA18042881

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Project: L2059205

CERTIFICATE OF ANALYSIS VA18042881

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

C-GAS05	C-IR07	LOG-22	ME-MS41
OA-ELE07	OA-VOL08m	PUL-31	S-CAL06a
S-GRA06	S-GRA06a	S-IR08	SPL-21
WEI-21			



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Account: APN

QC CERTIFICATE VA18042881

Project: L2059205

This report is for 10 Other samples submitted to our lab in Vancouver, BC, Canada on 26-FEB-2018.

The following have access to data associated with this certificate:

CASDG ALSE

ALSEV DATASUBLET

SHANE STACK

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI - 21	Received Sample Weight
SPL - 21	Split sample - riffle splitter
LOG - 22	Sample login - Rcd w/o BarCode
PUL - 31	Pulverize split to 85% <75 um

ANALYTICAL PROCEDURES

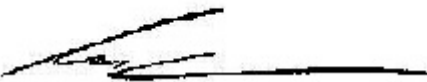
ALS CODE	DESCRIPTION	
C - GAS05	Inorganic Carbon (CO2)	
C - IR07	Total Carbon (Leco)	LECO
S - GRA06	Sulfate Sulfur - carbonate leach	WST - SEQ
ME - MS41	Ultra Trace Aqua Regia ICP - MS	
OA - VOL08m	Modified NP	
S - IR08	Total Sulphur (Leco)	LECO
OA - ELE07	Paste pH	
S - CAL06a	Sulfide Sulfur (calculated*)	
S - GRA06a	Sulfate Sulfur (HCl leachable)	WST - SEQ

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***** See Appendix Page for comments regarding this certificate *****

Signature:


Colin Ramshaw, Vancouver Laboratory Manager



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Project: L2059205

QC CERTIFICATE OF ANALYSIS VA18042881

Sample Description	Method Analyte Units LOR	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-ELE07	S-IR08	S-CAL06a	C-GAS05	C-GAS05	S-GRA06a	C-IR07	S-GRA06	ME-MS41	ME-MS41
		FIZZ RAT	MPA	NNP	NP	Ratio (N	pH	S	S	C	CO2	S	C	S	Ag	Al
		Unity	tCaCO3/1Kt	tCaCO3/1Kt	tCaCO3/1Kt	Unity	Unity	%	%	%	%	%	%	%	ppm	%
		1	0.3	1	1	0.01	0.1	0.01	0.01	0.05	0.2	0.01	0.01	0.01	0.01	0.01
STANDARDS																
Buffer pH6							6.0									
Buffer pH6							6.1									
Target Range - Lower Bound							5.3									
Upper Bound							6.7									
DS-1								2.61					3.11			
Target Range - Lower Bound								2.51					3.01			
Upper Bound								2.71					3.25			
GS310-10								0.27					1.11			
Target Range - Lower Bound								0.25					1.03			
Upper Bound								0.29					1.13			
KZK-1		2	25.0	32	57	2.28										
KZK-1		2	25.0	32	57	2.28										
Target Range - Lower Bound		<1	22.9	30	54	2.18										
Upper Bound		>4	27.1	38	64	2.53										
MRGeo08															4.42	2.66
Target Range - Lower Bound															4.00	2.44
Upper Bound															4.92	3.00
OREAS 905															0.52	0.77
Target Range - Lower Bound															0.45	0.73
Upper Bound															0.58	0.91
SY-4										0.89	3.3					
Target Range - Lower Bound										0.84	3.0					
Upper Bound										1.08	4.0					
UTS-1															0.87	
Target Range - Lower Bound															0.83	
Upper Bound															0.93	
UTS-1												0.92				
Target Range - Lower Bound												0.81				
Upper Bound												0.95				
UTS-4															1.71	
Target Range - Lower Bound															1.64	
Upper Bound															1.84	
UTS-4												1.76				
Target Range - Lower Bound												1.61				
Upper Bound												1.87				



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Sample Description	Method Analyte Units LOR	ME-MS41 As ppm 0.1	ME-MS41 Au ppm 0.02	ME-MS41 B ppm 10	ME-MS41 Ba ppm 10	ME-MS41 Be ppm 0.05	ME-MS41 Bi ppm 0.01	ME-MS41 Ca % 0.01	ME-MS41 Cd ppm 0.01	ME-MS41 Ce ppm 0.02	ME-MS41 Co ppm 0.1	ME-MS41 Cr ppm 1	ME-MS41 Cs ppm 0.05	ME-MS41 Cu ppm 0.2	ME-MS41 Fe % 0.01	ME-MS41 Ga ppm 0.05
STANDARDS																
Buffer pH6																
Buffer pH6																
Target Range - Lower Bound																
Upper Bound																
DS-1																
Target Range - Lower Bound																
Upper Bound																
GS310-10																
Target Range - Lower Bound																
Upper Bound																
KZK-1																
KZK-1																
Target Range - Lower Bound																
Upper Bound																
MRGeo08		34.6	<0.02	<10	440	0.85	0.62	1.09	2.26	73.1	19.4	91	10.05	634	3.70	9.76
Target Range - Lower Bound		29.6	<0.02	<10	370	0.67	0.60	1.00	2.01	66.2	17.0	81	9.40	587	3.22	8.73
Upper Bound		36.4	0.04	20	530	0.95	0.76	1.24	2.47	81.0	21.0	102	11.60	675	3.96	10.80
OREAS 905		32.9	0.39	<10	240	0.91	5.28	0.33	0.35	77.4	12.7	16	1.14	1530	3.46	6.08
Target Range - Lower Bound		28.4	0.33	<10	200	0.78	5.16	0.29	0.30	69.7	12.4	15	1.05	1450	3.14	5.45
Upper Bound		35.0	0.45	20	300	1.08	6.32	0.38	0.38	85.3	15.4	20	1.39	1670	3.86	6.77
SY-4																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18042881

Sample Description	Method Analyte Units LOR	ME-MS41 Ge ppm 0.05	ME-MS41 Hf ppm 0.02	ME-MS41 Hg ppm 0.01	ME-MS41 In ppm 0.005	ME-MS41 K % 0.01	ME-MS41 La ppm 0.2	ME-MS41 Li ppm 0.1	ME-MS41 Mg % 0.01	ME-MS41 Mn ppm 5	ME-MS41 Mo ppm 0.05	ME-MS41 Na % 0.01	ME-MS41 Nb ppm 0.05	ME-MS41 Ni ppm 0.2	ME-MS41 P ppm 10	ME-MS41 Pb ppm 0.2
STANDARDS																
Buffer pH6																
Buffer pH6																
Target Range - Lower Bound																
Upper Bound																
DS-1																
Target Range - Lower Bound																
Upper Bound																
GS310-10																
Target Range - Lower Bound																
Upper Bound																
KZK-1																
KZK-1																
Target Range - Lower Bound																
Upper Bound																
MRGeo08		0.14	0.71	0.06	0.149	1.30	37.0	32.5	1.16	413	14.95	0.36	0.93	714	1020	1075
Target Range - Lower Bound		0.07	0.64	0.04	0.137	1.12	33.2	29.6	1.03	378	13.10	0.30	0.79	622	900	959
Upper Bound		0.29	0.83	0.10	0.179	1.40	41.0	36.4	1.29	473	16.10	0.39	1.09	760	1130	1175
OREAS 905		0.09	1.21	0.02	0.577	0.32	39.5	4.1	0.15	338	2.99	0.10	0.29	8.4	240	15.2
Target Range - Lower Bound		<0.05	1.02	<0.01	0.517	0.28	34.7	4.0	0.13	310	2.65	0.07	0.19	7.8		14.4
Upper Bound		0.22	1.29	0.04	0.643	0.36	42.9	5.2	0.19	390	3.35	0.12	0.43	10.0		18.0
SY-4																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18042881

Sample Description	Method Analyte Units LOR	ME-MS41 Rb ppm 0.1	ME-MS41 Re ppm 0.001	ME-MS41 S % 0.01	ME-MS41 Sb ppm 0.05	ME-MS41 Sc ppm 0.1	ME-MS41 Se ppm 0.2	ME-MS41 Sn ppm 0.2	ME-MS41 Sr ppm 0.2	ME-MS41 Ta ppm 0.01	ME-MS41 Te ppm 0.01	ME-MS41 Th ppm 0.2	ME-MS41 Ti % 0.005	ME-MS41 Tl ppm 0.02	ME-MS41 U ppm 0.05	ME-MS41 V ppm 1
STANDARDS																
Buffer pH6																
Buffer pH6																
Target Range - Lower Bound																
Upper Bound																
DS-1																
Target Range - Lower Bound																
Upper Bound																
GS310-10																
Target Range - Lower Bound																
Upper Bound																
KZK-1																
KZK-1																
Target Range - Lower Bound																
Upper Bound																
MRGeo08		146.0	0.010	0.32	3.22	7.2	1.1	3.5	80.6	0.01	0.01	21.1	0.382	0.85	5.18	100
Target Range - Lower Bound		132.0	0.006	0.27	2.80	6.7	0.9	2.8	72.1	<0.01	<0.01	19.1	0.338	0.64	4.93	90
Upper Bound		162.0	0.010	0.35	3.90	8.4	1.9	4.0	88.5	0.03	0.04	23.7	0.424	0.92	6.13	112
OREAS 905		17.1	<0.001	0.07	0.97	1.7	2.3	1.3	11.6	<0.01	0.05	7.7	0.020	0.10	2.08	5
Target Range - Lower Bound		16.3	<0.001	0.04	0.83	1.5	1.8	0.8	10.9	<0.01	0.04	7.4	0.008	0.06	1.92	4
Upper Bound		20.1	0.002	0.09	1.23	2.0	2.8	1.7	13.7	0.02	0.09	9.4	0.030	0.16	2.46	8
SY-4																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																



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Sample Description	Method Analyte Units LOR	ME-MS41 W ppm 0.05	ME-MS41 Y ppm 0.05	ME-MS41 Zn ppm 2	ME-MS41 Zr ppm 0.5
STANDARDS					
Buffer pH6					
Buffer pH6					
Target Range - Lower Bound					
Upper Bound					
DS-1					
Target Range - Lower Bound					
Upper Bound					
GS310-10					
Target Range - Lower Bound					
Upper Bound					
KZK-1					
KZK-1					
Target Range - Lower Bound					
Upper Bound					
MRGeo08		2.93	19.70	775	23.0
Target Range - Lower Bound		2.44	17.50	708	18.1
Upper Bound		3.42	21.5	870	25.7
OREAS 905		0.54	6.58	64	46.8
Target Range - Lower Bound		0.41	6.32	56	39.9
Upper Bound		0.73	7.84	72	55.1
SY-4					
Target Range - Lower Bound					
Upper Bound					
UTS-1					
Target Range - Lower Bound					
Upper Bound					
UTS-1					
Target Range - Lower Bound					
Upper Bound					
UTS-4					
Target Range - Lower Bound					
Upper Bound					
UTS-4					
Target Range - Lower Bound					
Upper Bound					



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Sample Description	Method Analyte Units LOR	OA-VOL08m FIZZ RAT Unity	OA-VOL08m MPA tCaCO3/1Kt	OA-VOL08m NNP tCaCO3/1Kt	OA-VOL08m NP tCaCO3/1Kt	OA-VOL08m Ratio (N) Unity	OA-ELE07 pH Unity	S-IR08 S %	S-CAL06a S %	C-GAS05 C %	C-GAS05 CO2 %	S-GRA06a S %	C-IR07 C %	S-GRA06 S %	ME-MS41 Ag ppm	ME-MS41 Al %
		1	0.3	1	1	0.01	0.1	0.01	0.01	0.05	0.2	0.01	0.01	0.01	0.01	0.01
BLANKS																
BLANK										<0.05	<0.2					
Target Range - Lower Bound										<0.05	<0.2					
Upper Bound										0.10	0.4					
BLANK															<0.01	<0.01
Target Range - Lower Bound															<0.01	<0.01
Upper Bound															0.02	0.02
BLANK						6.3										
Target Range - Lower Bound						5.5										
Upper Bound						6.9										
BLANK															<0.01	
Target Range - Lower Bound															<0.01	
Upper Bound															0.02	
BLANK												<0.01				
Target Range - Lower Bound												<0.01				
Upper Bound												0.02				
BLANK								<0.01							<0.01	
Target Range - Lower Bound								<0.01							<0.01	
Upper Bound								0.02							0.02	
DUPLICATES																
L2059205-1 153340										0.22	0.8					
DUP										0.24	0.9					
Target Range - Lower Bound										0.17	0.6					
Upper Bound										0.29	1.1					
L2059205-7 153346															<0.01	
DUP															<0.01	
Target Range - Lower Bound															<0.01	
Upper Bound															0.02	
L2059205-10 JAN TAL 2018		2	3.8	17	21	5.60	8.2	0.12	0.05			0.07	0.30			
DUP		2	4.1	18	22	5.42	8.2	0.13	0.04			0.09	0.31			
Target Range - Lower Bound		<1	3.5	16	19	5.22	7.7	0.11	0.03			0.07	0.29			
Upper Bound		3	4.4	19	24	5.80	8.7	0.14	0.06			0.09	0.32			



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Sample Description	Method Analyte Units LOR	ME-MS41 As ppm 0.1	ME-MS41 Au ppm 0.02	ME-MS41 B ppm 10	ME-MS41 Ba ppm 10	ME-MS41 Be ppm 0.05	ME-MS41 Bi ppm 0.01	ME-MS41 Ca % 0.01	ME-MS41 Cd ppm 0.01	ME-MS41 Ce ppm 0.02	ME-MS41 Co ppm 0.1	ME-MS41 Cr ppm 1	ME-MS41 Cs ppm 0.05	ME-MS41 Cu ppm 0.2	ME-MS41 Fe % 0.01	ME-MS41 Ga ppm 0.05
BLANKS																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK		<0.1	<0.02	<10	<10	<0.05	<0.01	<0.01	<0.01	<0.02	<0.1	<1	<0.05	<0.2	<0.01	<0.05
Target Range - Lower Bound		<0.1	<0.02	<10	<10	<0.05	<0.01	<0.01	<0.01	<0.02	<0.1	<1	<0.05	<0.2	<0.01	<0.05
Upper Bound		0.2	0.04	20	20	0.10	0.02	0.02	0.02	0.04	0.2	2	0.10	0.4	0.02	0.10
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
DUPLICATES																
L2059205-1 153340																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2059205-7 153346																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2059205-10 JAN TAL 2018																
DUP																
Target Range - Lower Bound																
Upper Bound																



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Sample Description	Method Analyte Units LOR	ME-MS41 Ge ppm 0.05	ME-MS41 Hf ppm 0.02	ME-MS41 Hg ppm 0.01	ME-MS41 In ppm 0.005	ME-MS41 K % 0.01	ME-MS41 La ppm 0.2	ME-MS41 Li ppm 0.1	ME-MS41 Mg % 0.01	ME-MS41 Mn ppm 5	ME-MS41 Mo ppm 0.05	ME-MS41 Na % 0.01	ME-MS41 Nb ppm 0.05	ME-MS41 Ni ppm 0.2	ME-MS41 P ppm 10	ME-MS41 Pb ppm 0.2
BLANKS																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK		<0.05	<0.02	<0.01	<0.005	<0.01	<0.2	<0.1	<0.01	<5	<0.05	0.01	<0.05	<0.2	<10	<0.2
Target Range - Lower Bound		<0.05	<0.02	<0.01	<0.005	<0.01	<0.2	<0.1	<0.01	<5	<0.05	<0.01	<0.05	<0.2	<10	<0.2
Upper Bound		0.10	0.04	0.02	0.010	0.02	0.4	0.2	0.02	10	0.10	0.02	0.10	0.4	20	0.4
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
DUPLICATES																
L2059205-1 153340																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2059205-7 153346																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2059205-10 JAN TAL 2018																
DUP																
Target Range - Lower Bound																
Upper Bound																



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Sample Description	Method Analyte Units LOR	ME-MS41 Rb ppm 0.1	ME-MS41 Re ppm 0.001	ME-MS41 S % 0.01	ME-MS41 Sb ppm 0.05	ME-MS41 Sc ppm 0.1	ME-MS41 Se ppm 0.2	ME-MS41 Sn ppm 0.2	ME-MS41 Sr ppm 0.2	ME-MS41 Ta ppm 0.01	ME-MS41 Te ppm 0.01	ME-MS41 Th ppm 0.2	ME-MS41 Ti % 0.005	ME-MS41 Tl ppm 0.02	ME-MS41 U ppm 0.05	ME-MS41 V ppm 1
BLANKS																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK		<0.1	<0.001	0.01	<0.05	<0.1	<0.2	<0.2	<0.2	<0.01	<0.01	<0.2	<0.005	<0.02	<0.05	<1
Target Range - Lower Bound		<0.1	<0.001	<0.01	<0.05	<0.1	<0.2	<0.2	<0.2	<0.01	<0.01	<0.2	<0.005	<0.02	<0.05	<1
Upper Bound		0.2	0.002	0.02	0.10	0.2	0.4	0.4	0.4	0.02	0.02	0.4	0.010	0.04	0.10	2
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
DUPLICATES																
L2059205-1 153340																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2059205-7 153346																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2059205-10 JAN TAL 2018																
DUP																
Target Range - Lower Bound																
Upper Bound																



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Sample Description	Method Analyte Units LOR	ME-MS41 W ppm 0.05	ME-MS41 Y ppm 0.05	ME-MS41 Zn ppm 2	ME-MS41 Zr ppm 0.5
BLANKS					
BLANK					
Target Range - Lower Bound					
Upper Bound					
BLANK		<0.05	<0.05	<2	<0.5
Target Range - Lower Bound		<0.05	<0.05	<2	<0.5
Upper Bound		0.10	0.10	4	1.0
BLANK					
Target Range - Lower Bound					
Upper Bound					
BLANK					
Target Range - Lower Bound					
Upper Bound					
BLANK					
Target Range - Lower Bound					
Upper Bound					
BLANK					
Target Range - Lower Bound					
Upper Bound					
DUPLICATES					
L2059205-1 153340					
DUP					
Target Range - Lower Bound					
Upper Bound					
L2059205-7 153346					
DUP					
Target Range - Lower Bound					
Upper Bound					
L2059205-10 JAN TAL 2018					
DUP					
Target Range - Lower Bound					
Upper Bound					



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Sample Description	Method Analyte Units LOR	OA - VOL08m FIZZ RAT Unity	OA - VOL08m MPA tCaCO3/1Kt	OA - VOL08m NNP tCaCO3/1Kt	OA - VOL08m NP tCaCO3/1Kt	OA - VOL08m Ratio (N) Unity	OA - ELE07 pH Unity	S - IR08 S %	S - CAL06a S %	C - GAS05 C %	C - GAS05 CO2 %	S - GRA06a S %	C - IR07 C %	S - GRA06 S %	ME - MS41 Ag ppm	ME - MS41 Al %
		1	0.3	1	1	0.01	0.1	0.01	0.01	0.05	0.2	0.01	0.01	0.01	0.01	0.01
DUPLICATES																
ORIGINAL															0.72	1.41
DUP															0.83	1.45
Target Range - Lower Bound															0.73	1.35
Upper Bound															0.82	1.51



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QC CERTIFICATE OF ANALYSIS VA18042881

Sample Description	Method Analyte Units LOR	ME-MS41 As ppm 0.1	ME-MS41 Au ppm 0.02	ME-MS41 B ppm 10	ME-MS41 Ba ppm 10	ME-MS41 Be ppm 0.05	ME-MS41 Bi ppm 0.01	ME-MS41 Ca % 0.01	ME-MS41 Cd ppm 0.01	ME-MS41 Ce ppm 0.02	ME-MS41 Co ppm 0.1	ME-MS41 Cr ppm 1	ME-MS41 Cs ppm 0.05	ME-MS41 Cu ppm 0.2	ME-MS41 Fe % 0.01	ME-MS41 Ga ppm 0.05
DUPLICATES																
ORIGINAL		1.3	0.33	<10	100	0.70	0.87	1.74	0.10	37.1	19.4	154	1.37	43.3	3.37	7.33
DUP		1.4	0.30	<10	100	0.75	0.83	1.76	0.12	38.4	20.9	157	1.44	44.6	3.49	7.72
Target Range - Lower Bound		1.2	0.28	<10	80	0.64	0.80	1.65	0.09	35.8	19.0	147	1.28	42.2	3.25	7.10
Upper Bound		1.5	0.35	20	120	0.81	0.90	1.85	0.13	39.7	21.3	164	1.53	45.7	3.61	7.95



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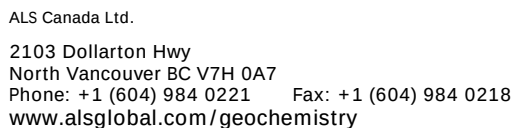
To: **ALS ENVIRONMENTAL**
100 - 8081 LOUGHEED HWY.
BURNABY BC V5A 1W9

Page: 4 - C
Total # Pages: 4 (A - E)
Plus Appendix Pages
Finalized Date: 13 - MAR - 2018
Account: APN

Project: L2059205

QC CERTIFICATE OF ANALYSIS VA18042881

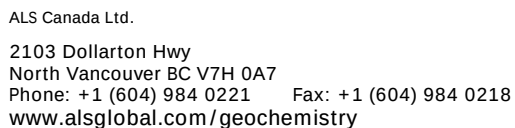
Sample Description	Method Analyte Units LOR	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
		Ge	Hf	Hg	In	K	La	Li	Mg	Mn	Mo	Na	Nb	Ni	P	Pb
		ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm
		0.05	0.02	0.01	0.005	0.01	0.2	0.1	0.01	5	0.05	0.01	0.05	0.2	10	0.2
		DUPLICATES														
ORIGINAL		0.10	0.68	<0.01	0.021	1.17	18.5	14.3	1.52	460	6.75	0.04	0.08	75.3	510	13.1
DUP		0.11	0.70	<0.01	0.023	1.20	19.3	15.5	1.55	477	6.88	0.04	0.08	80.5	510	14.5
Target Range - Lower Bound		<0.05	0.64	<0.01	0.016	1.12	17.8	14.1	1.45	440	6.42	0.03	<0.05	73.8	470	12.9
Upper Bound		0.16	0.74	0.02	0.028	1.25	20.0	15.7	1.62	497	7.21	0.05	0.10	82.0	550	14.7



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Total # Pages: 4 (A - E)
Plus Appendix Pages
Finalized Date: 13-MAR-2018
Account: APN

QC CERTIFICATE OF ANALYSIS VA18042881

***** See Appendix Page for comments regarding this certificate *****



Page: 4 - E
Total # Pages: 4 (A - E)
Plus Appendix Pages
Finalized Date: 13-MAR-2018
Account: APN

QC CERTIFICATE OF ANALYSIS VA18042881

***** See Appendix Page for comments regarding this certificate *****



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To: **ALS ENVIRONMENTAL**
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Page: **Appendix 1**
Total # Appendix Pages: **1**
Finalized Date: **13 - MAR - 2018**
Account: **APN**

Project: L2059205

QC CERTIFICATE OF ANALYSIS VA18042881

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

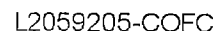
LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

C-GAS05	C-IR07	LOG-22	ME-MS41
OA-ELE07	OA-VOL08m	PUL-31	S-CAL06a
S-GRA06	S-GRA06a	S-IR08	SPL-21
WEI-21			



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Page of

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Report To					
Contact and company name below will appear on the final report					
Company:		Minto Explorations Ltd.			
Contact:		Minto Environment - Coordinator			
Phone:		1-604-759-4659			
Company address below will appear on the final report					
Street:		2100-510 West Georgia St.			
City/Province:		Vancouver, British Columbia			
Postal Code:		V6B 0M3			
Invoice To		Same as Report To ☐ YES ☒ NO			
		Copy of Invoice with Report ☐ YES ☒ NO			
Company:		Minto Explorations Ltd.			
Contact:		Ruth Cayetano			
Project Information					
ALS Account # / Quote #:					
Job #:					
PO / AFE: TBD					
LSD:					
ALS Lab Work Order # (lab use only)					
ALS Sample # (lab use only)		Sample Identification and/or Coordinates (This description will appear on the report)		Date (dd-mm-yy)	Time (hh:mm)
					Sample Type
		153340		30-01-18	Composite
		153341		31-01-18	WASTE
		153342		01-02-18	WASTE
		153343		01-02-18	WASTE
		153344		02-02-18	WASTE
		153345		02-Feb-18	WASTE
		153346		02-Feb-18	WASTE
		153347		07-Feb-18	WASTE
		153348		09-Feb-18	WASTE
		JAN TAL 2018		16-Feb-18	Tails
Drinking Water (DW) Samples ¹ (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)			
Are samples taken from a Regulated DW System? ☐ YES ☒ NO					
Are samples for human drinking water use? ☐ YES ☒ NO					
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)			
Released by: Kala Jatta		Date: Feb 16/18		Received by: (Signature)	
				Date: Feb 21/18	
				Time: 15:10	
				Received by: Z1 JC	
				Date: 2/22/18	
				Time: 12:25	
REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION					

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2011



Minto Explorations Ltd.
ATTN: Minto Environment
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 21-FEB-18
Report Date: 04-APR-18 13:46 (MT)
Version: FINAL

Client Phone: 604-759-0860

Certificate of Analysis

Lab Work Order #: L2059209

Project P.O. #: 220826

Job Reference:

C of C Numbers: 18-7

Legal Site Desc:

Comments: Please note, the ALS Minerals version of the finalized report and QC can be found at the end of the attachment.

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2059209-1 Waste 08-FEB-18 153349	L2059209-2 Waste 12-FEB-18 153350	L2059209-3 Waste 12-FEB-18 149476	L2059209-4 Waste 21-FEB-18 153321	L2059209-5 Waste 21-FEB-18 153322
Grouping	Analyte					
SOIL						
Physical Tests	pH (Unity)	9.3	9.0	9.0	9.0	9.0
Organic / Inorganic Carbon	Carbon (C) (%)	0.28	0.53	0.38	0.39	0.17
Acid Base Accounting	FIZZ RATING (Unity)	2	2	2	2	1
	MPA (tCaCO3/1Kt)	0.9	<0.3	7.2	<0.3	0.3
	Neutralization Potential (NP) (tCaCO3/1Kt)	21	36	28	29	15
	NNP (tCaCO3/1Kt)	20	36	21	29	15
	Ratio (NP/MPA) (Unity)	22.40	230.40	3.90	185.60	48.00
	Sulfate Sulfur (carbonate leach) (%)	<0.01	<0.01	<0.01	<0.01	<0.01
	Sulfate Sulfur (HCl leach) (%)	0.02	0.01	0.01	<0.01	0.01
	Sulfide Sulfur (T minus HCl leach) (%)	0.01	<0.01	0.22	<0.01	<0.01
	Total Sulfur (combustion) (%)	0.03	<0.01	0.23	<0.01	0.01
Total Metals	Aluminum (Al) (%)	0.82	0.69	0.92	1.03	0.95
	Antimony (Sb) (ppm)	<0.05	<0.05	0.16	<0.05	<0.05
	Arsenic (As) (ppm)	1.0	0.7	12.2	0.9	1.0
	Barium (Ba) (ppm)	240	140	210	220	320
	Beryllium (Be) (ppm)	0.22	0.25	0.23	0.30	0.23
	Bismuth (Bi) (ppm)	0.01	0.12	0.60	0.01	0.42
	Boron (B) (ppm)	<10	<10	<10	<10	<10
	Cadmium (Cd) (ppm)	0.07	0.04	0.17	0.02	0.14
	Calcium (Ca) (%)	0.73	1.26	0.95	1.07	0.55
	Cerium (Ce) (ppm)	15.35	40.1	25.3	28.2	24.4
	Cesium (Cs) (ppm)	0.39	0.29	0.41	0.53	0.65
	Chromium (Cr) (ppm)	3	3	4	5	4
	Cobalt (Co) (ppm)	4.4	4.8	6.1	6.4	6.4
	Copper (Cu) (ppm)	170.0	186.5	1715	45.4	1875
	Gallium (Ga) (ppm)	3.78	4.06	5.15	5.57	5.01
	Germanium (Ge) (ppm)	0.05	0.05	0.05	0.06	0.07
	Gold (Au) (ppm)	<0.02	<0.02	0.03	<0.02	0.05
	Hafnium (Hf) (ppm)	0.03	0.02	0.03	0.05	0.03
	Indium (In) (ppm)	0.037	0.017	0.065	0.023	0.027
	Iron (Fe) (%)	1.93	1.97	2.53	2.62	2.51
	Lanthanum (La) (ppm)	7.3	21.7	13.8	15.3	14.1
	Lead (Pb) (ppm)	2.7	2.4	3.3	2.7	2.5
	Lithium (Li) (ppm)	3.3	4.0	5.3	5.5	4.3
	Magnesium (Mg) (%)	0.49	0.50	0.63	0.61	0.47
	Manganese (Mn) (ppm)	465	433	467	535	542

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2059209-6 Waste 03-FEB-18 149478	L2059209-7 Waste 04-FEB-18 149479	L2059209-8 Waste 08-FEB-18 149480	L2059209-9 Waste 13-FEB-18 149481	L2059209-10 Waste 13-FEB-18 149482
Grouping	Analyte					
SOIL						
Physical Tests	pH (Unity)	8.9	9.0	9.4	9.2	9.0
Organic / Inorganic Carbon	Carbon (C) (%)	0.66	0.44	0.19	0.35	0.61
Acid Base Accounting	FIZZ RATING (Unity)	2	2	2	2	2
	MPA (tCaCO3/1Kt)	14.1	3.8	<0.3	<0.3	<0.3
	Neutralization Potential (NP) (tCaCO3/1Kt)	40	34	21	31	41
	NNP (tCaCO3/1Kt)	26	30	21	31	41
	Ratio (NP/MPA) (Unity)	2.84	9.07	134.40	198.40	262.40
	Sulfate Sulfur (carbonate leach) (%)	<0.01	0.01	<0.01	<0.01	<0.01
	Sulfate Sulfur (HCl leach) (%)	0.01	<0.01	<0.01	<0.01	0.02
	Sulfide Sulfur (T minus HCl leach) (%)	0.44	0.12	<0.01	<0.01	<0.01
	Total Sulfur (combustion) (%)	0.45	0.12	<0.01	<0.01	<0.01
Total Metals	Aluminum (Al) (%)	0.94	1.12	1.14	0.93	0.98
	Antimony (Sb) (ppm)	0.08	<0.05	<0.05	0.05	<0.05
	Arsenic (As) (ppm)	6.4	0.9	0.9	3.7	0.9
	Barium (Ba) (ppm)	250	280	210	190	240
	Beryllium (Be) (ppm)	0.29	0.32	0.30	0.33	0.40
	Bismuth (Bi) (ppm)	0.39	0.07	0.01	0.13	0.01
	Boron (B) (ppm)	<10	<10	<10	<10	<10
	Cadmium (Cd) (ppm)	0.17	0.13	0.02	0.04	0.03
	Calcium (Ca) (%)	1.23	1.27	0.91	1.13	1.46
	Cerium (Ce) (ppm)	29.8	44.2	22.4	19.50	25.6
	Cesium (Cs) (ppm)	0.66	0.42	0.37	0.47	0.64
	Chromium (Cr) (ppm)	4	5	5	4	3
	Cobalt (Co) (ppm)	8.4	7.6	5.9	5.7	6.4
	Copper (Cu) (ppm)	1475	684	42.7	12.9	10.8
	Gallium (Ga) (ppm)	5.38	6.20	5.65	4.93	4.18
	Germanium (Ge) (ppm)	0.08	0.08	0.07	0.08	0.05
	Gold (Au) (ppm)	<0.02	<0.02	<0.02	<0.02	<0.02
	Hafnium (Hf) (ppm)	0.05	0.04	0.05	0.05	0.08
	Indium (In) (ppm)	0.116	0.050	0.021	0.029	0.028
	Iron (Fe) (%)	3.24	2.69	2.21	2.23	2.39
	Lanthanum (La) (ppm)	15.8	23.6	11.3	8.7	12.8
	Lead (Pb) (ppm)	4.1	4.1	2.4	2.3	2.6
	Lithium (Li) (ppm)	4.2	6.6	5.9	5.0	3.5
	Magnesium (Mg) (%)	0.81	0.73	0.66	0.67	0.65
	Manganese (Mn) (ppm)	545	484	547	711	591

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2059209-11 Waste 13-FEB-18 149477				
Grouping	Analyte					
SOIL						
Physical Tests	pH (Unity)	9.1				
Organic / Inorganic Carbon	Carbon (C) (%)	0.6				
Acid Base Accounting	FIZZ RATING (Unity)	2				
	MPA (tCaCO3/1Kt)	6.6				
	Neutralization Potential (NP) (tCaCO3/1Kt)	41				
	NNP (tCaCO3/1Kt)	34				
	Ratio (NP/MPA) (Unity)	6.25				
	Sulfate Sulfur (carbonate leach) (%)	<0.01				
	Sulfate Sulfur (HCl leach) (%)	<0.01				
	Sulfide Sulfur (T minus HCl leach) (%)	0.21				
	Total Sulfur (combustion) (%)	0.21				
Total Metals	Aluminum (Al) (%)	0.87				
	Antimony (Sb) (ppm)	<0.05				
	Arsenic (As) (ppm)	1.8				
	Barium (Ba) (ppm)	230				
	Beryllium (Be) (ppm)	0.22				
	Bismuth (Bi) (ppm)	0.19				
	Boron (B) (ppm)	<10				
	Cadmium (Cd) (ppm)	0.17				
	Calcium (Ca) (%)	1.4				
	Cerium (Ce) (ppm)	21.6				
	Cesium (Cs) (ppm)	0.39				
	Chromium (Cr) (ppm)	3				
	Cobalt (Co) (ppm)	6.4				
	Copper (Cu) (ppm)	2110				
	Gallium (Ga) (ppm)	4.97				
	Germanium (Ge) (ppm)	0.05				
	Gold (Au) (ppm)	0.06				
	Hafnium (Hf) (ppm)	0.05				
	Indium (In) (ppm)	0.108				
	Iron (Fe) (%)	2.98				
	Lanthanum (La) (ppm)	11.6				
	Lead (Pb) (ppm)	3.1				
	Lithium (Li) (ppm)	4.5				
	Magnesium (Mg) (%)	0.63				
	Manganese (Mn) (ppm)	434				

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2059209-1 Waste 08-FEB-18 153349	L2059209-2 Waste 12-FEB-18 153350	L2059209-3 Waste 12-FEB-18 149476	L2059209-4 Waste 21-FEB-18 153321	L2059209-5 Waste 21-FEB-18 153322
Grouping	Analyte					
SOIL						
Total Metals	Mercury (Hg) (ppm)	<0.01	<0.01	0.01	<0.01	0.01
	Molybdenum (Mo) (ppm)	5.67	0.44	4.51	0.84	2.71
	Nickel (Ni) (ppm)	1.6	2.2	2.0	2.3	2.3
	Niobium (Nb) (ppm)	0.20	0.06	0.19	0.12	0.16
	Phosphorus (P) (ppm)	470	450	630	670	600
	Potassium (K) (%)	0.55	0.25	0.48	0.49	0.68
	Rhenium (Re) (ppm)	0.016	0.001	0.011	0.001	0.001
	Rubidium (Rb) (ppm)	26.1	11.6	24.9	24.4	35.5
	Scandium (Sc) (ppm)	3.9	1.9	4.1	4.3	2.6
	Selenium (Se) (ppm)	<0.2	<0.2	1.4	<0.2	0.9
	Silver (Ag) (ppm)	0.03	0.14	0.51	0.04	0.67
	Sodium (Na) (%)	0.08	0.08	0.07	0.08	0.07
	Strontium (Sr) (ppm)	47.4	77.8	74.1	75.7	39.8
	Sulfur (S) (%)	0.08	0.04	0.28	0.15	0.14
	Tantalum (Ta) (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01
	Tellurium (Te) (ppm)	0.01	0.01	0.08	<0.01	0.13
	Thallium (Tl) (ppm)	0.20	0.06	0.17	0.15	0.21
	Thorium (Th) (ppm)	2.2	4.9	3.2	3.2	2.7
	Tin (Sn) (ppm)	0.6	0.3	0.8	0.5	0.5
	Titanium (Ti) (%)	0.090	0.028	0.075	0.074	0.112
	Tungsten (W) (ppm)	0.23	0.27	0.40	0.45	0.65
	Uranium (U) (ppm)	0.29	0.40	24.3	0.35	0.19
	Vanadium (V) (ppm)	42	31	48	46	53
	Yttrium (Y) (ppm)	4.83	4.71	5.51	5.90	4.73
	Zinc (Zn) (ppm)	49	57	69	64	71
	Zirconium (Zr) (ppm)	0.7	0.5	0.7	1.3	0.8
Permanent Gases	Carbon Dioxide (CO2) (%)	1.0	2.0	1.4	1.4	0.6
Miscellaneous	Carbon (C) (%)	0.33	0.61	0.48	0.47	0.20

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2059209-6 Waste 03-FEB-18 149478	L2059209-7 Waste 04-FEB-18 149479	L2059209-8 Waste 08-FEB-18 149480	L2059209-9 Waste 13-FEB-18 149481	L2059209-10 Waste 13-FEB-18 149482
Grouping	Analyte					
SOIL						
Total Metals	Mercury (Hg) (ppm)	0.01	0.01	<0.01	<0.01	<0.01
	Molybdenum (Mo) (ppm)	5.63	1.46	0.52	0.23	0.33
	Nickel (Ni) (ppm)	2.3	2.4	3.3	1.6	1.4
	Niobium (Nb) (ppm)	0.30	0.20	0.17	0.07	0.10
	Phosphorus (P) (ppm)	790	720	660	600	780
	Potassium (K) (%)	0.64	0.55	0.52	0.46	0.50
	Rhenium (Re) (ppm)	0.015	0.004	<0.001	0.001	0.001
	Rubidium (Rb) (ppm)	33.4	27.3	25.3	21.9	22.3
	Scandium (Sc) (ppm)	6.1	5.5	3.7	4.3	5.1
	Selenium (Se) (ppm)	1.6	0.5	<0.2	<0.2	<0.2
	Silver (Ag) (ppm)	0.38	0.19	0.03	0.02	0.02
	Sodium (Na) (%)	0.07	0.07	0.11	0.08	0.10
	Strontium (Sr) (ppm)	103.5	87.7	74.1	104.5	143.5
	Sulfur (S) (%)	0.60	0.24	0.11	0.08	0.08
	Tantalum (Ta) (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01
	Tellurium (Te) (ppm)	0.08	0.02	<0.01	<0.01	<0.01
	Thallium (Tl) (ppm)	0.24	0.20	0.16	0.13	0.15
	Thorium (Th) (ppm)	4.3	5.9	2.4	2.0	2.9
	Tin (Sn) (ppm)	1.2	0.8	0.5	0.6	0.6
	Titanium (Ti) (%)	0.099	0.083	0.103	0.069	0.066
	Tungsten (W) (ppm)	0.91	0.77	0.81	0.27	0.23
	Uranium (U) (ppm)	10.55	0.39	0.27	5.27	0.37
	Vanadium (V) (ppm)	63	51	45	46	45
	Yttrium (Y) (ppm)	9.95	7.77	7.58	13.45	10.10
	Zinc (Zn) (ppm)	73	70	59	55	55
	Zirconium (Zr) (ppm)	1.3	0.9	0.9	0.7	2.4
Permanent Gases	Carbon Dioxide (CO2) (%)	2.4	1.6	0.7	1.3	2.3
Miscellaneous	Carbon (C) (%)	0.81	0.55	0.25	0.47	0.71

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2059209-11 Waste 13-FEB-18 149477				
Grouping	Analyte					
SOIL						
Total Metals	Mercury (Hg) (ppm)	<0.01				
	Molybdenum (Mo) (ppm)	1.83				
	Nickel (Ni) (ppm)	1.7				
	Niobium (Nb) (ppm)	0.18				
	Phosphorus (P) (ppm)	600				
	Potassium (K) (%)	0.51				
	Rhenium (Re) (ppm)	0.005				
	Rubidium (Rb) (ppm)	24.7				
	Scandium (Sc) (ppm)	4.1				
	Selenium (Se) (ppm)	1.6				
	Silver (Ag) (ppm)	0.52				
	Sodium (Na) (%)	0.07				
	Strontium (Sr) (ppm)	110				
	Sulfur (S) (%)	0.27				
	Tantalum (Ta) (ppm)	<0.01				
	Tellurium (Te) (ppm)	0.12				
	Thallium (Tl) (ppm)	0.17				
	Thorium (Th) (ppm)	3				
	Tin (Sn) (ppm)	0.7				
	Titanium (Ti) (%)	0.08				
	Tungsten (W) (ppm)	0.33				
	Uranium (U) (ppm)	0.24				
	Vanadium (V) (ppm)	54				
	Yttrium (Y) (ppm)	6.04				
	Zinc (Zn) (ppm)	64				
	Zirconium (Zr) (ppm)	1.2				
Permanent Gases	Carbon Dioxide (CO2) (%)	2.2				
Miscellaneous	Carbon (C) (%)	0.71				

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ABA-OA-VOL08-AX	Soil	Acid Base Accounting	OA-VOL08
CARBON-C-GAS05-AX	Soil	Carbon, TOC and CO ₂	C-GAS05
CARBON-C-IR07-AX	Soil	Carbon (C) using LECO analyzer	Total Carbon - Method Code C-IR07
Total Carbon & Sulfur - Method Codes C-IR07 & S-IR08			
A 0.1g sample is heated to approximately 1350°C in an induction furnace while passing a stream of oxygen through the sample. Carbon dioxide & sulfur dioxide released from the sample are measured by an IR detection system (Leco analyzer) and the total carbon & sulfur results are provided.			
ME-MS41-AX	Soil	Aqua Regia ICPMS	Aqua Regia ICPMS
A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences.			
PH-OA-ELE07-AX	Soil	pH	OA-ELE07
SULPHUR-S-CAL06A-AX	Soil	Sulfide Sulfur Calc from HCl Leach	ALS Minerals S-CAL06A
Sulfide Sulfur (as S) is calculated by subtracting the HCl Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion.			
SULPHUR-S-GRA06-AX	Soil	Sulfate Sulfur in Soil (Carbonate Leach)	ALS Minerals S-GRA06
A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).			
SULPHUR-S-GRA06A-AX	Soil	Sulfate Sulfur in Soil (HCl Leach)	ALS Minerals S-GRA06A
A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).			
SULPHUR-S-IR08-AX	Soil	Total Sulfur in Soil by Combustion	ALS Minerals S-IR08
The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
AX	ALS MINERALS - VANCOUVER, B.C., CANADA

Chain of Custody Numbers:

18-7

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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Plus Appendix Pages
Finalized Date: 13 - MAR - 2018
Account: APN

CERTIFICATE VA18044893

Project: L2059209

This report is for 11 Other samples submitted to our lab in Vancouver, BC, Canada on 26-FEB-2018.

The following have access to data associated with this certificate:

CASDG ALSE

ALSEV DATASUBLET

SHANE STACK

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI-21	Received Sample Weight
SPL-21	Split sample - riffle splitter
LOG-22	Sample login - Rcd w/o BarCode
PUL-31	Pulverize split to 85% <75 um

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	
C-GAS05	Inorganic Carbon (CO2)	
C-IR07	Total Carbon (Leco)	LECO
S-GRA06	Sulfate Sulfur - carbonate leach	WST-SEQ
ME-MS41	Ultra Trace Aqua Regia ICP-MS	
OA-VOL08m	Modified NP	
S-IR08	Total Sulphur (Leco)	LECO
OA-ELE07	Paste pH	
S-CAL06a	Sulfide Sulfur (calculated*)	
S-GRA06a	Sulfate Sulfur (HCl leachable)	WST-SEQ

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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature:

Colin Ramshaw, Vancouver Laboratory Manager



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CERTIFICATE OF ANALYSIS VA18044893

Sample Description	Method Analyte Units LOR	WEI-21	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-ELE07	S-IR08	S-CAL06a	C-GAS05	C-GAS05	S-GRA06a	C-IR07	S-GRA06	ME-MS41
		Recvd Wt.	FIZZ RAT	MPA	NNP	NP	Ratio (N	pH	S	S	C	CO2	S	C	S	Ag
		kg	Unity	tCaCO3/1Kt	tCaCO3/1Kt	tCaCO3/1Kt	Unity	Unity	%	%	%	%	%	%	%	ppm
		0.02	1	0.3	1	1	0.01	0.1	0.01	0.01	0.05	0.2	0.01	0.01	0.01	0.01
L2059209-1 153349		1.08	2	0.9	20	21	22.40	9.3	0.03	0.01	0.28	1.0	0.02	0.33	<0.01	0.03
L2059209-2 153350		1.10	2	<0.3	36	36	230.40	9.0	<0.01	<0.01	0.53	2.0	0.01	0.61	<0.01	0.14
L2059209-3 149476		1.10	2	7.2	21	28	3.90	9.0	0.23	0.22	0.38	1.4	0.01	0.48	<0.01	0.51
L2059209-4 153321		1.08	2	<0.3	29	29	185.60	9.0	<0.01	<0.01	0.39	1.4	<0.01	0.47	<0.01	0.04
L2059209-5 153322		1.08	1	0.3	15	15	48.00	9.0	0.01	<0.01	0.17	0.6	0.01	0.20	<0.01	0.67
L2059209-6 149478		1.10	2	14.1	26	40	2.84	8.9	0.45	0.44	0.66	2.4	0.01	0.81	<0.01	0.38
L2059209-7 149479		1.10	2	3.8	30	34	9.07	9.0	0.12	0.12	0.44	1.6	<0.01	0.55	0.01	0.19
L2059209-8 149480		1.06	2	<0.3	21	21	134.40	9.4	<0.01	<0.01	0.19	0.7	<0.01	0.25	<0.01	0.03
L2059209-9 149481		1.10	2	<0.3	31	31	198.40	9.2	<0.01	<0.01	0.35	1.3	<0.01	0.47	<0.01	0.02
L2059209-10 149482		1.08	2	<0.3	41	41	262.40	9.0	<0.01	<0.01	0.61	2.3	0.02	0.71	<0.01	0.02
L2059209-4 149477		1.04	2	6.6	34	41	6.25	9.1	0.21	0.21	0.60	2.2	<0.01	0.71	<0.01	0.52



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CERTIFICATE OF ANALYSIS VA18044893

Sample Description	Method Analyte Units LOR	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
		Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu
		%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm
		0.01	0.1	0.02	10	10	0.05	0.01	0.01	0.01	0.02	0.1	1	0.05	0.2
L2059209-1 153349		0.82	1.0	<0.02	<10	240	0.22	0.01	0.73	0.07	15.35	4.4	3	0.39	170.0
L2059209-2 153350		0.69	0.7	<0.02	<10	140	0.25	0.12	1.26	0.04	40.1	4.8	3	0.29	186.5
L2059209-3 149476		0.92	12.2	0.03	<10	210	0.23	0.60	0.95	0.17	25.3	6.1	4	0.41	1715
L2059209-4 153321		1.03	0.9	<0.02	<10	220	0.30	0.01	1.07	0.02	28.2	6.4	5	0.53	45.4
L2059209-5 153322		0.95	1.0	0.05	<10	320	0.23	0.42	0.55	0.14	24.4	6.4	4	0.65	1875
L2059209-6 149478		0.94	6.4	<0.02	<10	250	0.29	0.39	1.23	0.17	29.8	8.4	4	0.66	1475
L2059209-7 149479		1.12	0.9	<0.02	<10	280	0.32	0.07	1.27	0.13	44.2	7.6	5	0.42	684
L2059209-8 149480		1.14	0.9	<0.02	<10	210	0.30	0.01	0.91	0.02	22.4	5.9	5	0.37	42.7
L2059209-9 149481		0.93	3.7	<0.02	<10	190	0.33	0.13	1.13	0.04	19.50	5.7	4	0.47	12.9
L2059209-10 149482		0.98	0.9	<0.02	<10	240	0.40	0.01	1.46	0.03	25.6	6.4	3	0.64	10.8
L2059209-4 149477		0.87	1.8	0.06	<10	230	0.22	0.19	1.40	0.17	21.6	6.4	3	0.39	2110



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CERTIFICATE OF ANALYSIS VA18044893

Sample Description	Method Analyte Units LOR	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
		Ga	Ge	Hf	Hg	In	K	La	Li	Mg	Mn	Mo	Na	Nb	Ni
		ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	ppm	%	ppm	ppm
		0.05	0.05	0.02	0.01	0.005	0.01	0.2	0.1	0.01	5	0.05	0.01	0.05	0.2
L2059209-1 153349		3.78	0.05	0.03	<0.01	0.037	0.55	7.3	3.3	0.49	465	5.67	0.08	0.20	1.6
L2059209-2 153350		4.06	0.05	0.02	<0.01	0.017	0.25	21.7	4.0	0.50	433	0.44	0.08	0.06	2.2
L2059209-3 149476		5.15	0.05	0.03	0.01	0.065	0.48	13.8	5.3	0.63	467	4.51	0.07	0.19	2.0
L2059209-4 153321		5.57	0.06	0.05	<0.01	0.023	0.49	15.3	5.5	0.61	535	0.84	0.08	0.12	2.3
L2059209-5 153322		5.01	0.07	0.03	0.01	0.027	0.68	14.1	4.3	0.47	542	2.71	0.07	0.16	2.3
L2059209-6 149478		5.38	0.08	0.05	0.01	0.116	0.64	15.8	4.2	0.81	545	5.63	0.07	0.30	2.3
L2059209-7 149479		6.20	0.08	0.04	0.01	0.050	0.55	23.6	6.6	0.73	484	1.46	0.07	0.20	2.4
L2059209-8 149480		5.65	0.07	0.05	<0.01	0.021	0.52	11.3	5.9	0.66	547	0.52	0.11	0.17	3.3
L2059209-9 149481		4.93	0.08	0.05	<0.01	0.029	0.46	8.7	5.0	0.67	711	0.23	0.08	0.07	1.6
L2059209-10 149482		4.18	0.05	0.08	<0.01	0.028	0.50	12.8	3.5	0.65	591	0.33	0.10	0.10	1.4
L2059209-4 149477		4.97	0.05	0.05	<0.01	0.108	0.51	11.6	4.5	0.63	434	1.83	0.07	0.18	1.7



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CERTIFICATE OF ANALYSIS VA18044893

Sample Description	Method Analyte Units LOR	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
		Pb	Rb	Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl
		ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm
		0.2	0.1	0.001	0.01	0.05	0.1	0.2	0.2	0.2	0.01	0.01	0.2	0.005	0.02
L2059209-1 153349		2.7	26.1	0.016	0.08	<0.05	3.9	<0.2	0.6	47.4	<0.01	0.01	2.2	0.090	0.20
L2059209-2 153350		2.4	11.6	0.001	0.04	<0.05	1.9	<0.2	0.3	77.8	<0.01	0.01	4.9	0.028	0.06
L2059209-3 149476		3.3	24.9	0.011	0.28	0.16	4.1	1.4	0.8	74.1	<0.01	0.08	3.2	0.075	0.17
L2059209-4 153321		2.7	24.4	0.001	0.15	<0.05	4.3	<0.2	0.5	75.7	<0.01	<0.01	3.2	0.074	0.15
L2059209-5 153322		2.5	35.5	0.001	0.14	<0.05	2.6	0.9	0.5	39.8	<0.01	0.13	2.7	0.112	0.21
L2059209-6 149478		4.1	33.4	0.015	0.60	0.08	6.1	1.6	1.2	103.5	<0.01	0.08	4.3	0.099	0.24
L2059209-7 149479		4.1	27.3	0.004	0.24	<0.05	5.5	0.5	0.8	87.7	<0.01	0.02	5.9	0.083	0.20
L2059209-8 149480		2.4	25.3	<0.001	0.11	<0.05	3.7	<0.2	0.5	74.1	<0.01	<0.01	2.4	0.103	0.16
L2059209-9 149481		2.3	21.9	0.001	0.08	0.05	4.3	<0.2	0.6	104.5	<0.01	<0.01	2.0	0.069	0.13
L2059209-10 149482		2.6	22.3	0.001	0.08	<0.05	5.1	<0.2	0.6	143.5	<0.01	<0.01	2.9	0.066	0.15
L2059209-4 149477		3.1	24.7	0.005	0.27	<0.05	4.1	1.6	0.7	110.0	<0.01	0.12	3.0	0.080	0.17



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CERTIFICATE OF ANALYSIS VA18044893

Sample Description	Method Analyte Units LOR	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
		V	W	Y	Zn	Zr
		ppm 1	ppm 0.05	ppm 0.05	ppm 2	ppm 0.5
L2059209-1 153349		42	0.23	4.83	49	0.7
L2059209-2 153350		31	0.27	4.71	57	0.5
L2059209-3 149476		48	0.40	5.51	69	0.7
L2059209-4 153321		46	0.45	5.90	64	1.3
L2059209-5 153322		53	0.65	4.73	71	0.8
L2059209-6 149478		63	0.91	9.95	73	1.3
L2059209-7 149479		51	0.77	7.77	70	0.9
L2059209-8 149480		45	0.81	7.58	59	0.9
L2059209-9 149481		46	0.27	13.45	55	0.7
L2059209-10 149482		45	0.23	10.10	55	2.4
L2059209-4 149477		54	0.33	6.04	64	1.2



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CERTIFICATE OF ANALYSIS VA18044893

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

C-GAS05	C-IR07	LOG-22	ME-MS41
OA-ELE07	OA-VOL08m	PUL-31	S-CAL06a
S-GRA06	S-GRA06a	S-IR08	SPL-21
WEI-21			



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Account: APN

QC CERTIFICATE VA18044893

Project: L2059209

This report is for 11 Other samples submitted to our lab in Vancouver, BC, Canada on 26-FEB-2018.

The following have access to data associated with this certificate:

CASDG ALSE

ALSEV DATASUBLET

SHANE STACK

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI - 21	Received Sample Weight
SPL - 21	Split sample - riffle splitter
LOG - 22	Sample login - Rcd w/o BarCode
PUL - 31	Pulverize split to 85% <75 um

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	
C - GAS05	Inorganic Carbon (CO2)	
C - IR07	Total Carbon (Leco)	LECO
S - GRA06	Sulfate Sulfur - carbonate leach	WST - SEQ
ME - MS41	Ultra Trace Aqua Regia ICP - MS	
OA - VOL08m	Modified NP	
S - IR08	Total Sulphur (Leco)	LECO
OA - ELE07	Paste pH	
S - CAL06a	Sulfide Sulfur (calculated*)	
S - GRA06a	Sulfate Sulfur (HCl leachable)	WST - SEQ

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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature:

Colin Ramshaw, Vancouver Laboratory Manager



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QC CERTIFICATE OF ANALYSIS VA18044893

Sample Description	Method Analyte Units LOR	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-ELE07	S-IR08	S-CAL06a	C-GAS05	C-GAS05	S-GRA06a	C-IR07	S-GRA06	ME-MS41	ME-MS41
		FIZZ RAT	MPA	NNP	NP	Ratio (N	pH	S	S	C	CO2	S	C	S	Ag	Al
		Unity	tCaCO3/1Kt	tCaCO3/1Kt	tCaCO3/1Kt	Unity	Unity	%	%	%	%	%	%	%	ppm	%
		1	0.3	1	1	0.01	0.1	0.01	0.01	0.05	0.2	0.01	0.01	0.01	0.01	0.01
STANDARDS																
Buffer pH6							6.0									
Buffer pH6							6.1									
Target Range - Lower Bound							5.3									
Upper Bound							6.7									
CO-ASSAY										0.51	1.9					
Target Range - Lower Bound										0.42	1.5					
Upper Bound										0.64	2.4					
DS-1								2.61						3.11		
Target Range - Lower Bound								2.51						3.01		
Upper Bound								2.71						3.25		
GS310-10								0.27						1.11		
Target Range - Lower Bound								0.25						1.03		
Upper Bound								0.29						1.13		
KZK-1		2	25.0	32	57	2.28										
KZK-1		2	25.0	32	57	2.28										
Target Range - Lower Bound		<1	22.9	30	54	2.18										
Upper Bound		>4	27.1	38	64	2.53										
MRGeo08															4.42	2.66
Target Range - Lower Bound															4.00	2.44
Upper Bound															4.92	3.00
OGGeo08															19.60	2.23
Target Range - Lower Bound															18.15	2.05
Upper Bound															22.2	2.53
OREAS 905															0.52	0.77
Target Range - Lower Bound															0.45	0.73
Upper Bound															0.58	0.91
OREAS 920															0.09	2.32
Target Range - Lower Bound															0.07	2.18
Upper Bound															0.12	2.68
SY-4										0.89	3.3					
SY-4										0.86	3.2					
Target Range - Lower Bound										0.84	3.0					
Upper Bound										1.08	4.0					
UTS-1															0.87	
Target Range - Lower Bound															0.83	
Upper Bound															0.93	
UTS-1												0.92				



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QC CERTIFICATE OF ANALYSIS VA18044893

Sample Description	Method Analyte Units LOR	ME-MS41 As ppm 0.1	ME-MS41 Au ppm 0.02	ME-MS41 B ppm 10	ME-MS41 Ba ppm 10	ME-MS41 Be ppm 0.05	ME-MS41 Bi ppm 0.01	ME-MS41 Ca % 0.01	ME-MS41 Cd ppm 0.01	ME-MS41 Ce ppm 0.02	ME-MS41 Co ppm 0.1	ME-MS41 Cr ppm 1	ME-MS41 Cs ppm 0.05	ME-MS41 Cu ppm 0.2	ME-MS41 Fe % 0.01	ME-MS41 Ga ppm 0.05
STANDARDS																
Buffer pH6																
Buffer pH6																
Target Range - Lower Bound																
Upper Bound																
CO - ASSAY																
Target Range - Lower Bound																
Upper Bound																
DS-1																
Target Range - Lower Bound																
Upper Bound																
GS310-10																
Target Range - Lower Bound																
Upper Bound																
KZK-1																
KZK-1																
Target Range - Lower Bound																
Upper Bound																
MRGeo08		34.6	<0.02	<10	440	0.85	0.62	1.09	2.26	73.1	19.4	91	10.05	634	3.70	9.76
Target Range - Lower Bound		29.6	<0.02	<10	370	0.67	0.60	1.00	2.01	66.2	17.0	81	9.40	587	3.22	8.73
Upper Bound		36.4	0.04	20	530	0.95	0.76	1.24	2.47	81.0	21.0	102	11.60	675	3.96	10.80
OGGeo08		126.0	0.07	<10	80	0.78	10.75	0.89	19.80	60.0	99.5	81	8.98	8530	5.21	8.41
Target Range - Lower Bound		107.0	0.03	<10	60	0.61	9.44	0.82	16.75	56.7	87.2	75	8.68	7800	4.51	7.69
Upper Bound		131.0	0.11	30	110	0.89	11.55	1.02	20.5	69.3	107.0	93	10.70	8980	5.53	9.51
OREAS 905		32.9	0.39	<10	240	0.91	5.28	0.33	0.35	77.4	12.7	16	1.14	1530	3.46	6.08
Target Range - Lower Bound		28.4	0.33	<10	200	0.78	5.16	0.29	0.30	69.7	12.4	15	1.05	1450	3.14	5.45
Upper Bound		35.0	0.45	20	300	1.08	6.32	0.38	0.38	85.3	15.4	20	1.39	1670	3.86	6.77
OREAS 920		4.9	<0.02	<10	70	0.70	0.63	0.31	0.05	70.2	14.2	41	1.82	114.0	3.60	6.36
Target Range - Lower Bound		3.8	<0.02	<10	50	0.59	0.60	0.28	0.04	64.8	13.4	37	1.84	102.0	3.26	6.12
Upper Bound		4.9	0.04	20	110	0.87	0.76	0.37	0.09	79.2	16.6	48	2.36	118.0	4.00	7.60
SY-4																
SY-4																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-1																



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QC CERTIFICATE OF ANALYSIS VA18044893

Sample Description	Method Analyte Units LOR	ME-MS41 Ge ppm 0.05	ME-MS41 Hf ppm 0.02	ME-MS41 Hg ppm 0.01	ME-MS41 In ppm 0.005	ME-MS41 K % 0.01	ME-MS41 La ppm 0.2	ME-MS41 Li ppm 0.1	ME-MS41 Mg % 0.01	ME-MS41 Mn ppm 5	ME-MS41 Mo ppm 0.05	ME-MS41 Na % 0.01	ME-MS41 Nb ppm 0.05	ME-MS41 Ni ppm 0.2	ME-MS41 P ppm 10	ME-MS41 Pb ppm 0.2
STANDARDS																
Buffer pH6																
Buffer pH6																
Target Range - Lower Bound																
Upper Bound																
CO - ASSAY																
Target Range - Lower Bound																
Upper Bound																
DS-1																
Target Range - Lower Bound																
Upper Bound																
GS310-10																
Target Range - Lower Bound																
Upper Bound																
KZK-1																
KZK-1																
Target Range - Lower Bound																
Upper Bound																
MRGeo08		0.14	0.71	0.06	0.149	1.30	37.0	32.5	1.16	413	14.95	0.36	0.93	714	1020	1075
Target Range - Lower Bound		0.07	0.64	0.04	0.137	1.12	33.2	29.6	1.03	378	13.10	0.30	0.79	622	900	959
Upper Bound		0.29	0.83	0.10	0.179	1.40	41.0	36.4	1.29	473	16.10	0.39	1.09	760	1130	1175
OGGeo08		0.19	0.79	0.47	1.425	1.08	29.4	30.3	0.95	383	874	0.32	0.97	8970	800	7200
Target Range - Lower Bound		0.21	0.72	0.41	1.335	0.94	26.7	28.4	0.84	350	811	0.26	0.97	7760	700	6520
Upper Bound		0.45	0.92	0.57	1.645	1.18	33.1	35.0	1.05	438	991	0.34	1.29	9480	880	7970
OREAS 905		0.09	1.21	0.02	0.577	0.32	39.5	4.1	0.15	338	2.99	0.10	0.29	8.4	240	15.2
Target Range - Lower Bound		<0.05	1.02	<0.01	0.517	0.28	34.7	4.0	0.13	310	2.65	0.07	0.19	7.8		14.4
Upper Bound		0.22	1.29	0.04	0.643	0.36	42.9	5.2	0.19	390	3.35	0.12	0.43	10.0		18.0
OREAS 920		0.08	0.56	0.01	0.030	0.40	35.5	20.3	1.05	495	0.37	0.04	0.30	36.9	690	19.5
Target Range - Lower Bound		<0.05	0.53	<0.01	0.019	0.39	33.3	19.0	0.98	472	0.29	<0.01	0.31	34.4		19.2
Upper Bound		0.22	0.69	0.02	0.043	0.50	41.1	23.4	1.22	588	0.53	0.02	0.55	42.4		23.9
SY-4																
SY-4																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-1																



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Sample Description	Method Analyte Units LOR	ME-MS41 Rb ppm 0.1	ME-MS41 Re ppm 0.001	ME-MS41 S % 0.01	ME-MS41 Sb ppm 0.05	ME-MS41 Sc ppm 0.1	ME-MS41 Se ppm 0.2	ME-MS41 Sn ppm 0.2	ME-MS41 Sr ppm 0.2	ME-MS41 Ta ppm 0.01	ME-MS41 Te ppm 0.01	ME-MS41 Th ppm 0.2	ME-MS41 Ti % 0.005	ME-MS41 Tl ppm 0.02	ME-MS41 U ppm 0.05	ME-MS41 V ppm 1
STANDARDS																
Buffer pH6																
Buffer pH6																
Target Range - Lower Bound																
Upper Bound																
CO-ASSAY																
Target Range - Lower Bound																
Upper Bound																
DS-1																
Target Range - Lower Bound																
Upper Bound																
GS310-10																
Target Range - Lower Bound																
Upper Bound																
KZK-1																
KZK-1																
Target Range - Lower Bound																
Upper Bound																
MRGeo08		146.0	0.010	0.32	3.22	7.2	1.1	3.5	80.6	0.01	0.01	21.1	0.382	0.85	5.18	100
Target Range - Lower Bound		132.0	0.006	0.27	2.80	6.7	0.9	2.8	72.1	<0.01	<0.01	19.1	0.338	0.64	4.93	90
Upper Bound		162.0	0.010	0.35	3.90	8.4	1.9	4.0	88.5	0.03	0.04	23.7	0.424	0.92	6.13	112
OGGeo08		119.5	1.420	2.78	19.25	5.9	10.4	13.2	62.8	0.01	0.14	16.4	0.313	1.46	4.76	79
Target Range - Lower Bound		109.5	1.295	2.51	17.70	5.6	9.7	12.0	59.6	<0.01	0.14	14.8	0.279	1.14	4.45	70
Upper Bound		134.5	1.585	3.09	24.1	7.0	12.3	15.1	73.2	0.03	0.20	18.6	0.353	1.58	5.55	88
OREAS 905		17.1	<0.001	0.07	0.97	1.7	2.3	1.3	11.6	<0.01	0.05	7.7	0.020	0.10	2.08	5
Target Range - Lower Bound		16.3	<0.001	0.04	0.83	1.5	1.8	0.8	10.9	<0.01	0.04	7.4	0.008	0.06	1.92	4
Upper Bound		20.1	0.002	0.09	1.23	2.0	2.8	1.7	13.7	0.02	0.09	9.4	0.030	0.16	2.46	8
OREAS 920		22.9	<0.001	0.07	0.55	2.6	0.2	1.0	16.5	0.01	0.01	15.3	0.120	0.16	2.02	24
Target Range - Lower Bound		22.2	<0.001	<0.01	0.45	2.5	<0.2	0.7	15.0	<0.01	<0.01	13.6	0.106	0.07	1.89	23
Upper Bound		27.4	0.002	0.05	0.77	3.3	0.7	1.7	18.8	0.02	0.04	17.0	0.140	0.18	2.42	30
SY-4																
SY-4																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-1																



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QC CERTIFICATE OF ANALYSIS VA18044893

Sample Description	Method Analyte Units LOR	ME-MS41 W ppm 0.05	ME-MS41 Y ppm 0.05	ME-MS41 Zn ppm 2	ME-MS41 Zr ppm 0.5
STANDARDS					
Buffer pH6					
Buffer pH6					
Target Range - Lower Bound					
Upper Bound					
CO-ASSAY					
Target Range - Lower Bound					
Upper Bound					
DS-1					
Target Range - Lower Bound					
Upper Bound					
GS310-10					
Target Range - Lower Bound					
Upper Bound					
KZK-1					
KZK-1					
Target Range - Lower Bound					
Upper Bound					
MRGeo08		2.93	19.70	775	23.0
Target Range - Lower Bound		2.44	17.50	708	18.1
Upper Bound		3.42	21.5	870	25.7
OGGeo08		3.13	16.80	6950	22.8
Target Range - Lower Bound		2.58	15.35	6500	19.5
Upper Bound		3.60	18.85	7950	27.5
OREAS 905		0.54	6.58	64	46.8
Target Range - Lower Bound		0.41	6.32	56	39.9
Upper Bound		0.73	7.84	72	55.1
OREAS 920		0.44	17.00	102	19.0
Target Range - Lower Bound		0.31	16.85	93	17.6
Upper Bound		0.61	20.7	119	25.0
SY-4					
SY-4					
Target Range - Lower Bound					
Upper Bound					
UTS-1					
Target Range - Lower Bound					
Upper Bound					
UTS-1					



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QC CERTIFICATE OF ANALYSIS VA18044893

Sample Description	Method Analyte Units LOR	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-ELE07	S-IR08	S-CAL06a	C-GAS05	C-GAS05	S-GRA06a	C-IR07	S-GRA06	ME-MS41	ME-MS41
		FIZZ RAT	MPA	NNP	NP	Ratio (N	pH	S	S	C	CO2	S	C	S	Ag	Al
		Unity	tCaCO3/1Kt	tCaCO3/1Kt	tCaCO3/1Kt	Unity	Unity	%	%	%	%	%	%	%	ppm	%
		1	0.3	1	1	0.01	0.1	0.01	0.01	0.05	0.2	0.01	0.01	0.01	0.01	0.01
STANDARDS																
Target Range - Lower Bound												0.81				
Upper Bound												0.95				
UTS-4														1.71		
Target Range - Lower Bound														1.64		
Upper Bound														1.84		
UTS-4												1.76				
Target Range - Lower Bound												1.61				
Upper Bound												1.87				
BLANKS																
BLANK										<0.05	<0.2					
BLANK										<0.05	<0.2					
Target Range - Lower Bound										<0.05	<0.2					
Upper Bound										0.10	0.4					
BLANK															<0.01	<0.01
BLANK															<0.01	<0.01
Target Range - Lower Bound															<0.01	<0.01
Upper Bound															0.02	0.02
BLANK							6.3									
Target Range - Lower Bound							5.5									
Upper Bound							6.9									
BLANK															<0.01	
Target Range - Lower Bound															<0.01	
Upper Bound															0.02	
BLANK												<0.01				
Target Range - Lower Bound												<0.01				
Upper Bound												0.02				
BLANK								<0.01							<0.01	
Target Range - Lower Bound								<0.01							<0.01	
Upper Bound								0.02							0.02	



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Sample Description	Method Analyte Units LOR	ME-MS41 As ppm 0.1	ME-MS41 Au ppm 0.02	ME-MS41 B ppm 10	ME-MS41 Ba ppm 10	ME-MS41 Be ppm 0.05	ME-MS41 Bi ppm 0.01	ME-MS41 Ca % 0.01	ME-MS41 Cd ppm 0.01	ME-MS41 Ce ppm 0.02	ME-MS41 Co ppm 0.1	ME-MS41 Cr ppm 1	ME-MS41 Cs ppm 0.05	ME-MS41 Cu ppm 0.2	ME-MS41 Fe % 0.01	ME-MS41 Ga ppm 0.05
STANDARDS																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																
BLANK																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK		<0.1	<0.02	<10	<10	<0.05	<0.01	<0.01	<0.01	<0.02	<0.1	<1	<0.05	<0.2	<0.01	<0.05
BLANK		<0.1	<0.02	<10	<10	<0.05	<0.01	<0.01	<0.01	<0.02	<0.1	<1	<0.05	<0.2	<0.01	<0.05
Target Range - Lower Bound		<0.1	<0.02	<10	<10	<0.05	<0.01	<0.01	<0.01	<0.02	<0.1	<1	<0.05	<0.2	<0.01	<0.05
Upper Bound		0.2	0.04	20	20	0.10	0.02	0.02	0.02	0.04	0.2	2	0.10	0.4	0.02	0.10
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18044893

Sample Description	Method Analyte Units LOR	ME-MS41 Ge ppm 0.05	ME-MS41 Hf ppm 0.02	ME-MS41 Hg ppm 0.01	ME-MS41 In ppm 0.005	ME-MS41 K % 0.01	ME-MS41 La ppm 0.2	ME-MS41 Li ppm 0.1	ME-MS41 Mg % 0.01	ME-MS41 Mn ppm 5	ME-MS41 Mo ppm 0.05	ME-MS41 Na % 0.01	ME-MS41 Nb ppm 0.05	ME-MS41 Ni ppm 0.2	ME-MS41 P ppm 10	ME-MS41 Pb ppm 0.2
STANDARDS																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																
BLANK																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK		<0.05	<0.02	<0.01	<0.005	<0.01	<0.2	<0.1	<0.01	<5	<0.05	0.01	<0.05	<0.2	<10	<0.2
BLANK		<0.05	<0.02	<0.01	<0.005	<0.01	<0.2	0.1	<0.01	<5	<0.05	0.01	<0.05	<0.2	<10	<0.2
Target Range - Lower Bound		<0.05	<0.02	<0.01	<0.005	<0.01	<0.2	<0.1	<0.01	<5	<0.05	<0.01	<0.05	<0.2	<10	<0.2
Upper Bound		0.10	0.04	0.02	0.010	0.02	0.4	0.2	0.02	10	0.10	0.02	0.10	0.4	20	0.4
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																



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Sample Description	Method Analyte Units LOR	ME-MS41 Rb ppm 0.1	ME-MS41 Re ppm 0.001	ME-MS41 S % 0.01	ME-MS41 Sb ppm 0.05	ME-MS41 Sc ppm 0.1	ME-MS41 Se ppm 0.2	ME-MS41 Sn ppm 0.2	ME-MS41 Sr ppm 0.2	ME-MS41 Ta ppm 0.01	ME-MS41 Te ppm 0.01	ME-MS41 Th ppm 0.2	ME-MS41 Ti % 0.005	ME-MS41 Tl ppm 0.02	ME-MS41 U ppm 0.05	ME-MS41 V ppm 1
STANDARDS																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																
BLANK																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK		<0.1	<0.001	0.01	<0.05	<0.1	<0.2	<0.2	<0.2	<0.01	<0.01	<0.2	<0.005	<0.02	<0.05	<1
BLANK		<0.1	<0.001	<0.01	<0.05	<0.1	<0.2	<0.2	<0.2	<0.01	<0.01	<0.2	<0.005	<0.02	<0.05	<1
Target Range - Lower Bound		<0.1	<0.001	<0.01	<0.05	<0.1	<0.2	<0.2	<0.2	<0.01	<0.01	<0.2	<0.005	<0.02	<0.05	<1
Upper Bound		0.2	0.002	0.02	0.10	0.2	0.4	0.4	0.4	0.02	0.02	0.4	0.010	0.04	0.10	2
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																



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Project: L2059209

QC CERTIFICATE OF ANALYSIS VA18044893

Sample Description	Method Analyte Units LOR	ME-MS41 W ppm 0.05	ME-MS41 Y ppm 0.05	ME-MS41 Zn ppm 2	ME-MS41 Zr ppm 0.5
STANDARDS					
Target Range - Lower Bound					
Upper Bound					
UTS-4					
Target Range - Lower Bound					
Upper Bound					
UTS-4					
Target Range - Lower Bound					
Upper Bound					
BLANKS					
BLANK					
BLANK					
Target Range - Lower Bound					
Upper Bound					
BLANK		<0.05	<0.05	<2	<0.5
BLANK		<0.05	<0.05	<2	<0.5
Target Range - Lower Bound		<0.05	<0.05	<2	<0.5
Upper Bound		0.10	0.10	4	1.0
BLANK					
Target Range - Lower Bound					
Upper Bound					
BLANK					
Target Range - Lower Bound					
Upper Bound					
BLANK					
Target Range - Lower Bound					
Upper Bound					
BLANK					
Target Range - Lower Bound					
Upper Bound					



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Project: L2059209

QC CERTIFICATE OF ANALYSIS VA18044893

Sample Description	Method Analyte Units LOR	OA-VOL08m FIZZ RAT Unity	OA-VOL08m MPA tCaCO3/1Kt	OA-VOL08m NNP tCaCO3/1Kt	OA-VOL08m NP tCaCO3/1Kt	OA-VOL08m Ratio (N) Unity	OA-ELE07 pH Unity	S-IR08 S %	S-CAL06a S %	C-GAS05 C %	C-GAS05 CO2 %	S-GRA06a S %	C-IR07 C %	S-GRA06 S %	ME-MS41 Ag ppm	ME-MS41 Al %
		1	0.3	1	1	0.01	0.1	0.01	0.01	0.05	0.2	0.01	0.01	0.01	0.01	0.01
ORIGINAL DUP Target Range - Lower Bound Upper Bound															3.20 3.21 3.03 3.38	0.70 0.81 0.71 0.80
L2059205-1 153340 DUP Target Range - Lower Bound Upper Bound										0.22 0.24 0.17 0.29	0.8 0.9 0.6 1.1					
L2059205-7 153346 DUP Target Range - Lower Bound Upper Bound														<0.01 <0.01 <0.01 0.02		
L2059205-10 JAN TAL 2018 DUP Target Range - Lower Bound Upper Bound		2 2 <1 3	3.8 4.1 3.5 4.4	17 18 16 19	21 22 19 24	5.60 5.42 5.22 5.80	8.2 8.2 7.7 8.7	0.12 0.13 0.11 0.14	0.05 0.04 0.03 0.06			0.07 0.09 0.07 0.09	0.30 0.31 0.29 0.32			
L2059209-4 149477 DUP Target Range - Lower Bound Upper Bound										0.60 0.61 0.52 0.69	2.2 2.2 1.9 2.5					
ORIGINAL DUP Target Range - Lower Bound Upper Bound															0.72 0.83 0.73 0.82	1.41 1.45 1.35 1.51



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QC CERTIFICATE OF ANALYSIS VA18044893

Sample Description	Method Analyte Units LOR	ME-MS41 As ppm 0.1	ME-MS41 Au ppm 0.02	ME-MS41 B ppm 10	ME-MS41 Ba ppm 10	ME-MS41 Be ppm 0.05	ME-MS41 Bi ppm 0.01	ME-MS41 Ca % 0.01	ME-MS41 Cd ppm 0.01	ME-MS41 Ce ppm 0.02	ME-MS41 Co ppm 0.1	ME-MS41 Cr ppm 1	ME-MS41 Cs ppm 0.05	ME-MS41 Cu ppm 0.2	ME-MS41 Fe % 0.01	ME-MS41 Ga ppm 0.05
DUPLICATES																
ORIGINAL		47.4	<0.02	20	70	0.87	0.10	5.02	17.15	23.8	7.2	21	1.81	176.0	1.62	3.56
DUP		47.2	<0.02	20	80	0.91	0.11	5.34	17.35	24.0	7.3	24	1.90	183.5	1.74	3.73
Target Range - Lower Bound		44.8	<0.02	<10	60	0.80	0.09	4.91	16.40	22.7	6.8	20	1.71	173.5	1.59	3.41
Upper Bound		49.8	0.04	30	90	0.98	0.12	5.45	18.10	25.1	7.7	25	2.00	186.0	1.77	3.88
L2059205-1 153340 DUP Target Range - Lower Bound Upper Bound																
L2059205-7 153346 DUP Target Range - Lower Bound Upper Bound																
L2059205-10 JAN TAL 2018 DUP Target Range - Lower Bound Upper Bound																
L2059209-4 149477 DUP Target Range - Lower Bound Upper Bound																
ORIGINAL		1.3	0.33	<10	100	0.70	0.87	1.74	0.10	37.1	19.4	154	1.37	43.3	3.37	7.33
DUP		1.4	0.30	<10	100	0.75	0.83	1.76	0.12	38.4	20.9	157	1.44	44.6	3.49	7.72
Target Range - Lower Bound		1.2	0.28	<10	80	0.64	0.80	1.65	0.09	35.8	19.0	147	1.28	42.2	3.25	7.10
Upper Bound		1.5	0.35	20	120	0.81	0.90	1.85	0.13	39.7	21.3	164	1.53	45.7	3.61	7.95



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QC CERTIFICATE OF ANALYSIS VA18044893

Sample Description	Method Analyte Units LOR	ME-MS41 Ge ppm 0.05	ME-MS41 Hf ppm 0.02	ME-MS41 Hg ppm 0.01	ME-MS41 In ppm 0.005	ME-MS41 K % 0.01	ME-MS41 La ppm 0.2	ME-MS41 Li ppm 0.1	ME-MS41 Mg % 0.01	ME-MS41 Mn ppm 5	ME-MS41 Mo ppm 0.05	ME-MS41 Na % 0.01	ME-MS41 Nb ppm 0.05	ME-MS41 Ni ppm 0.2	ME-MS41 P ppm 10	ME-MS41 Pb ppm 0.2
DUPLICATES																
ORIGINAL		0.10	0.12	0.76	0.019	0.38	12.3	2.1	2.59	444	56.1	0.03	<0.05	102.0	3030	9.7
DUP		0.10	0.05	0.81	0.019	0.43	12.6	2.3	2.80	474	56.6	0.04	<0.05	106.0	3280	10.0
Target Range - Lower Bound		<0.05	0.06	0.72	0.013	0.37	11.6	2.0	2.55	431	53.5	0.02	<0.05	98.6	2990	9.2
Upper Bound		0.16	0.11	0.85	0.025	0.44	13.3	2.4	2.84	487	59.2	0.05	0.10	109.5	3320	10.5
L2059205-1 153340																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2059205-7 153346																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2059205-10 JAN TAL 2018																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2059209-4 149477																
DUP																
Target Range - Lower Bound																
Upper Bound																
ORIGINAL		0.10	0.68	<0.01	0.021	1.17	18.5	14.3	1.52	460	6.75	0.04	0.08	75.3	510	13.1
DUP		0.11	0.70	<0.01	0.023	1.20	19.3	15.5	1.55	477	6.88	0.04	0.08	80.5	510	14.5
Target Range - Lower Bound		<0.05	0.64	<0.01	0.016	1.12	17.8	14.1	1.45	440	6.42	0.03	<0.05	73.8	470	12.9
Upper Bound		0.16	0.74	0.02	0.028	1.25	20.0	15.7	1.62	497	7.21	0.05	0.10	82.0	550	14.7



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QC CERTIFICATE OF ANALYSIS VA18044893

Sample Description	Method Analyte Units LOR	ME-MS41 Rb ppm 0.1	ME-MS41 Re ppm 0.001	ME-MS41 S % 0.01	ME-MS41 Sb ppm 0.05	ME-MS41 Sc ppm 0.1	ME-MS41 Se ppm 0.2	ME-MS41 Sn ppm 0.2	ME-MS41 Sr ppm 0.2	ME-MS41 Ta ppm 0.01	ME-MS41 Te ppm 0.01	ME-MS41 Th ppm 0.2	ME-MS41 Ti % 0.005	ME-MS41 Tl ppm 0.02	ME-MS41 U ppm 0.05	ME-MS41 V ppm 1
DUPLICATES																
ORIGINAL		16.0	0.049	1.73	15.20	3.5	18.7	0.4	83.1	<0.01	0.12	4.0	0.005	0.39	12.40	356
DUP		16.8	0.050	1.85	14.95	3.6	17.4	0.4	86.2	<0.01	0.14	4.2	0.005	0.35	12.85	398
Target Range - Lower Bound		15.5	0.046	1.69	13.90	3.3	16.9	<0.2	80.2	<0.01	0.11	3.7	<0.005	0.32	11.95	357
Upper Bound		17.3	0.053	1.89	16.25	3.8	19.2	0.6	89.1	0.02	0.15	4.5	0.010	0.42	13.30	397
L2059205-1 153340																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2059205-7 153346																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2059205-10 JAN TAL 2018																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2059209-4 149477																
DUP																
Target Range - Lower Bound																
Upper Bound																
ORIGINAL		49.9	0.001	1.74	0.06	7.3	0.5	0.4	178.0	<0.01	2.76	4.1	0.151	0.35	1.84	63
DUP		52.6	0.002	1.81	0.06	7.8	0.6	0.4	185.5	<0.01	2.74	4.0	0.155	0.38	1.00	64
Target Range - Lower Bound		48.6	<0.001	1.68	<0.05	7.1	0.3	<0.2	172.5	<0.01	2.60	3.6	0.140	0.32	1.30	59
Upper Bound		53.9	0.002	1.87	0.10	8.0	0.8	0.6	191.0	0.02	2.90	4.5	0.166	0.41	1.54	68



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Project: L2059209

QC CERTIFICATE OF ANALYSIS VA18044893

Sample Description	Method Analyte Units LOR	ME-MS41 W ppm 0.05	ME-MS41 Y ppm 0.05	ME-MS41 Zn ppm 2	ME-MS41 Zr ppm 0.5
DUPLICATES					
ORIGINAL		0.26	34.2	1420	6.5
DUP		0.27	34.1	1520	4.0
Target Range - Lower Bound		0.20	32.4	1395	4.4
Upper Bound		0.33	35.9	1545	6.1
L2059205-1 153340					
DUP					
Target Range - Lower Bound					
Upper Bound					
L2059205-7 153346					
DUP					
Target Range - Lower Bound					
Upper Bound					
L2059205-10 JAN TAL 2018					
DUP					
Target Range - Lower Bound					
Upper Bound					
L2059209-4 149477					
DUP					
Target Range - Lower Bound					
Upper Bound					
ORIGINAL		7.02	5.91	72	25.3
DUP		7.96	6.09	74	26.4
Target Range - Lower Bound		6.88	5.65	67	23.4
Upper Bound		8.10	6.35	79	28.3



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QC CERTIFICATE OF ANALYSIS VA18044893

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

C - GAS05	C - IR07	LOG - 22	ME - MS41
OA - ELE07	OA - VOL08m	PUL - 31	S - CAL06a
S - GRA06	S - GRA06a	S - IR08	SPL - 21
WEI - 21			



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OCTOBER 2015 EDITION



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Vancouver BC V6B 0M3

Date Received: 05-MAR-18
Report Date: 04-APR-18 13:17 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2063664
Project P.O. #: PO#229850
Job Reference:
C of C Numbers: 18-8
Legal Site Desc:

Comments: Please note, the ALS Minerals version of the finalized report and QC can be found at the end of the attachment.

Shane Stack
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2063664-1 Waste 14-FEB-18 149483	L2063664-2 Waste 14-FEB-18 149484	L2063664-3 Waste 16-FEB-18 149485	L2063664-4 Waste 16-FEB-18 149486	L2063664-5 Waste 18-FEB-18 149487
Grouping	Analyte					
SOIL						
Physical Tests	pH (Unity)	8.6	8.6	8.8	8.9	8.6
Organic / Inorganic Carbon	Carbon (C) (%)	0.31	0.68	0.22	0.30	0.35
Acid Base Accounting	FIZZ RATING (Unity)	2	2	2	2	2
	MPA (tCaCO3/1Kt)	0.6	4.7	5.9	0.9	1.6
	Neutralization Potential (NP) (tCaCO3/1Kt)	29	45	22	25	31
	NNP (tCaCO3/1Kt)	28	40	16	24	29
	Ratio (NP/MPA) (Unity)	46.40	9.60	3.71	26.67	19.84
	Sulfate Sulfur (carbonate leach) (%)	0.01	<0.01	<0.01	0.01	<0.01
	Sulfate Sulfur (HCl leach) (%)	<0.01	<0.01	<0.01	<0.01	<0.01
	Sulfide Sulfur (T minus HCl leach) (%)	0.02	0.15	0.19	0.03	0.05
	Total Sulfur (combustion) (%)	0.02	0.15	0.19	0.03	0.05
Total Metals	Aluminum (Al) (%)	1.00	0.89	1.26	1.05	1.12
	Antimony (Sb) (ppm)	0.15	0.07	0.09	0.06	<0.05
	Arsenic (As) (ppm)	1.3	1.5	1.4	0.9	0.7
	Barium (Ba) (ppm)	270	150	310	300	190
	Beryllium (Be) (ppm)	0.20	0.23	0.16	0.19	0.19
	Bismuth (Bi) (ppm)	0.08	0.10	0.18	0.10	0.08
	Boron (B) (ppm)	<10	<10	<10	<10	<10
	Cadmium (Cd) (ppm)	0.07	0.15	0.28	0.05	0.08
	Calcium (Ca) (%)	1.13	1.48	0.87	0.81	1.19
	Cerium (Ce) (ppm)	27.0	25.2	18.75	26.8	32.8
	Cesium (Cs) (ppm)	0.49	0.34	0.38	0.47	0.26
	Chromium (Cr) (ppm)	4	4	5	4	5
	Cobalt (Co) (ppm)	4.8	5.0	4.8	4.6	4.8
	Copper (Cu) (ppm)	43.6	1595	2080	266	475
	Gallium (Ga) (ppm)	4.75	4.84	6.09	5.01	6.53
	Germanium (Ge) (ppm)	0.06	<0.05	0.06	0.05	<0.05
	Gold (Au) (ppm)	<0.02	0.02	0.05	<0.02	0.02
	Hafnium (Hf) (ppm)	0.06	0.03	0.03	0.04	0.02
	Indium (In) (ppm)	0.025	0.055	0.060	0.033	0.026
	Iron (Fe) (%)	2.18	2.41	2.61	2.21	2.28
	Lanthanum (La) (ppm)	14.4	13.5	9.8	13.6	17.7
	Lead (Pb) (ppm)	4.1	8.8	15.3	2.7	4.1
	Lithium (Li) (ppm)	2.8	3.0	3.6	3.3	4.4
	Magnesium (Mg) (%)	0.49	0.70	0.62	0.57	0.61
	Manganese (Mn) (ppm)	547	522	448	542	442

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2063664-6 Waste 18-FEB-18 149488	L2063664-7 Waste 18-FEB-18 149489	L2063664-8 Waste 18-FEB-18 149490	L2063664-9 Waste 22-FEB-18 149491	L2063664-10 Waste 23-FEB-18 149492
Grouping	Analyte					
SOIL						
Physical Tests	pH (Unity)	8.6	8.8	8.8	8.8	8.8
Organic / Inorganic Carbon	Carbon (C) (%)	0.27	0.19	0.41	0.70	0.42
Acid Base Accounting	FIZZ RATING (Unity)	2	2	2	2	2
	MPA (tCaCO3/1Kt)	20.0	2.2	0.3	1.9	0.3
	Neutralization Potential (NP) (tCaCO3/1Kt)	25	22	38	47	36
	NNP (tCaCO3/1Kt)	5	20	38	45	36
	Ratio (NP/MPA) (Unity)	1.25	10.06	121.60	25.07	115.20
	Sulfate Sulfur (carbonate leach) (%)	<0.01	<0.01	<0.01	<0.01	<0.01
	Sulfate Sulfur (HCl leach) (%)	<0.01	0.03	<0.01	<0.01	<0.01
	Sulfide Sulfur (T minus HCl leach) (%)	0.64	0.04	0.01	0.06	0.01
	Total Sulfur (combustion) (%)	0.64	0.07	0.01	0.06	0.01
Total Metals	Aluminum (Al) (%)	1.48	1.21	0.80	0.91	0.87
	Antimony (Sb) (ppm)	<0.05	<0.05	<0.05	<0.05	<0.05
	Arsenic (As) (ppm)	0.8	0.6	0.9	0.9	0.8
	Barium (Ba) (ppm)	270	240	160	200	170
	Beryllium (Be) (ppm)	0.21	0.19	0.26	0.26	0.23
	Bismuth (Bi) (ppm)	0.15	0.05	0.02	0.35	0.02
	Boron (B) (ppm)	<10	<10	<10	<10	<10
	Cadmium (Cd) (ppm)	0.20	0.03	0.06	0.09	0.05
	Calcium (Ca) (%)	0.86	0.88	1.41	1.47	1.37
	Cerium (Ce) (ppm)	28.5	23.6	20.6	24.3	18.40
	Cesium (Cs) (ppm)	0.58	0.32	0.45	0.48	0.25
	Chromium (Cr) (ppm)	4	6	4	4	4
	Cobalt (Co) (ppm)	7.4	5.3	4.6	5.1	4.3
	Copper (Cu) (ppm)	1855	607	47.4	967	40.4
	Gallium (Ga) (ppm)	8.01	6.27	4.14	4.41	4.82
	Germanium (Ge) (ppm)	0.06	0.05	<0.05	0.05	<0.05
	Gold (Au) (ppm)	0.04	<0.02	<0.02	0.03	<0.02
	Hafnium (Hf) (ppm)	0.05	0.04	0.05	0.04	0.05
	Indium (In) (ppm)	0.139	0.027	0.024	0.036	0.021
	Iron (Fe) (%)	3.92	2.43	2.04	2.31	1.90
	Lanthanum (La) (ppm)	15.1	12.9	10.5	12.9	9.4
	Lead (Pb) (ppm)	5.2	2.6	3.5	3.9	4.0
	Lithium (Li) (ppm)	4.7	4.5	2.4	3.4	2.7
	Magnesium (Mg) (%)	0.82	0.67	0.37	0.68	0.48
	Manganese (Mn) (ppm)	418	467	545	542	561

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2063664-1 Waste 14-FEB-18 149483	L2063664-2 Waste 14-FEB-18 149484	L2063664-3 Waste 16-FEB-18 149485	L2063664-4 Waste 16-FEB-18 149486	L2063664-5 Waste 18-FEB-18 149487
Grouping	Analyte					
SOIL						
Total Metals	Mercury (Hg) (ppm)	0.01	0.02	0.04	<0.01	0.01
	Molybdenum (Mo) (ppm)	0.47	0.43	0.37	0.52	0.59
	Nickel (Ni) (ppm)	2.2	2.2	2.1	2.0	2.7
	Niobium (Nb) (ppm)	0.14	0.13	0.22	0.17	0.16
	Phosphorus (P) (ppm)	550	600	630	520	520
	Potassium (K) (%)	0.56	0.31	0.67	0.60	0.29
	Rhenium (Re) (ppm)	0.001	0.001	<0.001	0.001	0.001
	Rubidium (Rb) (ppm)	25.5	15.8	31.6	28.6	14.8
	Scandium (Sc) (ppm)	4.0	2.4	3.1	4.9	3.9
	Selenium (Se) (ppm)	<0.2	1.2	1.3	0.2	0.4
	Silver (Ag) (ppm)	0.04	0.34	0.47	0.13	0.15
	Sodium (Na) (%)	0.09	0.08	0.11	0.10	0.07
	Strontium (Sr) (ppm)	73.1	141.5	57.5	70.8	57.2
	Sulfur (S) (%)	0.01	0.15	0.18	0.01	0.05
	Tantalum (Ta) (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01
	Tellurium (Te) (ppm)	0.01	0.04	0.07	0.03	0.03
	Thallium (Tl) (ppm)	0.15	0.13	0.25	0.17	0.10
	Thorium (Th) (ppm)	2.7	3.2	2.6	3.6	4.7
	Tin (Sn) (ppm)	0.5	0.7	0.8	0.6	0.6
	Titanium (Ti) (%)	0.082	0.037	0.113	0.095	0.033
	Tungsten (W) (ppm)	0.31	0.28	0.37	0.32	0.30
	Uranium (U) (ppm)	0.30	0.28	0.14	0.17	0.33
	Vanadium (V) (ppm)	47	42	56	46	42
	Yttrium (Y) (ppm)	8.38	5.24	4.72	7.70	5.14
	Zinc (Zn) (ppm)	79	89	114	65	65
	Zirconium (Zr) (ppm)	0.8	0.7	0.7	0.8	0.5
Permanent Gases	Carbon Dioxide (CO2) (%)	1.2	2.5	0.8	1.1	1.3
Miscellaneous	Carbon (C) (%)	0.38	0.79	0.28	0.37	0.40

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2063664-6 Waste 18-FEB-18 149488	L2063664-7 Waste 18-FEB-18 149489	L2063664-8 Waste 18-FEB-18 149490	L2063664-9 Waste 22-FEB-18 149491	L2063664-10 Waste 23-FEB-18 149492
Grouping	Analyte					
SOIL						
Total Metals	Mercury (Hg) (ppm)	0.01	<0.01	<0.01	0.01	<0.01
	Molybdenum (Mo) (ppm)	3.24	3.23	1.52	0.37	0.66
	Nickel (Ni) (ppm)	2.3	2.8	2.1	2.4	3.1
	Niobium (Nb) (ppm)	0.24	0.23	0.18	0.18	0.17
	Phosphorus (P) (ppm)	760	600	520	560	490
	Potassium (K) (%)	0.68	0.48	0.29	0.46	0.28
	Rhenium (Re) (ppm)	0.008	0.008	<0.001	0.001	<0.001
	Rubidium (Rb) (ppm)	33.4	22.4	14.9	23.0	12.9
	Scandium (Sc) (ppm)	5.2	4.4	3.7	5.0	3.0
	Selenium (Se) (ppm)	1.5	0.6	0.2	0.8	<0.2
	Silver (Ag) (ppm)	0.44	0.09	0.02	0.47	0.02
	Sodium (Na) (%)	0.08	0.09	0.08	0.09	0.08
	Strontium (Sr) (ppm)	51.3	63.9	84.9	143.0	78.6
	Sulfur (S) (%)	0.65	0.06	<0.01	0.06	<0.01
	Tantalum (Ta) (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01
	Tellurium (Te) (ppm)	0.12	0.01	0.01	0.07	0.01
	Thallium (Tl) (ppm)	0.28	0.12	0.08	0.13	0.07
	Thorium (Th) (ppm)	5.1	3.1	2.0	3.1	1.8
	Tin (Sn) (ppm)	1.3	0.6	0.5	0.6	0.5
	Titanium (Ti) (%)	0.097	0.073	0.034	0.062	0.036
	Tungsten (W) (ppm)	0.36	0.49	0.17	0.20	0.38
	Uranium (U) (ppm)	0.45	0.19	0.34	0.30	0.33
	Vanadium (V) (ppm)	65	49	38	44	33
	Yttrium (Y) (ppm)	9.73	5.21	9.22	8.02	8.86
	Zinc (Zn) (ppm)	80	59	58	64	57
	Zirconium (Zr) (ppm)	1.2	0.9	1.0	0.8	0.8
Permanent Gases	Carbon Dioxide (CO2) (%)	1.0	0.7	1.5	2.6	1.5
Miscellaneous	Carbon (C) (%)	0.33	0.26	0.46	0.78	0.48

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ABA-OA-VOL08-AX	Soil	Acid Base Accounting	OA-VOL08
CARBON-C-GAS05-AX	Soil	Carbon, TOC and CO ₂	C-GAS05
CARBON-C-IR07-AX	Soil	Carbon (C) using LECO analyzer	Total Carbon - Method Code C-IR07
Total Carbon & Sulfur - Method Codes C-IR07 & S-IR08			
A 0.1g sample is heated to approximately 1350°C in an induction furnace while passing a stream of oxygen through the sample. Carbon dioxide & sulfur dioxide released from the sample are measured by an IR detection system (Leco analyzer) and the total carbon & sulfur results are provided.			
ME-MS41-AX	Soil	Aqua Regia ICPMS	Aqua Regia ICPMS
A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences.			
PH-OA-ELE07-AX	Soil	pH	OA-ELE07
SULPHUR-S-CAL06A-AX	Soil	Sulfide Sulfur Calc from HCl Leach	ALS Minerals S-CAL06A
Sulfide Sulfur (as S) is calculated by subtracting the HCl Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion.			
SULPHUR-S-GRA06-AX	Soil	Sulfate Sulfur in Soil (Carbonate Leach)	ALS Minerals S-GRA06
A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).			
SULPHUR-S-GRA06A-AX	Soil	Sulfate Sulfur in Soil (HCl Leach)	ALS Minerals S-GRA06A
A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).			
SULPHUR-S-IR08-AX	Soil	Total Sulfur in Soil by Combustion	ALS Minerals S-IR08
The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
AX	ALS MINERALS - VANCOUVER, B.C., CANADA

Chain of Custody Numbers:

18-8

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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Total # Pages: 2 (A - E)
Plus Appendix Pages
Finalized Date: 3-APR-2018
Account: APN

CERTIFICATE VA18052712

Project: L2063664

This report is for 10 Other samples submitted to our lab in Vancouver, BC, Canada on 9-MAR-2018.

The following have access to data associated with this certificate:

CASDG ALSE

ALSEV DATASUBLET

SHANE STACK

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI-21	Received Sample Weight
SPL-21	Split sample - riffle splitter
LOG-22	Sample login - Rcd w/o BarCode
PUL-31	Pulverize split to 85% <75 um

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	
C-GAS05	Inorganic Carbon (CO2)	
C-IR07	Total Carbon (Leco)	LECO
S-GRA06	Sulfate Sulfur - carbonate leach	WST-SEQ
ME-MS41	Ultra Trace Aqua Regia ICP-MS	
OA-VOL08m	Modified NP	
S-IR08	Total Sulphur (Leco)	LECO
OA-ELE07	Paste pH	
S-CAL06a	Sulfide Sulfur (calculated*)	
S-GRA06a	Sulfate Sulfur (HCl leachable)	WST-SEQ

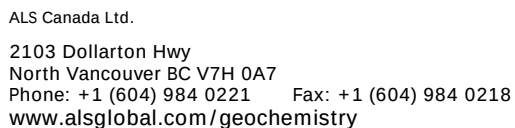
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***** See Appendix Page for comments regarding this certificate *****

Signature:

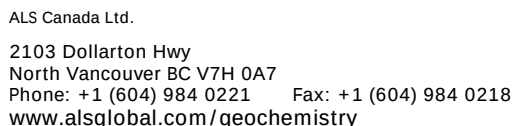
Colin Ramshaw, Vancouver Laboratory Manager



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CERTIFICATE OF ANALYSIS VA18052712

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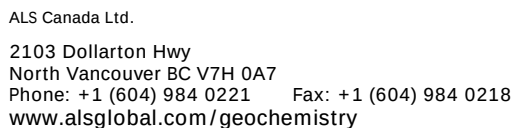
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Project: L2063664

CERTIFICATE OF ANALYSIS VA18052712

Sample Description	Method Analyte Units LOR	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
		Pb	Rb	Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl
		ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm
		0.2	0.1	0.001	0.01	0.05	0.1	0.2	0.2	0.2	0.01	0.01	0.2	0.005	0.02
L2063664-1 149483		4.1	25.5	0.001	0.01	0.15	4.0	<0.2	0.5	73.1	<0.01	0.01	2.7	0.082	0.15
L2063664-2 149484		8.8	15.8	0.001	0.15	0.07	2.4	1.2	0.7	141.5	<0.01	0.04	3.2	0.037	0.13
L2063664-3 149485		15.3	31.6	<0.001	0.18	0.09	3.1	1.3	0.8	57.5	<0.01	0.07	2.6	0.113	0.25
L2063664-4 149486		2.7	28.6	0.001	0.01	0.06	4.9	0.2	0.6	70.8	<0.01	0.03	3.6	0.095	0.17
L2063664-5 149487		4.1	14.8	0.001	0.05	<0.05	3.9	0.4	0.6	57.2	<0.01	0.03	4.7	0.033	0.10
L2063664-6 149488		5.2	33.4	0.008	0.65	<0.05	5.2	1.5	1.3	51.3	<0.01	0.12	5.1	0.097	0.28
L2063664-7 149489		2.6	22.4	0.008	0.06	<0.05	4.4	0.6	0.6	63.9	<0.01	0.01	3.1	0.073	0.12
L2063664-8 149490		3.5	14.9	<0.001	<0.01	<0.05	3.7	0.2	0.5	84.9	<0.01	0.01	2.0	0.034	0.08
L2063664-9 149491		3.9	23.0	0.001	0.06	<0.05	5.0	0.8	0.6	143.0	<0.01	0.07	3.1	0.062	0.13
L2063664-10 149492		4.0	12.9	<0.001	<0.01	<0.05	3.0	<0.2	0.5	78.6	<0.01	0.01	1.8	0.036	0.07



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CERTIFICATE OF ANALYSIS VA18052712

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CERTIFICATE OF ANALYSIS VA18052712

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

C-GAS05	C-IR07	LOG-22	ME-MS41
OA-ELE07	OA-VOL08m	PUL-31	S-CAL06a
S-GRA06	S-GRA06a	S-IR08	SPL-21
WEI-21			



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QC CERTIFICATE VA18052712

Project: L2063664

This report is for 10 Other samples submitted to our lab in Vancouver, BC, Canada on 9-MAR-2018.

The following have access to data associated with this certificate:

CASDG ALSE

ALSEV DATASUBLET

SHANE STACK

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI-21	Received Sample Weight
SPL-21	Split sample - riffle splitter
LOG-22	Sample login - Rcd w/o BarCode
PUL-31	Pulverize split to 85% <75 um

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	
C-GAS05	Inorganic Carbon (CO2)	
C-IR07	Total Carbon (Leco)	LECO
S-GRA06	Sulfate Sulfur - carbonate leach	WST-SEQ
ME-MS41	Ultra Trace Aqua Regia ICP-MS	
OA-VOL08m	Modified NP	
S-IR08	Total Sulphur (Leco)	LECO
OA-ELE07	Paste pH	
S-CAL06a	Sulfide Sulfur (calculated*)	
S-GRA06a	Sulfate Sulfur (HCl leachable)	WST-SEQ

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Signature:

Colin Ramshaw, Vancouver Laboratory Manager



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Project: L2063664

QC CERTIFICATE OF ANALYSIS VA18052712

Sample Description	Method Analyte Units LOR	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-ELE07	S-IR08	C-GAS05	C-GAS05	S-GRA06a	C-IR07	S-GRA06	ME-MS41	ME-MS41	ME-MS41
		FIZZ RAT	MPA	NNP	NP	Ratio (N	pH	S	C	CO2	S	C	S	Ag	Al	As
		Unity	tCaCO3/1Kt	tCaCO3/1Kt	tCaCO3/1Kt	Unity	Unity	%	%	%	%	%	%	ppm	%	ppm
		1	0.3	1	1	0.01	0.1	0.01	0.05	0.2	0.01	0.01	0.01	0.01	0.01	0.1
STANDARDS																
Buffer pH6							6.0									
Buffer pH6							6.0									
Target Range - Lower Bound							5.3									
Upper Bound							6.7									
CO-ASSAY									0.51	1.9						
Target Range - Lower Bound									0.42	1.5						
Upper Bound									0.64	2.4						
GS310-10								0.28				1.03				
Target Range - Lower Bound								0.25				1.03				
Upper Bound								0.29				1.13				
KZK-1		2	25.0	32	57	2.28										
Target Range - Lower Bound		<1	22.9	30	54	2.18										
Upper Bound		>4	27.1	38	64	2.53										
MA-1b								1.19				2.42				
Target Range - Lower Bound								1.12				2.34				
Upper Bound								1.22				2.54				
MA-2c									1.51	5.5						
Target Range - Lower Bound									1.50	5.5						
Upper Bound									1.84	6.8						
OGGeo08														20.8	2.20	122.5
Target Range - Lower Bound														18.15	2.05	107.0
Upper Bound														22.2	2.53	131.0
OREAS 920														0.09	2.29	4.6
Target Range - Lower Bound														0.07	2.18	3.8
Upper Bound														0.12	2.68	4.9
UTS-1													0.89			
Target Range - Lower Bound													0.83			
Upper Bound													0.93			
UTS-1											0.87					
Target Range - Lower Bound											0.81					
Upper Bound											0.95					
UTS-4													1.79			
UTS-4													1.74			
Target Range - Lower Bound													1.64			
Upper Bound													1.84			
UTS-4											1.79					
Target Range - Lower Bound											1.61					
Upper Bound											1.87					



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Account: APN

Project: L2063664

QC CERTIFICATE OF ANALYSIS VA18052712

Sample Description	Method Analyte Units LOR	ME-MS41 Au ppm 0.02	ME-MS41 B ppm 10	ME-MS41 Ba ppm 10	ME-MS41 Be ppm 0.05	ME-MS41 Bi ppm 0.01	ME-MS41 Ca % 0.01	ME-MS41 Cd ppm 0.01	ME-MS41 Ce ppm 0.02	ME-MS41 Co ppm 0.1	ME-MS41 Cr ppm 1	ME-MS41 Cs ppm 0.05	ME-MS41 Cu ppm 0.2	ME-MS41 Fe % 0.01	ME-MS41 Ga ppm 0.05	ME-MS41 Ge ppm 0.05
STANDARDS																
Buffer pH6																
Buffer pH6																
Target Range - Lower Bound																
Upper Bound																
CO-ASSAY																
Target Range - Lower Bound																
Upper Bound																
GS310-10																
Target Range - Lower Bound																
Upper Bound																
KZK-1																
Target Range - Lower Bound																
Upper Bound																
MA-1b																
Target Range - Lower Bound																
Upper Bound																
MA-2c																
Target Range - Lower Bound																
Upper Bound																
OGGeo08		0.07	<10	70	0.62	10.75	0.91	19.85	63.0	96.9	81	9.85	8560	5.09	8.18	0.12
Target Range - Lower Bound		0.03	<10	60	0.61	9.44	0.82	16.75	56.7	87.2	75	8.68	7800	4.51	7.69	0.21
Upper Bound		0.11	30	110	0.89	11.55	1.02	20.5	69.3	107.0	93	10.70	8980	5.53	9.51	0.45
OREAS 920		<0.02	<10	90	0.64	0.60	0.31	0.06	73.8	15.1	41	1.83	112.0	3.50	6.27	0.07
Target Range - Lower Bound		<0.02	<10	50	0.59	0.60	0.28	0.04	64.8	13.4	37	1.84	102.0	3.26	6.12	<0.05
Upper Bound		0.04	20	110	0.87	0.76	0.37	0.09	79.2	16.6	48	2.36	118.0	4.00	7.60	0.22
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
UTS-4																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18052712

Sample Description	Method Analyte Units LOR	ME-MS41 Hf ppm 0.02	ME-MS41 Hg ppm 0.01	ME-MS41 In ppm 0.005	ME-MS41 K % 0.01	ME-MS41 La ppm 0.2	ME-MS41 Li ppm 0.1	ME-MS41 Mg % 0.01	ME-MS41 Mn ppm 5	ME-MS41 Mo ppm 0.05	ME-MS41 Na % 0.01	ME-MS41 Nb ppm 0.05	ME-MS41 Ni ppm 0.2	ME-MS41 P ppm 10	ME-MS41 Pb ppm 0.2	ME-MS41 Rb ppm 0.1
STANDARDS																
Buffer pH6																
Buffer pH6																
Target Range - Lower Bound																
Upper Bound																
CO - ASSAY																
Target Range - Lower Bound																
Upper Bound																
GS310-10																
Target Range - Lower Bound																
Upper Bound																
KZK-1																
Target Range - Lower Bound																
Upper Bound																
MA-1b																
Target Range - Lower Bound																
Upper Bound																
MA-2c																
Target Range - Lower Bound																
Upper Bound																
OGGeo08		0.85	0.47	1.475	1.07	30.6	25.1	0.97	380	894	0.30	0.95	8930	790	7190	120.5
Target Range - Lower Bound		0.72	0.41	1.335	0.94	26.7	28.4	0.84	350	811	0.26	0.97	7760	700	6520	109.5
Upper Bound		0.92	0.57	1.645	1.18	33.1	35.0	1.05	438	991	0.34	1.29	9480	880	7970	134.5
OREAS 920		0.58	0.01	0.030	0.40	37.7	19.7	1.06	495	0.31	0.02	0.38	38.7	700	21.3	22.9
Target Range - Lower Bound		0.53	<0.01	0.019	0.39	33.3	19.0	0.98	472	0.29	<0.01	0.31	34.4		19.2	22.2
Upper Bound		0.69	0.02	0.043	0.50	41.1	23.4	1.22	588	0.53	0.02	0.55	42.4		23.9	27.4
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
UTS-4																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18052712

Sample Description	Method Analyte Units LOR	ME-MS41 Re ppm	ME-MS41 S %	ME-MS41 Sb ppm	ME-MS41 Sc ppm	ME-MS41 Se ppm	ME-MS41 Sn ppm	ME-MS41 Sr ppm	ME-MS41 Ta ppm	ME-MS41 Te ppm	ME-MS41 Th ppm	ME-MS41 Ti %	ME-MS41 Tl ppm	ME-MS41 U ppm	ME-MS41 V ppm	ME-MS41 W ppm
		0.001	0.01	0.05	0.1	0.2	0.2	0.2	0.01	0.01	0.2	0.005	0.02	0.05	1	0.05
STANDARDS																
Buffer pH6																
Buffer pH6																
Target Range - Lower Bound																
Upper Bound																
CO-ASSAY																
Target Range - Lower Bound																
Upper Bound																
GS310-10																
Target Range - Lower Bound																
Upper Bound																
KZK-1																
Target Range - Lower Bound																
Upper Bound																
MA-1b																
Target Range - Lower Bound																
Upper Bound																
MA-2c																
Target Range - Lower Bound																
Upper Bound																
OGGeo08		1.405	2.75	18.60	5.7	10.8	13.0	64.1	0.01	0.15	17.1	0.311	1.35	4.74	80	2.95
Target Range - Lower Bound		1.295	2.51	17.70	5.6	9.7	12.0	59.6	<0.01	0.14	14.8	0.279	1.14	4.45	70	2.58
Upper Bound		1.585	3.09	24.1	7.0	12.3	15.1	73.2	0.03	0.20	18.6	0.353	1.58	5.55	88	3.60
OREAS 920		<0.001	0.03	0.51	2.7	0.2	1.0	16.6	0.01	0.02	16.4	0.113	0.15	2.09	24	0.42
Target Range - Lower Bound		<0.001	<0.01	0.45	2.5	<0.2	0.7	15.0	<0.01	<0.01	13.6	0.106	0.07	1.89	23	0.31
Upper Bound		0.002	0.05	0.77	3.3	0.7	1.7	18.8	0.02	0.04	17.0	0.140	0.18	2.42	30	0.61
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
UTS-4																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18052712

Sample Description	Method Analyte Units LOR	ME-MS41 Y ppm 0.05	ME-MS41 Zn ppm 2	ME-MS41 Zr ppm 0.5
STANDARDS				
Buffer pH6				
Buffer pH6				
Target Range - Lower Bound				
Upper Bound				
CO-ASSAY				
Target Range - Lower Bound				
Upper Bound				
GS310-10				
Target Range - Lower Bound				
Upper Bound				
KZK-1				
Target Range - Lower Bound				
Upper Bound				
MA-1b				
Target Range - Lower Bound				
Upper Bound				
MA-2c				
Target Range - Lower Bound				
Upper Bound				
OGGeo08		16.95	6870	23.4
Target Range - Lower Bound		15.35	6500	19.5
Upper Bound		18.85	7950	27.5
OREAS 920		17.50	101	21.6
Target Range - Lower Bound		16.85	93	17.6
Upper Bound		20.7	119	25.0
UTS-1				
Target Range - Lower Bound				
Upper Bound				
UTS-1				
Target Range - Lower Bound				
Upper Bound				
UTS-4				
UTS-4				
Target Range - Lower Bound				
Upper Bound				
UTS-4				
Target Range - Lower Bound				
Upper Bound				



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Sample Description	Method Analyte Units LOR	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-ELE07	S-IR08	C-GAS05	C-GAS05	S-GRA06a	C-IR07	S-GRA06	ME-MS41	ME-MS41	ME-MS41
		FIZZ RAT	MPA	NNP	NP	Ratio (N	pH	S	C	CO2	S	C	S	Ag	Al	As
		Unity	tCaCO3/1Kt	tCaCO3/1Kt	tCaCO3/1Kt	Unity	Unity	%	%	%	%	%	%	ppm	%	ppm
		1	0.3	1	1	0.01	0.1	0.01	0.05	0.2	0.01	0.01	0.01	0.01	0.01	0.1
BLANKS																
BLANK									<0.05	<0.2						
Target Range - Lower Bound									<0.05	<0.2						
Upper Bound									0.10	0.4						
BLANK														<0.01	<0.01	<0.1
Target Range - Lower Bound														<0.01	<0.01	<0.1
Upper Bound														0.02	0.02	0.2
BLANK							6.2									
Target Range - Lower Bound							5.5									
Upper Bound							6.9									
BLANK													<0.01			
BLANK													<0.01			
Target Range - Lower Bound													<0.01			
Upper Bound													0.02			
BLANK											<0.01					
Target Range - Lower Bound											<0.01					
Upper Bound											0.02					
BLANK								0.01				<0.01				
Target Range - Lower Bound								<0.01				<0.01				
Upper Bound								0.02				0.02				
DUPLICATES																
ORIGINAL								0.02					0.53			
DUP								0.02					0.53			
Target Range - Lower Bound								<0.01					0.51			
Upper Bound								0.03					0.55			
L2063664 -1 149483														0.01		
DUP														0.01		
Target Range - Lower Bound														<0.01		
Upper Bound														0.02		
L2063664 -8 149490									0.41	1.5						
DUP									0.40	1.5						
Target Range - Lower Bound									0.33	1.2						
Upper Bound									0.48	1.8						



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Sample Description	Method Analyte Units LOR	ME-MS41 Au ppm 0.02	ME-MS41 B ppm 10	ME-MS41 Ba ppm 10	ME-MS41 Be ppm 0.05	ME-MS41 Bi ppm 0.01	ME-MS41 Ca % 0.01	ME-MS41 Cd ppm 0.01	ME-MS41 Ce ppm 0.02	ME-MS41 Co ppm 0.1	ME-MS41 Cr ppm 1	ME-MS41 Cs ppm 0.05	ME-MS41 Cu ppm 0.2	ME-MS41 Fe % 0.01	ME-MS41 Ga ppm 0.05	ME-MS41 Ge ppm 0.05
BLANKS																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK		<0.02	<10	10	<0.05	0.01	<0.01	0.01	<0.02	<0.1	<1	<0.05	<0.2	<0.01	<0.05	<0.05
Target Range - Lower Bound		<0.02	<10	<10	<0.05	<0.01	<0.01	<0.01	<0.02	<0.1	<1	<0.05	<0.2	<0.01	<0.05	<0.05
Upper Bound		0.04	20	20	0.10	0.02	0.02	0.02	0.04	0.2	2	0.10	0.4	0.02	0.10	0.10
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
DUPLICATES																
ORIGINAL																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2063664 -1 149483																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2063664 -8 149490																
DUP																
Target Range - Lower Bound																
Upper Bound																



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Sample Description	Method Analyte Units LOR	ME-MS41 Hf ppm 0.02	ME-MS41 Hg ppm 0.01	ME-MS41 In ppm 0.005	ME-MS41 K % 0.01	ME-MS41 La ppm 0.2	ME-MS41 Li ppm 0.1	ME-MS41 Mg % 0.01	ME-MS41 Mn ppm 5	ME-MS41 Mo ppm 0.05	ME-MS41 Na % 0.01	ME-MS41 Nb ppm 0.05	ME-MS41 Ni ppm 0.2	ME-MS41 P ppm 10	ME-MS41 Pb ppm 0.2	ME-MS41 Rb ppm 0.1
BLANKS																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK		<0.02	<0.01	<0.005	<0.01	<0.2	<0.1	<0.01	<5	<0.05	<0.01	0.05	<0.2	<10	<0.2	<0.1
Target Range - Lower Bound		<0.02	<0.01	<0.005	<0.01	<0.2	<0.1	<0.01	<5	<0.05	<0.01	<0.05	<0.2	<10	<0.2	<0.1
Upper Bound		0.04	0.02	0.010	0.02	0.4	0.2	0.02	10	0.10	0.02	0.10	0.4	20	0.4	0.2
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
DUPLICATES																
ORIGINAL																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2063664-1 149483																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2063664-8 149490																
DUP																
Target Range - Lower Bound																
Upper Bound																



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Sample Description	Method Analyte Units LOR	ME-MS41 Re ppm	ME-MS41 S %	ME-MS41 Sb ppm	ME-MS41 Sc ppm	ME-MS41 Se ppm	ME-MS41 Sn ppm	ME-MS41 Sr ppm	ME-MS41 Ta ppm	ME-MS41 Te ppm	ME-MS41 Th ppm	ME-MS41 Ti %	ME-MS41 Tl ppm	ME-MS41 U ppm	ME-MS41 V ppm	ME-MS41 W ppm
		0.001	0.01	0.05	0.1	0.2	0.2	0.2	0.01	0.01	0.2	0.005	0.02	0.05	1	0.05
BLANKS																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK		<0.001	<0.01	<0.05	<0.1	<0.2	<0.2	<0.2	<0.01	<0.01	<0.2	<0.005	<0.02	<0.05	<1	<0.05
Target Range - Lower Bound		<0.001	<0.01	<0.05	<0.1	<0.2	<0.2	<0.2	<0.01	<0.01	<0.2	<0.005	<0.02	<0.05	<1	<0.05
Upper Bound		0.002	0.02	0.10	0.2	0.4	0.4	0.4	0.02	0.02	0.4	0.010	0.04	0.10	2	0.10
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
DUPLICATES																
ORIGINAL																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2063664 -1 149483																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2063664 -8 149490																
DUP																
Target Range - Lower Bound																
Upper Bound																



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Sample Description	Method Analyte Units LOR	ME-MS41 Y ppm 0.05	ME-MS41 Zn ppm 2	ME-MS41 Zr ppm 0.5
BLANKS				
BLANK				
Target Range - Lower Bound				
Upper Bound				
BLANK		<0.05	<2	<0.5
Target Range - Lower Bound		<0.05	<2	<0.5
Upper Bound		0.10	4	1.0
BLANK				
Target Range - Lower Bound				
Upper Bound				
BLANK				
BLANK				
Target Range - Lower Bound				
Upper Bound				
BLANK				
Target Range - Lower Bound				
Upper Bound				
BLANK				
Target Range - Lower Bound				
Upper Bound				
DUPLICATES				
ORIGINAL				
DUP				
Target Range - Lower Bound				
Upper Bound				
L2063664 -1 149483				
DUP				
Target Range - Lower Bound				
Upper Bound				
L2063664 -8 149490				
DUP				
Target Range - Lower Bound				
Upper Bound				



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Sample Description	Method Analyte Units LOR	OA-VOL08m FIZZ RAT Unity	OA-VOL08m MPA tCaCO3/1Kt	OA-VOL08m NNP tCaCO3/1Kt	OA-VOL08m NP tCaCO3/1Kt	OA-VOL08m Ratio (N) Unity	OA-ELE07 pH Unity	S-IR08 S %	C-GAS05 C %	C-GAS05 CO2 %	S-GRA06a S %	C-IR07 C %	S-GRA06 S %	ME-MS41 Ag ppm	ME-MS41 Al %	ME-MS41 As ppm
		1	0.3	1	1	0.01	0.1	0.01	0.05	0.2	0.01	0.01	0.01	0.01	0.01	0.1
L2063664-9 149491 DUP Target Range - Lower Bound Upper Bound														0.47 0.45 0.43 0.49	0.91 0.93 0.86 0.98	0.9 0.9 0.8 1.0
L2063664-10 149492 DUP Target Range - Lower Bound Upper Bound		2 2 <1 3	0.3 0.3 <0.3 0.6	36 36 33 39	36 36 33 39	115.20 115.20 109.43 120.97	8.8 8.9 8.3 9.4				<0.01 <0.01 <0.01 0.02		<0.01 <0.01 <0.01 0.02			



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Sample Description	Method Analyte Units LOR	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
		Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga
		ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm
		0.02	10	10	0.05	0.01	0.01	0.01	0.02	0.1	1	0.05	0.2	0.01	0.05
DUPLICATES															
L2063664-9 149491		0.03	<10	200	0.26	0.35	1.47	0.09	24.3	5.1	4	0.48	967	2.31	4.41
DUP		0.06	<10	210	0.26	0.34	1.50	0.09	23.8	5.1	5	0.50	969	2.33	4.57
Target Range - Lower Bound		<0.02	<10	180	0.20	0.32	1.40	0.08	22.8	4.7	3	0.42	934	2.19	4.22
Upper Bound		0.07	20	230	0.32	0.37	1.57	0.10	25.3	5.5	6	0.56	1000	2.45	4.76
L2063664-10 149492															
DUP															
Target Range - Lower Bound															
Upper Bound															



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Sample Description	Method Analyte Units LOR	ME-MS41 Hf ppm 0.02	ME-MS41 Hg ppm 0.01	ME-MS41 In ppm 0.005	ME-MS41 K % 0.01	ME-MS41 La ppm 0.2	ME-MS41 Li ppm 0.1	ME-MS41 Mg % 0.01	ME-MS41 Mn ppm 5	ME-MS41 Mo ppm 0.05	ME-MS41 Na % 0.01	ME-MS41 Nb ppm 0.05	ME-MS41 Ni ppm 0.2	ME-MS41 P ppm 10	ME-MS41 Pb ppm 0.2	ME-MS41 Rb ppm 0.1
DUPLICATES																
L2063664-9 149491		0.04	0.01	0.036	0.46	12.9	3.4	0.68	542	0.37	0.09	0.18	2.4	560	3.9	23.0
DUP		0.04	0.01	0.038	0.47	12.8	3.5	0.69	550	0.36	0.09	0.20	2.9	570	4.0	23.3
Target Range - Lower Bound		<0.02	<0.01	0.030	0.43	12.0	3.2	0.64	514	0.30	0.08	0.13	2.3	530	3.6	21.9
Upper Bound		0.06	0.02	0.044	0.50	13.7	3.7	0.73	578	0.43	0.10	0.25	3.0	600	4.3	24.4
L2063664-10 149492																
DUP																
Target Range - Lower Bound																
Upper Bound																



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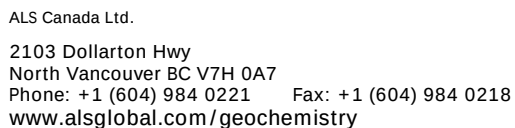
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Project: L2063664

QC CERTIFICATE OF ANALYSIS VA18052712

Sample Description	Method Analyte Units LOR	ME-MS41 Re ppm 0.001	ME-MS41 S % 0.01	ME-MS41 Sb ppm 0.05	ME-MS41 Sc ppm 0.1	ME-MS41 Se ppm 0.2	ME-MS41 Sn ppm 0.2	ME-MS41 Sr ppm 0.2	ME-MS41 Ta ppm 0.01	ME-MS41 Te ppm 0.01	ME-MS41 Th ppm 0.2	ME-MS41 Ti % 0.005	ME-MS41 Tl ppm 0.02	ME-MS41 U ppm 0.05	ME-MS41 V ppm 1	ME-MS41 W ppm 0.05
DUPLICATES																
L2063664-9 149491		0.001	0.06	<0.05	5.0	0.8	0.6	143.0	<0.01	0.07	3.1	0.062	0.13	0.30	44	0.20
DUP		<0.001	0.06	0.05	5.1	0.8	0.6	145.0	<0.01	0.08	3.0	0.064	0.14	0.31	45	0.19
Target Range - Lower Bound		<0.001	0.05	<0.05	4.7	0.6	0.4	136.5	<0.01	0.06	2.7	0.055	0.10	0.24	41	0.13
Upper Bound		0.002	0.07	0.10	5.4	1.0	0.8	151.5	0.02	0.09	3.4	0.071	0.17	0.37	48	0.26
L2063664-10 149492																
DUP																
Target Range - Lower Bound																
Upper Bound																



Page: 4 - E
Total # Pages: 4 (A - E)
Plus Appendix Pages
Finalized Date: 3-APR-2018
Account: APN

QC CERTIFICATE OF ANALYSIS VA18052712

***** See Appendix Page for comments regarding this certificate *****



ALS Canada Ltd.
2103 Dollarton Hwy
North Vancouver BC V7H 0A7
Phone: +1 (604) 984 0221 Fax: +1 (604) 984 0218
www.alsglobal.com/geochemistry

To: **ALS ENVIRONMENTAL**
100 - 8081 LOUGHEED HWY.
BURNABY BC V5A 1W9

Page: Appendix 1
Total # Appendix Pages: 1
Finalized Date: 3-APR-2018
Account: APN

Project: L2063664

QC CERTIFICATE OF ANALYSIS VA18052712

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

C-GAS05	C-IR07	LOG-22	ME-MS41
OA-ELE07	OA-VOL08m	PUL-31	S-CAL06a
S-GRA06	S-GRA06a	S-IR08	SPL-21
WEI-21			



L2063664-COFC

COC Number: 15-

Page 1 of 1

18-8

Report To Contact and company name below will appear on the final report		Report Format / Distribution		Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply																																			
Company: Minto Explorations Ltd.		Select Report Format: ☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)		Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply																																			
Contact: Minto Environment - Coordinator		Quality Control (QC) Report with Report ☒ YES ☐ NO		<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td rowspan="3" style="width:5%; text-align: center; vertical-align: middle;">PRIORITY (Business Days)</td> <td style="width:20%;">4 day [P4]</td> <td style="width:5%; text-align: center;">☐</td> <td rowspan="3" style="width:5%; text-align: center; vertical-align: middle;">EMERGENCY</td> <td colspan="6" style="width:60%;">1 Business day [E1] ☐</td> </tr> <tr> <td>3 day [P3]</td> <td style="text-align: center;">☐</td> <td colspan="6">Same Day, Weekend or Statutory holiday [E0] ☐</td> </tr> <tr> <td>2 day [P2]</td> <td style="text-align: center;">☐</td> <td colspan="6"></td> </tr> </table>										PRIORITY (Business Days)	4 day [P4]	☐	EMERGENCY	1 Business day [E1] ☐						3 day [P3]	☐	Same Day, Weekend or Statutory holiday [E0] ☐						2 day [P2]	☐						
PRIORITY (Business Days)	4 day [P4]	☐	EMERGENCY	1 Business day [E1] ☐																																			
	3 day [P3]	☐		Same Day, Weekend or Statutory holiday [E0] ☐																																			
	2 day [P2]	☐																																					
Phone: 1-804-759-4659		☒ Compare Results to Criteria on Report - provide details below if box checked																																					
Company address below will appear on the final report		Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX																																					
Street: 2100-510 West Georgia St.		Email 1 or Fax minto_environment@mintomine.com																																					
City/Province: Vancouver, British Columbia		Email 2																																					
Postal Code: V6B 0M3		Email 3																																					
Invoice To: Same as Report To ☐ YES ☒ NO		Invoice Distribution		Analysis Request																																			
Copy of Invoice with Report ☐ YES ☒ NO		Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (FP) below																																			
Company: Minto Explorations Ltd.		Email 1 or Fax ap@mintomine.com																																					
Contact: Ruth Cayetano		Email 2																																					
Project Information		Oil and Gas Required Fields (client use)																																					
ALS Account # / Quote #:		AFE/Cost Center:		PO#								Number of Containers																											
Job #:		Major/Minor Code:		Routing Code:																																			
PO / AFE: TBD		Requisitioner:																																					
LSD:		Location:																																					
ALS Lab Work Order # (lab use only)		ALS Contact:		Sampler:																																			
ALS Sample # (lab use only)		Sample Identification and/or Coordinates (This description will appear on the report)		Date (dd-mm-yy)		Time (hh:mm)		Sample Type																															
		149483		14-FEB-18				Composite																															
		149484		14-FEB-18				WASTE																															
		149485		16-FEB-18				WASTE																															
		149486		16-FEB-18				WASTE																															
		149487		18-FEB-18				WASTE																															
		149488		18-FEB-18				WASTE																															
		149489		18-FEB-18				WASTE																															
		149490		18-FEB-18				WASTE																															
		149491		22-FEB-18				WASTE																															
		149492		23-FEB-18				WASTE																															
Drinking Water (DW) Samples¹ (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)		SAMPLE CONDITION AS RECEIVED (lab use only)																																			
Are samples taken from a Regulated DW System? ☐ YES ☒ NO				Frozen ☐ SIF Observations Yes ☐ No ☐																																			
Are samples for human drinking water use? ☐ YES ☒ NO				Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐																																			
				Cooling Initiated ☐																																			
				INITIAL COOLER TEMPERATURES °C: 10°C																																			
				FINAL COOLER TEMPERATURES °C:																																			
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)		FINAL SHIPMENT RECEPTION (lab use only)																																			
Released by: JDEY		Date: Mar. 02/18		Received by: (Signature)		Date: March 5/18		Time: 15:30		Received by:		Date:		Time:																									

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 16-MAR-18
Report Date: 11-APR-18 17:44 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2069235

Project P.O. #: 229850

Job Reference:

C of C Numbers: 18-09

Legal Site Desc:

Comments: Please note, the ALS Minerals version of the finalized report and QC can be found at the end of the attachment.

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2069235-1 Waste 23-FEB-18 08:20 149493	L2069235-2 Waste 26-FEB-18 08:20 149499	L2069235-3 Waste 25-FEB-18 08:20 149497	L2069235-4 Waste 26-FEB-18 08:20 149498	L2069235-5 Waste 25-FEB-18 08:20 149496
Grouping	Analyte					
SOIL						
Physical Tests	pH (Unity)	8.9	8.8	9.0	8.5	9.0
Organic / Inorganic Carbon	Carbon (C) (%)	0.20	0.31	0.20	0.55	0.21
Acid Base Accounting	FIZZ RATING (Unity)	2	2	2	2	2
	MPA (tCaCO3/1Kt)	0.3	2.2	0.6	37.2	0.3
	Neutralization Potential (NP) (tCaCO3/1Kt)	20	27	22	38	22
	NNP (tCaCO3/1Kt)	20	25	21	1	22
	Ratio (NP/MPA) (Unity)	64.00	12.34	35.20	1.02	70.40
	Sulfate Sulfur (carbonate leach) (%)	0.02	<0.01	<0.01	<0.01	<0.01
	Sulfate Sulfur (HCl leach) (%)	<0.01	<0.01	<0.01	0.03	<0.01
	Sulfide Sulfur (T minus HCl leach) (%)	0.01	0.07	0.02	1.16	0.01
	Total Sulfur (combustion) (%)	0.01	0.07	0.02	1.19	0.01
Total Metals	Aluminum (Al) (%)	1.17	1.23	1.18	0.94	1.21
	Antimony (Sb) (ppm)	<0.05	<0.05	<0.05	<0.05	<0.05
	Arsenic (As) (ppm)	0.6	0.7	0.7	1.0	0.9
	Barium (Ba) (ppm)	270	260	190	180	120
	Beryllium (Be) (ppm)	0.24	0.25	0.33	0.26	0.33
	Bismuth (Bi) (ppm)	0.01	0.11	0.01	3.05	0.01
	Boron (B) (ppm)	<10	<10	<10	<10	<10
	Cadmium (Cd) (ppm)	0.05	0.12	0.03	0.69	0.03
	Calcium (Ca) (%)	0.80	1.05	0.92	1.42	0.99
	Cerium (Ce) (ppm)	25.9	39.4	29.9	6.89	28.0
	Cesium (Cs) (ppm)	0.44	0.45	0.36	0.23	0.27
	Chromium (Cr) (ppm)	4	4	5	2	4
	Cobalt (Co) (ppm)	5.7	5.6	5.2	7.8	5.0
	Copper (Cu) (ppm)	55.3	731	45.2	>10000	24.1
	Gallium (Ga) (ppm)	5.80	6.54	5.58	11.15	5.91
	Germanium (Ge) (ppm)	0.08	0.08	0.08	0.08	0.05
	Gold (Au) (ppm)	<0.02	0.02	<0.02	0.47	<0.02
	Hafnium (Hf) (ppm)	0.05	0.03	0.05	0.05	0.03
	Indium (In) (ppm)	0.030	0.031	0.023	0.253	0.012
	Iron (Fe) (%)	2.43	2.58	2.14	7.13	2.05
	Lanthanum (La) (ppm)	13.6	21.5	16.2	3.7	15.0
	Lead (Pb) (ppm)	1.4	2.3	2.3	6.5	3.2
	Lithium (Li) (ppm)	5.5	6.7	6.8	6.8	7.7
	Magnesium (Mg) (%)	0.63	0.68	0.72	0.53	0.69
	Manganese (Mn) (ppm)	663	500	537	1150	495

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2069235-6 Waste 24-FEB-18 08:20 149494	L2069235-7 Waste 24-FEB-18 08:20 149495	L2069235-8 Waste 27-FEB-18 149500	L2069235-9 Waste 27-FEB-18 156251	
Grouping	Analyte					
SOIL						
Physical Tests	pH (Unity)	8.6	8.9	9.0	9.0	
Organic / Inorganic Carbon	Carbon (C) (%)	1.03	0.38	0.81	0.88	
Acid Base Accounting	FIZZ RATING (Unity)	2	2	2	2	
	MPA (tCaCO3/1Kt)	19.7	7.8	28.8	21.9	
	Neutralization Potential (NP) (tCaCO3/1Kt)	60	29	48	39	
	NNP (tCaCO3/1Kt)	40	21	19	17	
	Ratio (NP/MPA) (Unity)	3.05	3.71	1.67	1.78	
	Sulfate Sulfur (carbonate leach) (%)	<0.01	<0.01	<0.01	<0.01	
	Sulfate Sulfur (HCl leach) (%)	<0.01	<0.01	<0.01	<0.01	
	Sulfide Sulfur (T minus HCl leach) (%)	0.63	0.25	0.92	0.70	
	Total Sulfur (combustion) (%)	0.63	0.25	0.92	0.70	
Total Metals	Aluminum (Al) (%)	0.80	1.34	1.12	0.82	
	Antimony (Sb) (ppm)	<0.05	<0.05	<0.05	<0.05	
	Arsenic (As) (ppm)	1.6	0.6	1.3	0.6	
	Barium (Ba) (ppm)	280	210	270	110	
	Beryllium (Be) (ppm)	0.35	0.26	0.25	0.30	
	Bismuth (Bi) (ppm)	0.16	0.02	0.02	0.02	
	Boron (B) (ppm)	<10	<10	<10	<10	
	Cadmium (Cd) (ppm)	0.17	0.03	0.18	0.09	
	Calcium (Ca) (%)	1.78	1.10	1.52	1.29	
	Cerium (Ce) (ppm)	24.1	29.1	24.0	30.7	
	Cesium (Cs) (ppm)	0.36	0.46	0.74	0.72	
	Chromium (Cr) (ppm)	3	3	3	2	
	Cobalt (Co) (ppm)	8.5	8.1	16.2	12.1	
	Copper (Cu) (ppm)	3220	195.5	907	490	
	Gallium (Ga) (ppm)	4.35	6.15	5.82	4.89	
	Germanium (Ge) (ppm)	0.07	0.08	0.09	0.07	
	Gold (Au) (ppm)	0.07	<0.02	<0.02	<0.02	
	Hafnium (Hf) (ppm)	0.06	0.09	0.06	0.07	
	Indium (In) (ppm)	0.165	0.057	0.095	0.133	
	Iron (Fe) (%)	3.71	3.02	3.80	3.64	
	Lanthanum (La) (ppm)	12.7	15.4	12.3	16.3	
	Lead (Pb) (ppm)	5.8	2.7	3.3	4.3	
	Lithium (Li) (ppm)	3.0	5.9	3.8	2.8	
	Magnesium (Mg) (%)	0.81	0.81	0.94	0.71	
	Manganese (Mn) (ppm)	560	563	588	834	

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2069235-1 Waste 23-FEB-18 08:20 149493	L2069235-2 Waste 26-FEB-18 08:20 149499	L2069235-3 Waste 25-FEB-18 08:20 149497	L2069235-4 Waste 26-FEB-18 08:20 149498	L2069235-5 Waste 25-FEB-18 08:20 149496
Grouping	Analyte					
SOIL						
Total Metals	Mercury (Hg) (ppm)	<0.01	0.01	<0.01	0.03	<0.01
	Molybdenum (Mo) (ppm)	0.47	0.57	0.47	0.58	0.30
	Nickel (Ni) (ppm)	4.4	3.0	2.6	1.9	2.5
	Niobium (Nb) (ppm)	0.13	0.19	0.15	<0.05	0.07
	Phosphorus (P) (ppm)	670	540	700	320	560
	Potassium (K) (%)	0.77	0.66	0.45	0.12	0.25
	Rhenium (Re) (ppm)	<0.001	0.001	0.001	0.001	0.001
	Rubidium (Rb) (ppm)	39.1	33.2	20.8	6.1	12.3
	Scandium (Sc) (ppm)	4.8	4.1	5.5	3.1	2.7
	Selenium (Se) (ppm)	<0.2	0.7	<0.2	13.0	<0.2
	Silver (Ag) (ppm)	0.01	0.26	0.02	5.54	0.02
	Sodium (Na) (%)	0.06	0.05	0.07	0.02	0.06
	Strontium (Sr) (ppm)	51.2	48.8	94.2	46.6	83.7
	Sulfur (S) (%)	0.01	0.06	0.02	1.11	0.01
	Tantalum (Ta) (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01
	Tellurium (Te) (ppm)	0.01	0.06	0.01	0.84	0.01
	Thallium (Tl) (ppm)	0.21	0.20	0.13	0.06	0.07
	Thorium (Th) (ppm)	2.9	5.8	3.9	2.2	3.2
	Tin (Sn) (ppm)	0.6	0.7	0.6	0.7	0.4
	Titanium (Ti) (%)	0.124	0.108	0.077	0.015	0.042
	Tungsten (W) (ppm)	0.70	0.68	1.02	0.72	0.40
	Uranium (U) (ppm)	0.27	0.35	0.46	0.25	0.23
	Vanadium (V) (ppm)	53	57	42	62	38
	Yttrium (Y) (ppm)	11.65	5.79	7.38	2.39	4.46
	Zinc (Zn) (ppm)	78	70	57	115	63
	Zirconium (Zr) (ppm)	0.7	0.8	0.9	1.4	0.5
Permanent Gases	Carbon Dioxide (CO2) (%)	0.8	1.1	0.7	2.0	0.8
Miscellaneous	Carbon (C) (%)	0.25	0.38	0.32	0.58	0.31

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2069235-6 Waste 24-FEB-18 08:20 149494	L2069235-7 Waste 24-FEB-18 08:20 149495	L2069235-8 Waste 27-FEB-18 149500	L2069235-9 Waste 27-FEB-18 156251	
Grouping	Analyte					
SOIL						
Total Metals	Mercury (Hg) (ppm)	0.01	<0.01	0.01	<0.01	
	Molybdenum (Mo) (ppm)	10.15	0.56	5.29	10.10	
	Nickel (Ni) (ppm)	2.5	2.2	2.7	2.2	
	Niobium (Nb) (ppm)	0.18	0.12	0.29	0.30	
	Phosphorus (P) (ppm)	870	860	910	820	
	Potassium (K) (%)	0.38	0.51	0.81	0.57	
	Rhenium (Re) (ppm)	0.018	0.002	0.014	0.023	
	Rubidium (Rb) (ppm)	19.0	24.5	42.8	35.7	
	Scandium (Sc) (ppm)	5.4	5.6	6.3	6.4	
	Selenium (Se) (ppm)	2.6	0.3	1.2	0.9	
	Silver (Ag) (ppm)	0.68	0.05	0.17	0.11	
	Sodium (Na) (%)	0.03	0.08	0.06	0.05	
	Strontium (Sr) (ppm)	149.5	87.2	105.0	56.2	
	Sulfur (S) (%)	0.64	0.25	0.93	0.67	
	Tantalum (Ta) (ppm)	<0.01	<0.01	<0.01	<0.01	
	Tellurium (Te) (ppm)	0.20	0.03	0.09	0.07	
	Thallium (Tl) (ppm)	0.12	0.21	0.36	0.44	
	Thorium (Th) (ppm)	2.9	4.1	3.3	6.3	
	Tin (Sn) (ppm)	0.8	1.3	2.2	1.7	
	Titanium (Ti) (%)	0.054	0.080	0.135	0.086	
	Tungsten (W) (ppm)	0.38	0.10	0.65	0.22	
	Uranium (U) (ppm)	0.30	0.39	0.38	0.86	
	Vanadium (V) (ppm)	60	58	75	66	
	Yttrium (Y) (ppm)	7.78	9.09	9.80	10.65	
	Zinc (Zn) (ppm)	79	63	69	67	
	Zirconium (Zr) (ppm)	1.7	2.4	1.7	1.9	
Permanent Gases	Carbon Dioxide (CO2) (%)	3.8	1.4	3.0	3.2	
Miscellaneous	Carbon (C) (%)	1.19	0.43	0.86	0.95	

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ABA-OA-VOL08-AX	Soil	Acid Base Accounting	OA-VOL08
CARBON-C-GAS05-AX	Soil	Carbon, TOC and CO ₂	C-GAS05
CARBON-C-IR07-AX	Soil	Carbon (C) using LECO analyzer	Total Carbon - Method Code C-IR07
Total Carbon & Sulfur - Method Codes C-IR07 & S-IR08			
A 0.1g sample is heated to approximately 1350°C in an induction furnace while passing a stream of oxygen through the sample. Carbon dioxide & sulfur dioxide released from the sample are measured by an IR detection system (Leco analyzer) and the total carbon & sulfur results are provided.			
ME-MS41-AX	Soil	Aqua Regia ICPMS	Aqua Regia ICPMS
A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences.			
PH-OA-ELE07-AX	Soil	pH	OA-ELE07
SULPHUR-S-CAL06A-AX	Soil	Sulfide Sulfur Calc from HCl Leach	ALS Minerals S-CAL06A
Sulfide Sulfur (as S) is calculated by subtracting the HCl Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion.			
SULPHUR-S-GRA06-AX	Soil	Sulfate Sulfur in Soil (Carbonate Leach)	ALS Minerals S-GRA06
A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).			
SULPHUR-S-GRA06A-AX	Soil	Sulfate Sulfur in Soil (HCl Leach)	ALS Minerals S-GRA06A
A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).			
SULPHUR-S-IR08-AX	Soil	Total Sulfur in Soil by Combustion	ALS Minerals S-IR08
The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
AX	ALS MINERALS - VANCOUVER, B.C., CANADA

Chain of Custody Numbers:

18-09

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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100 - 8081 LOUGHEED HWY.
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Total # Pages: 2 (A - E)
Plus Appendix Pages
Finalized Date: 10-APR-2018
Account: APN

CERTIFICATE VA18062593

Project: L2069235

This report is for 9 Other samples submitted to our lab in Vancouver, BC, Canada on 21-MAR-2018.

The following have access to data associated with this certificate:

CASDG ALSE

ALSEV DATASUBLET

SHANE STACK

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI-21	Received Sample Weight
SPL-21	Split sample - riffle splitter
PUL-QC	Pulverizing QC Test
LOG-22	Sample login - Rcd w/o BarCode
PUL-31	Pulverize split to 85% <75 um

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	
C-GAS05	Inorganic Carbon (CO2)	
C-IR07	Total Carbon (Leco)	LECO
S-GRA06	Sulfate Sulfur - carbonate leach	WST-SEQ
ME-MS41	Ultra Trace Aqua Regia ICP-MS	
ME-OG46	Ore Grade Elements - AquaRegia	ICP-AES
Cu-OG46	Ore Grade Cu - Aqua Regia	ICP-AES
OA-VOL08m	Modified NP	
S-IR08	Total Sulphur (Leco)	LECO
OA-ELE07	Paste pH	
S-CAL06a	Sulfide Sulfur (calculated*)	
S-GRA06a	Sulfate Sulfur (HCl leachable)	WST-SEQ

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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature:

Colin Ramshaw, Vancouver Laboratory Manager



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Project: L2069235

CERTIFICATE OF ANALYSIS VA18062593

Sample Description	Method Analyte Units LOR	WEI-21	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-ELE07	S-IR08	S-CAL06a	C-GAS05	C-GAS05	S-GRA06a	C-IR07	S-GRA06	ME-MS41
		Recvd Wt.	FIZZ RAT	MPA	NNP	NP	Ratio (N	pH	S	S	C	CO2	S	C	S	Ag
		kg	Unity	tCaCO3/1Kt	tCaCO3/1Kt	tCaCO3/1Kt	Unity	Unity	%	%	%	%	%	%	%	ppm
		0.02	1	0.3	1	1	0.01	0.1	0.01	0.01	0.05	0.2	0.01	0.01	0.01	0.01
L2069235-1 149493		1.10	2	0.3	20	20	64.00	8.9	0.01	0.01	0.20	0.8	<0.01	0.25	0.02	0.01
L2069235-2 149499		1.04	2	2.2	25	27	12.34	8.8	0.07	0.07	0.31	1.1	<0.01	0.38	<0.01	0.26
L2069235-3 149497		1.08	2	0.6	21	22	35.20	9.0	0.02	0.02	0.20	0.7	<0.01	0.32	<0.01	0.02
L2069235-4 149498		1.10	2	37.2	1	38	1.02	8.5	1.19	1.16	0.55	2.0	0.03	0.58	<0.01	5.54
L2069235-5 149496		1.10	2	0.3	22	22	70.40	9.0	0.01	0.01	0.21	0.8	<0.01	0.31	<0.01	0.02
L2069235-6 149494		1.12	2	19.7	40	60	3.05	8.6	0.63	0.63	1.03	3.8	<0.01	1.19	<0.01	0.68
L2069235-7 149495		1.10	2	7.8	21	29	3.71	8.9	0.25	0.25	0.38	1.4	<0.01	0.43	<0.01	0.05
L2069235-8 149500		1.04	2	28.8	19	48	1.67	9.0	0.92	0.92	0.81	3.0	<0.01	0.86	<0.01	0.17
L2069235-9 156251		1.08	2	21.9	17	39	1.78	9.0	0.70	0.70	0.88	3.2	<0.01	0.95	<0.01	0.11



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CERTIFICATE OF ANALYSIS VA18062593

Sample Description	Method Analyte Units LOR	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
		Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu
		%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm
		0.01	0.1	0.02	10	10	0.05	0.01	0.01	0.01	0.02	0.1	1	0.05	0.2
L2069235-1 149493		1.17	0.6	<0.02	<10	270	0.24	0.01	0.80	0.05	25.9	5.7	4	0.44	55.3
L2069235-2 149499		1.23	0.7	0.02	<10	260	0.25	0.11	1.05	0.12	39.4	5.6	4	0.45	731
L2069235-3 149497		1.18	0.7	<0.02	<10	190	0.33	0.01	0.92	0.03	29.9	5.2	5	0.36	45.2
L2069235-4 149498		0.94	1.0	0.47	<10	180	0.26	3.05	1.42	0.69	6.89	7.8	2	0.23	>10000
L2069235-5 149496		1.21	0.9	<0.02	<10	120	0.33	0.01	0.99	0.03	28.0	5.0	4	0.27	24.1
L2069235-6 149494		0.80	1.6	0.07	<10	280	0.35	0.16	1.78	0.17	24.1	8.5	3	0.36	3220
L2069235-7 149495		1.34	0.6	<0.02	<10	210	0.26	0.02	1.10	0.03	29.1	8.1	3	0.46	195.5
L2069235-8 149500		1.12	1.3	<0.02	<10	270	0.25	0.02	1.52	0.18	24.0	16.2	3	0.74	907
L2069235-9 156251		0.82	0.6	<0.02	<10	110	0.30	0.02	1.29	0.09	30.7	12.1	2	0.72	490



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CERTIFICATE OF ANALYSIS VA18062593

Sample Description	Method Analyte Units LOR	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
		Ga	Ge	Hf	Hg	In	K	La	Li	Mg	Mn	Mo	Na	Nb	Ni
		ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	ppm	%	ppm	ppm
		0.05	0.05	0.02	0.01	0.005	0.01	0.2	0.1	0.01	5	0.05	0.01	0.05	0.2
L2069235-1 149493		5.80	0.08	0.05	<0.01	0.030	0.77	13.6	5.5	0.63	663	0.47	0.06	0.13	4.4
L2069235-2 149499		6.54	0.08	0.03	0.01	0.031	0.66	21.5	6.7	0.68	500	0.57	0.05	0.19	3.0
L2069235-3 149497		5.58	0.08	0.05	<0.01	0.023	0.45	16.2	6.8	0.72	537	0.47	0.07	0.15	2.6
L2069235-4 149498		11.15	0.08	0.05	0.03	0.253	0.12	3.7	6.8	0.53	1150	0.58	0.02	<0.05	1.9
L2069235-5 149496		5.91	0.05	0.03	<0.01	0.012	0.25	15.0	7.7	0.69	495	0.30	0.06	0.07	2.5
L2069235-6 149494		4.35	0.07	0.06	0.01	0.165	0.38	12.7	3.0	0.81	560	10.15	0.03	0.18	2.5
L2069235-7 149495		6.15	0.08	0.09	<0.01	0.057	0.51	15.4	5.9	0.81	563	0.56	0.08	0.12	2.2
L2069235-8 149500		5.82	0.09	0.06	0.01	0.095	0.81	12.3	3.8	0.94	588	5.29	0.06	0.29	2.7
L2069235-9 156251		4.89	0.07	0.07	<0.01	0.133	0.57	16.3	2.8	0.71	834	10.10	0.05	0.30	2.2



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Project: L2069235

CERTIFICATE OF ANALYSIS VA18062593

Sample Description	Method Analyte Units LOR	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
		Pb	Rb	Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl
		ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm
		0.2	0.1	0.001	0.01	0.05	0.1	0.2	0.2	0.2	0.01	0.01	0.2	0.005	0.02
L2069235-1 149493		1.4	39.1	<0.001	0.01	<0.05	4.8	<0.2	0.6	51.2	<0.01	0.01	2.9	0.124	0.21
L2069235-2 149499		2.3	33.2	0.001	0.06	<0.05	4.1	0.7	0.7	48.8	<0.01	0.06	5.8	0.108	0.20
L2069235-3 149497		2.3	20.8	0.001	0.02	<0.05	5.5	<0.2	0.6	94.2	<0.01	0.01	3.9	0.077	0.13
L2069235-4 149498		6.5	6.1	0.001	1.11	<0.05	3.1	13.0	0.7	46.6	<0.01	0.84	2.2	0.015	0.06
L2069235-5 149496		3.2	12.3	0.001	0.01	<0.05	2.7	<0.2	0.4	83.7	<0.01	0.01	3.2	0.042	0.07
L2069235-6 149494		5.8	19.0	0.018	0.64	<0.05	5.4	2.6	0.8	149.5	<0.01	0.20	2.9	0.054	0.12
L2069235-7 149495		2.7	24.5	0.002	0.25	<0.05	5.6	0.3	1.3	87.2	<0.01	0.03	4.1	0.080	0.21
L2069235-8 149500		3.3	42.8	0.014	0.93	<0.05	6.3	1.2	2.2	105.0	<0.01	0.09	3.3	0.135	0.36
L2069235-9 156251		4.3	35.7	0.023	0.67	<0.05	6.4	0.9	1.7	56.2	<0.01	0.07	6.3	0.086	0.44



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Project: L2069235

CERTIFICATE OF ANALYSIS VA18062593

Sample Description	Method Analyte Units LOR	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	Cu-OG46
		V	W	Y	Zn	Zr	Cu
		ppm 1	ppm 0.05	ppm 0.05	ppm 2	ppm 0.5	% 0.001
L2069235-1 149493		53	0.70	11.65	78	0.7	
L2069235-2 149499		57	0.68	5.79	70	0.8	
L2069235-3 149497		42	1.02	7.38	57	0.9	
L2069235-4 149498		62	0.72	2.39	115	1.4	1.835
L2069235-5 149496		38	0.40	4.46	63	0.5	
L2069235-6 149494		60	0.38	7.78	79	1.7	
L2069235-7 149495		58	0.10	9.09	63	2.4	
L2069235-8 149500		75	0.65	9.80	69	1.7	
L2069235-9 156251		66	0.22	10.65	67	1.9	



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CERTIFICATE OF ANALYSIS VA18062593

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

C - GAS05	C - IR07	Cu - OG46	LOG - 22
ME - MS41	ME - OG46	OA - ELE07	OA - VOL08m
PUL - 31	PUL - QC	S - CAL06a	S - GRA06
S - GRA06a	S - IR08	SPL - 21	WEI - 21



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Account: **APN**

QC CERTIFICATE VA18062593

Project: L2069235

This report is for 9 Other samples submitted to our lab in Vancouver, BC, Canada on 21-MAR-2018.

The following have access to data associated with this certificate:

CASDG ALSE

ALSEV DATASUBLET

SHANE STACK

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI-21	Received Sample Weight
SPL-21	Split sample - riffle splitter
PUL-QC	Pulverizing QC Test
LOG-22	Sample login - Rcd w/o BarCode
PUL-31	Pulverize split to 85% <75 um

ANALYTICAL PROCEDURES

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ME-OG46	Ore Grade Elements - AquaRegia	ICP-AES
Cu-OG46	Ore Grade Cu - Aqua Regia	ICP-AES
OA-VOL08m	Modified NP	
S-IR08	Total Sulphur (Leco)	LECO
OA-ELE07	Paste pH	
S-CAL06a	Sulfide Sulfur (calculated*)	
S-GRA06a	Sulfate Sulfur (HCl leachable)	WST-SEQ

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***** See Appendix Page for comments regarding this certificate *****

Signature:

Colin Ramshaw, Vancouver Laboratory Manager



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QC CERTIFICATE OF ANALYSIS VA18062593

Sample Description	Method Analyte Units LOR	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-ELE07	S-IR08	C-GAS05	C-GAS05	S-GRA06a	C-IR07	S-GRA06	ME-MS41	ME-MS41	ME-MS41
		FIZZ RAT	MPA	NNP	NP	Ratio (N	pH	S	C	CO2	S	C	S	Ag	Al	As
		Unity	tCaCO3/1Kt	tCaCO3/1Kt	tCaCO3/1Kt	Unity	Unity	%	%	%	%	%	%	ppm	%	ppm
		1	0.3	1	1	0.01	0.1	0.01	0.05	0.2	0.01	0.01	0.01	0.01	0.01	0.1
STANDARDS																
Buffer pH6							6.0									
Buffer pH6							6.1									
Target Range - Lower Bound							5.3									
Upper Bound							6.7									
CO-ASSAY									0.50	1.8						
Target Range - Lower Bound									0.42	1.5						
Upper Bound									0.64	2.4						
GS310-10								0.28				1.06				
Target Range - Lower Bound								0.25				1.03				
Upper Bound								0.29				1.13				
KZK-1		2	25.0	31	56	2.24										
KZK-1		2	25.0	31	56	2.24										
Target Range - Lower Bound		<1	22.9	30	54	2.18										
Upper Bound		>4	27.1	38	64	2.53										
MA-1b								1.17				2.39				
Target Range - Lower Bound								1.12				2.34				
Upper Bound								1.22				2.54				
MRGeo08														4.25	2.57	32.5
Target Range - Lower Bound														4.00	2.44	29.6
Upper Bound														4.92	3.00	36.4
OGGeo08																
Target Range - Lower Bound																
Upper Bound																
OREAS 905														0.49	0.76	32.3
Target Range - Lower Bound														0.45	0.73	28.4
Upper Bound														0.58	0.91	35.0
OREAS 932																
Target Range - Lower Bound																
Upper Bound																
OREAS-133b																
Target Range - Lower Bound																
Upper Bound																
OREAS-134b																
Target Range - Lower Bound																
Upper Bound																
UTS-1													0.89			
Target Range - Lower Bound													0.83			
Upper Bound													0.93			
UTS-1											0.92					



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QC CERTIFICATE OF ANALYSIS VA18062593

Sample Description	Method Analyte Units LOR	ME-MS41 Au ppm 0.02	ME-MS41 B ppm 10	ME-MS41 Ba ppm 10	ME-MS41 Be ppm 0.05	ME-MS41 Bi ppm 0.01	ME-MS41 Ca % 0.01	ME-MS41 Cd ppm 0.01	ME-MS41 Ce ppm 0.02	ME-MS41 Co ppm 0.1	ME-MS41 Cr ppm 1	ME-MS41 Cs ppm 0.05	ME-MS41 Cu ppm 0.2	ME-MS41 Fe % 0.01	ME-MS41 Ga ppm 0.05	ME-MS41 Ge ppm 0.05
STANDARDS																
Buffer pH6																
Buffer pH6																
Target Range - Lower Bound																
Upper Bound																
CO - ASSAY																
Target Range - Lower Bound																
Upper Bound																
GS310-10																
Target Range - Lower Bound																
Upper Bound																
KZK-1																
KZK-1																
Target Range - Lower Bound																
Upper Bound																
MA-1b																
Target Range - Lower Bound																
Upper Bound																
MRGeo08		<0.02	<10	410	0.71	0.61	1.03	2.14	70.8	17.5	83	10.30	624	3.36	8.91	0.14
Target Range - Lower Bound		<0.02	<10	370	0.67	0.60	1.00	2.01	66.2	17.0	81	9.40	587	3.22	8.73	0.07
Upper Bound		0.04	20	530	0.95	0.76	1.24	2.47	81.0	21.0	102	11.60	675	3.96	10.80	0.29
OGGeo08																
Target Range - Lower Bound																
Upper Bound																
OREAS 905		0.36	<10	220	0.80	5.38	0.31	0.33	76.4	13.0	15	1.13	1520	3.16	5.76	0.08
Target Range - Lower Bound		0.33	<10	200	0.78	5.16	0.29	0.30	69.7	12.4	15	1.05	1450	3.14	5.45	<0.05
Upper Bound		0.45	20	300	1.08	6.32	0.38	0.38	85.3	15.4	20	1.39	1670	3.86	6.77	0.22
OREAS 932																
Target Range - Lower Bound																
Upper Bound																
OREAS-133b																
Target Range - Lower Bound																
Upper Bound																
OREAS-134b																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-1																



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QC CERTIFICATE OF ANALYSIS VA18062593

Sample Description	Method Analyte Units LOR	ME-MS41 Hf ppm 0.02	ME-MS41 Hg ppm 0.01	ME-MS41 In ppm 0.005	ME-MS41 K % 0.01	ME-MS41 La ppm 0.2	ME-MS41 Li ppm 0.1	ME-MS41 Mg % 0.01	ME-MS41 Mn ppm 5	ME-MS41 Mo ppm 0.05	ME-MS41 Na % 0.01	ME-MS41 Nb ppm 0.05	ME-MS41 Ni ppm 0.2	ME-MS41 P ppm 10	ME-MS41 Pb ppm 0.2	ME-MS41 Rb ppm 0.1
STANDARDS																
Buffer pH6																
Buffer pH6																
Target Range - Lower Bound																
Upper Bound																
CO - ASSAY																
Target Range - Lower Bound																
Upper Bound																
GS310-10																
Target Range - Lower Bound																
Upper Bound																
KZK-1																
KZK-1																
Target Range - Lower Bound																
Upper Bound																
MA-1b																
Target Range - Lower Bound																
Upper Bound																
MRGeo08		0.70	0.06	0.149	1.19	35.3	32.4	1.11	384	13.55	0.32	1.02	672	940	1005	135.0
Target Range - Lower Bound		0.64	0.04	0.137	1.12	33.2	29.6	1.03	378	13.10	0.30	0.79	622	900	959	132.0
Upper Bound		0.83	0.10	0.179	1.40	41.0	36.4	1.29	473	16.10	0.39	1.09	760	1130	1175	162.0
OGGeo08																
Target Range - Lower Bound																
Upper Bound																
OREAS 905		1.09	0.01	0.549	0.29	38.4	3.9	0.14	311	2.69	0.09	0.24	8.4	220	15.2	17.0
Target Range - Lower Bound		1.02	<0.01	0.517	0.28	34.7	4.0	0.13	310	2.65	0.07	0.19	7.8		14.4	16.3
Upper Bound		1.29	0.04	0.643	0.36	42.9	5.2	0.19	390	3.35	0.12	0.43	10.0		18.0	20.1
OREAS 932																
Target Range - Lower Bound																
Upper Bound																
OREAS-133b																
Target Range - Lower Bound																
Upper Bound																
OREAS-134b																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-1																



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QC CERTIFICATE OF ANALYSIS VA18062593

Sample Description	Method Analyte Units LOR	ME-MS41 Re ppm	ME-MS41 S %	ME-MS41 Sb ppm	ME-MS41 Sc ppm	ME-MS41 Se ppm	ME-MS41 Sn ppm	ME-MS41 Sr ppm	ME-MS41 Ta ppm	ME-MS41 Te ppm	ME-MS41 Th ppm	ME-MS41 Ti %	ME-MS41 Tl ppm	ME-MS41 U ppm	ME-MS41 V ppm	ME-MS41 W ppm
		0.001	0.01	0.05	0.1	0.2	0.2	0.2	0.01	0.01	0.2	0.005	0.02	0.05	1	0.05
STANDARDS																
Buffer pH6																
Buffer pH6																
Target Range - Lower Bound																
Upper Bound																
CO - ASSAY																
Target Range - Lower Bound																
Upper Bound																
GS310-10																
Target Range - Lower Bound																
Upper Bound																
KZK-1																
KZK-1																
Target Range - Lower Bound																
Upper Bound																
MA-1b																
Target Range - Lower Bound																
Upper Bound																
MRGeo08		0.007	0.29	2.90	7.0	0.9	3.2	74.5	0.01	0.02	20.3	0.358	0.73	5.09	93	2.75
Target Range - Lower Bound		0.006	0.27	2.80	6.7	0.9	2.8	72.1	<0.01	<0.01	19.1	0.338	0.64	4.93	90	2.44
Upper Bound		0.010	0.35	3.90	8.4	1.9	4.0	88.5	0.03	0.04	23.7	0.424	0.92	6.13	112	3.42
OGGeo08																
Target Range - Lower Bound																
Upper Bound																
OREAS 905		<0.001	0.07	0.90	1.6	2.4	1.2	11.8	<0.01	0.07	8.1	0.018	0.10	2.06	5	0.50
Target Range - Lower Bound		<0.001	0.04	0.83	1.5	1.8	0.8	10.9	<0.01	0.04	7.4	0.008	0.06	1.92	4	0.41
Upper Bound		0.002	0.09	1.23	2.0	2.8	1.7	13.7	0.02	0.09	9.4	0.030	0.16	2.46	8	0.73
OREAS 932																
Target Range - Lower Bound																
Upper Bound																
OREAS-133b																
Target Range - Lower Bound																
Upper Bound																
OREAS-134b																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-1																



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QC CERTIFICATE OF ANALYSIS VA18062593

Sample Description	Method Analyte Units LOR	ME-MS41 Y ppm 0.05	ME-MS41 Zn ppm 2	ME-MS41 Zr ppm 0.5	Cu-OG46 Cu % 0.001
STANDARDS					
Buffer pH6					
Buffer pH6					
Target Range - Lower Bound					
Upper Bound					
CO - ASSAY					
Target Range - Lower Bound					
Upper Bound					
GS310-10					
Target Range - Lower Bound					
Upper Bound					
KZK-1					
KZK-1					
Target Range - Lower Bound					
Upper Bound					
MA-1b					
Target Range - Lower Bound					
Upper Bound					
MRGeo08		18.45	720	22.5	
Target Range - Lower Bound		17.50	708	18.1	
Upper Bound		21.5	870	25.7	
OGGeo08					0.850
Target Range - Lower Bound					0.809
Upper Bound					0.869
OREAS 905		6.74	59	44.0	
Target Range - Lower Bound		6.32	56	39.9	
Upper Bound		7.84	72	55.1	
OREAS 932					6.04
Target Range - Lower Bound					5.90
Upper Bound					6.32
OREAS-133b					0.032
Target Range - Lower Bound					0.031
Upper Bound					0.035
OREAS-134b					0.139
Target Range - Lower Bound					0.131
Upper Bound					0.142
UTS-1					
Target Range - Lower Bound					
Upper Bound					
UTS-1					



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Sample Description	Method Analyte Units LOR	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-ELE07	S-IR08	C-GAS05	C-GAS05	S-GRA06a	C-IR07	S-GRA06	ME-MS41	ME-MS41	ME-MS41
		FIZZ RAT	MPA	NNP	NP	Ratio (N	pH	S	C	CO2	S	C	S	Ag	Al	As
		Unity	tCaCO3/1Kt	tCaCO3/1Kt	tCaCO3/1Kt	Unity	Unity	%	%	%	%	%	%	ppm	%	ppm
		1	0.3	1	1	0.01	0.1	0.01	0.05	0.2	0.01	0.01	0.01	0.01	0.01	0.1
STANDARDS																
Target Range - Lower Bound											0.81					
Upper Bound											0.95					
UTS-4													1.76			
Target Range - Lower Bound													1.64			
Upper Bound													1.84			
UTS-4											1.77					
Target Range - Lower Bound											1.61					
Upper Bound											1.87					
BLANKS																
BLANK									<0.05	<0.2						
Target Range - Lower Bound									<0.05	<0.2						
Upper Bound									0.10	0.4						
BLANK														<0.01	<0.01	<0.1
Target Range - Lower Bound														<0.01	<0.01	<0.1
Upper Bound														0.02	0.02	0.2
BLANK							6.3									
Target Range - Lower Bound							5.5									
Upper Bound							6.9									
BLANK													<0.01			
Target Range - Lower Bound													<0.01			
Upper Bound													0.02			
BLANK											<0.01					
Target Range - Lower Bound											<0.01					
Upper Bound											0.02					
BLANK								<0.01				0.01				
Target Range - Lower Bound								<0.01				<0.01				
Upper Bound								0.02				0.02				



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QC CERTIFICATE OF ANALYSIS VA18062593

Sample Description	Method Analyte Units LOR	ME-MS41 Au ppm 0.02	ME-MS41 B ppm 10	ME-MS41 Ba ppm 10	ME-MS41 Be ppm 0.05	ME-MS41 Bi ppm 0.01	ME-MS41 Ca % 0.01	ME-MS41 Cd ppm 0.01	ME-MS41 Ce ppm 0.02	ME-MS41 Co ppm 0.1	ME-MS41 Cr ppm 1	ME-MS41 Cs ppm 0.05	ME-MS41 Cu ppm 0.2	ME-MS41 Fe % 0.01	ME-MS41 Ga ppm 0.05	ME-MS41 Ge ppm 0.05
STANDARDS																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																
BLANKS																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK		<0.02	<10	<10	<0.05	<0.01	<0.01	<0.01	<0.02	<0.1	<1	<0.05	<0.2	<0.01	<0.05	<0.05
Target Range - Lower Bound		<0.02	<10	<10	<0.05	<0.01	<0.01	<0.01	<0.02	<0.1	<1	<0.05	<0.2	<0.01	<0.05	<0.05
Upper Bound		0.04	20	20	0.10	0.02	0.02	0.02	0.04	0.2	2	0.10	0.4	0.02	0.10	0.10
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18062593

Sample Description	Method Analyte Units LOR	ME-MS41 Hf ppm 0.02	ME-MS41 Hg ppm 0.01	ME-MS41 In ppm 0.005	ME-MS41 K % 0.01	ME-MS41 La ppm 0.2	ME-MS41 Li ppm 0.1	ME-MS41 Mg % 0.01	ME-MS41 Mn ppm 5	ME-MS41 Mo ppm 0.05	ME-MS41 Na % 0.01	ME-MS41 Nb ppm 0.05	ME-MS41 Ni ppm 0.2	ME-MS41 P ppm 10	ME-MS41 Pb ppm 0.2	ME-MS41 Rb ppm 0.1
STANDARDS																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																
BLANKS																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK		<0.02	<0.01	<0.005	<0.01	<0.2	<0.1	<0.01	<5	<0.05	<0.01	<0.05	<0.2	<10	<0.2	<0.1
Target Range - Lower Bound		<0.02	<0.01	<0.005	<0.01	<0.2	<0.1	<0.01	<5	<0.05	<0.01	<0.05	<0.2	<10	<0.2	<0.1
Upper Bound		0.04	0.02	0.010	0.02	0.4	0.2	0.02	10	0.10	0.02	0.10	0.4	20	0.4	0.2
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18062593

Sample Description	Method Analyte Units LOR	ME-MS41 Re ppm	ME-MS41 S %	ME-MS41 Sb ppm	ME-MS41 Sc ppm	ME-MS41 Se ppm	ME-MS41 Sn ppm	ME-MS41 Sr ppm	ME-MS41 Ta ppm	ME-MS41 Te ppm	ME-MS41 Th ppm	ME-MS41 Ti %	ME-MS41 Tl ppm	ME-MS41 U ppm	ME-MS41 V ppm	ME-MS41 W ppm
		0.001	0.01	0.05	0.1	0.2	0.2	0.2	0.01	0.01	0.2	0.005	0.02	0.05	1	0.05
STANDARDS																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																
BLANKS																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK		<0.001	<0.01	<0.05	<0.1	<0.2	<0.2	<0.2	<0.01	<0.01	<0.2	<0.005	<0.02	<0.05	<1	<0.05
Target Range - Lower Bound		<0.001	<0.01	<0.05	<0.1	<0.2	<0.2	<0.2	<0.01	<0.01	<0.2	<0.005	<0.02	<0.05	<1	<0.05
Upper Bound		0.002	0.02	0.10	0.2	0.4	0.4	0.4	0.02	0.02	0.4	0.010	0.04	0.10	2	0.10
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																



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Sample Description	Method Analyte Units LOR	ME-MS41 Y ppm 0.05	ME-MS41 Zn ppm 2	ME-MS41 Zr ppm 0.5	Cu-OG46 Cu % 0.001
STANDARDS					
Target Range - Lower Bound					
Upper Bound					
UTS-4					
Target Range - Lower Bound					
Upper Bound					
UTS-4					
Target Range - Lower Bound					
Upper Bound					
BLANKS					
BLANK					
Target Range - Lower Bound					
Upper Bound					
BLANK					<0.001
Target Range - Lower Bound					<0.001
Upper Bound					0.002
BLANK		<0.05	<2	<0.5	
Target Range - Lower Bound		<0.05	<2	<0.5	
Upper Bound		0.10	4	1.0	
BLANK					
Target Range - Lower Bound					
Upper Bound					
BLANK					
Target Range - Lower Bound					
Upper Bound					
BLANK					
Target Range - Lower Bound					
Upper Bound					
BLANK					
Target Range - Lower Bound					
Upper Bound					



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Sample Description	Method Analyte Units LOR	OA - VOL08m	OA - VOL08m	OA - VOL08m	OA - VOL08m	OA - VOL08m	OA - ELE07	S - IR08	C - GAS05	C - GAS05	S - GRA06a	C - IR07	S - GRA06	ME - MS41	ME - MS41	ME - MS41
		FIZZ RAT	MPA	NNP	NP	Ratio (N	pH	S	C	CO2	S	C	S	Ag	Al	As
		Unity	tCaCO3/1Kt	tCaCO3/1Kt	tCaCO3/1Kt	Unity	Unity	%	%	%	%	%	%	ppm	%	ppm
		1	0.3	1	1	0.01	0.1	0.01	0.05	0.2	0.01	0.01	0.01	0.01	0.01	0.01
ORIGINAL DUP Target Range - Lower Bound Upper Bound	DUPLICATES															
														0.08	0.40	1.3
														0.08	0.45	1.4
														0.07	0.39	1.2
ORIGINAL DUP Target Range - Lower Bound Upper Bound																
														<0.01		
														0.02		
														<0.01		
L2069235 - 8 149500 DUP Target Range - Lower Bound Upper Bound																
														<0.01		
														<0.01		
														<0.01		
L2069236 - 1 156252 DUP Target Range - Lower Bound Upper Bound	2	7.2	28	35	4.87	9.0		0.63	2.3							
	2	7.2	27	34	4.73	9.1		0.62	2.3							
	<1	6.5	25	32	4.55	8.5		0.54	2.0							
	3	7.9	30	37	5.05	9.6		0.71	2.6							
ORIGINAL DUP Target Range - Lower Bound Upper Bound																
								0.01					0.05			
								<0.01					0.05			
								<0.01					0.04			
								0.02					0.06			



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Sample Description	Method Analyte Units LOR	ME-MS41 Au ppm 0.02	ME-MS41 B ppm 10	ME-MS41 Ba ppm 10	ME-MS41 Be ppm 0.05	ME-MS41 Bi ppm 0.01	ME-MS41 Ca % 0.01	ME-MS41 Cd ppm 0.01	ME-MS41 Ce ppm 0.02	ME-MS41 Co ppm 0.1	ME-MS41 Cr ppm 1	ME-MS41 Cs ppm 0.05	ME-MS41 Cu ppm 0.2	ME-MS41 Fe % 0.01	ME-MS41 Ga ppm 0.05	ME-MS41 Ge ppm 0.05
DUPLICATES																
ORIGINAL		<0.02	<10	<10	<0.05	1.25	0.03	<0.01	1.76	0.9	3	<0.05	3.3	0.42	1.71	<0.05
DUP		<0.02	<10	10	<0.05	1.28	0.05	0.01	1.97	0.9	3	<0.05	3.3	0.42	1.88	<0.05
Target Range - Lower Bound		<0.02	<10	<10	<0.05	1.19	0.03	<0.01	1.75	0.8	2	<0.05	3.0	0.39	1.66	<0.05
Upper Bound		0.04	20	20	0.10	1.34	0.05	0.02	1.98	1.0	4	0.10	3.6	0.45	1.93	0.10
ORIGINAL																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2069235-8 149500																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2069236-1 156252																
DUP																
Target Range - Lower Bound																
Upper Bound																
ORIGINAL																
DUP																
Target Range - Lower Bound																
Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18062593

Sample Description	Method Analyte Units LOR	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
		Hf	Hg	In	K	La	Li	Mg	Mn	Mo	Na	Nb	Ni	P	Pb	Rb
		ppm	ppm	ppm	%	ppm	ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm
		0.02	0.01	0.005	0.01	0.2	0.1	0.01	5	0.05	0.01	0.05	0.2	10	0.2	0.1
		DUPLICATES														
ORIGINAL		0.02	<0.01	0.005	0.07	0.9	0.1	0.01	33	0.95	0.06	<0.05	0.9	50	6.8	0.4
DUP		0.02	<0.01	<0.005	0.08	1.0	<0.1	0.01	33	0.97	0.07	<0.05	0.9	60	7.2	0.4
Target Range - Lower Bound		<0.02	<0.01	<0.005	0.06	0.7	<0.1	<0.01	26	0.86	0.05	<0.05	0.7	40	6.5	0.3
Upper Bound		0.04	0.02	0.010	0.09	1.2	0.2	0.02	40	1.06	0.08	0.10	1.1	70	7.6	0.5
ORIGINAL																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2069235-8 149500																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2069236-1 156252																
DUP																
Target Range - Lower Bound																
Upper Bound																
ORIGINAL																
DUP																
Target Range - Lower Bound																
Upper Bound																



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Page: 4 - D
Total # Pages: 4 (A - E)
Plus Appendix Pages
Finalized Date: 10 - APR - 2018
Account: APN

Project: L2069235

QC CERTIFICATE OF ANALYSIS VA18062593

Sample Description	Method Analyte Units LOR	ME-MS41 Re ppm	ME-MS41 S %	ME-MS41 Sb ppm	ME-MS41 Sc ppm	ME-MS41 Se ppm	ME-MS41 Sn ppm	ME-MS41 Sr ppm	ME-MS41 Ta ppm	ME-MS41 Te ppm	ME-MS41 Th ppm	ME-MS41 Ti %	ME-MS41 Tl ppm	ME-MS41 U ppm	ME-MS41 V ppm	ME-MS41 W ppm
		0.001	0.01	0.05	0.1	0.2	0.2	0.2	0.01	0.01	0.2	0.005	0.02	0.05	1	0.05
DUPLICATES																
ORIGINAL		<0.001	0.35	0.34	0.4	1.2	0.7	20.5	<0.01	0.23	0.2	<0.005	0.03	<0.05	7	<0.05
DUP		<0.001	0.39	0.37	0.4	1.2	0.8	23.1	<0.01	0.25	0.2	<0.005	0.03	<0.05	8	<0.05
Target Range - Lower Bound		<0.001	0.34	0.28	0.3	0.9	0.5	20.5	<0.01	0.22	<0.2	<0.005	<0.02	<0.05	6	<0.05
Upper Bound		0.002	0.40	0.43	0.5	1.5	1.0	23.1	0.02	0.26	0.4	0.010	0.04	0.10	9	0.10
ORIGINAL																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2069235-8 149500																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2069236-1 156252																
DUP																
Target Range - Lower Bound																
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ORIGINAL																
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Target Range - Lower Bound																
Upper Bound																



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Page: 4 - E
Total # Pages: 4 (A - E)
Plus Appendix Pages
Finalized Date: 10 - APR - 2018
Account: APN

Project: L2069235

QC CERTIFICATE OF ANALYSIS VA18062593

Sample Description	Method Analyte Units LOR	ME-MS41 Y ppm 0.05	ME-MS41 Zn ppm 2	ME-MS41 Zr ppm 0.5	Cu-OG46 Cu % 0.001
DUPLICATES					
ORIGINAL		0.20	2	0.7	
DUP		0.20	2	0.7	
Target Range - Lower Bound		0.14	<2	<0.5	
Upper Bound		0.26	4	1.0	
ORIGINAL					
DUP					
Target Range - Lower Bound					
Upper Bound					
L2069235-8 149500					
DUP					
Target Range - Lower Bound					
Upper Bound					
L2069236-1 156252					
DUP					
Target Range - Lower Bound					
Upper Bound					
ORIGINAL					
DUP					
Target Range - Lower Bound					
Upper Bound					



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Project: L2069235

QC CERTIFICATE OF ANALYSIS VA18062593

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

C - GAS05	C - IR07	Cu - OG46	LOG - 22
ME - MS41	ME - OG46	OA - ELE07	OA - VOL08m
PUL - 31	PUL - QC	S - CAL06a	S - GRA06
S - GRA06a	S - IR08	SPL - 21	WEI - 21



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 16-MAR-18
Report Date: 11-APR-18 17:24 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2069236
Project P.O. #: PO#229850
Job Reference:
C of C Numbers: 18-10
Legal Site Desc:

Comments: Please note, the ALS Minerals version of the finalized report and QC can be found at the end of the attachment.

Shane Stack
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2069236-1 Waste 27-FEB-18 156252	L2069236-2 Waste 28-FEB-18 156253	L2069236-3 Waste 01-MAR-18 156254	L2069236-4 Waste 01-MAR-18 156255	L2069236-5 Waste 02-MAR-18 156256
Grouping	Analyte					
SOIL						
Physical Tests	pH (Unity)	9.0	9.0	9.0	9.0	9.0
Organic / Inorganic Carbon	Carbon (C) (%)	0.63	0.47	0.24	0.44	0.34
Acid Base Accounting	FIZZ RATING (Unity)	2	2	2	2	2
	MPA (tCaCO3/1Kt)	7.2	<0.3	0.3	5.6	0.6
	Neutralization Potential (NP) (tCaCO3/1Kt)	35	34	27	31	32
	NNP (tCaCO3/1Kt)	28	34	27	25	31
	Ratio (NP/MPA) (Unity)	4.87	217.60	86.40	5.51	51.20
	Sulfate Sulfur (carbonate leach) (%)	<0.01	<0.01	<0.01	<0.01	<0.01
	Sulfate Sulfur (HCl leach) (%)	<0.01	<0.01	<0.01	<0.01	<0.01
	Sulfide Sulfur (T minus HCl leach) (%)	0.23	<0.01	0.01	0.18	0.02
	Total Sulfur (combustion) (%)	0.23	<0.01	0.01	0.18	0.02
Total Metals	Aluminum (Al) (%)	0.99	0.97	1.23	1.05	1.23
	Antimony (Sb) (ppm)	<0.05	<0.05	<0.05	<0.05	<0.05
	Arsenic (As) (ppm)	0.6	0.8	1.2	0.6	0.8
	Barium (Ba) (ppm)	230	150	90	180	150
	Beryllium (Be) (ppm)	0.26	0.31	0.42	0.30	0.36
	Bismuth (Bi) (ppm)	0.02	0.01	0.01	0.49	0.05
	Boron (B) (ppm)	<10	<10	<10	<10	<10
	Cadmium (Cd) (ppm)	0.03	0.02	0.03	0.10	0.06
	Calcium (Ca) (%)	1.07	1.17	1.13	1.10	1.29
	Cerium (Ce) (ppm)	22.8	35.4	19.65	28.3	27.7
	Cesium (Cs) (ppm)	0.61	0.43	0.35	0.44	0.35
	Chromium (Cr) (ppm)	3	4	4	4	4
	Cobalt (Co) (ppm)	7.5	4.8	5.0	5.1	5.1
	Copper (Cu) (ppm)	228	9.6	177.0	2790	355
	Gallium (Ga) (ppm)	4.89	5.12	6.04	5.49	5.88
	Germanium (Ge) (ppm)	0.05	0.07	0.06	0.06	0.06
	Gold (Au) (ppm)	<0.02	<0.02	<0.02	0.05	<0.02
	Hafnium (Hf) (ppm)	0.04	0.03	0.05	0.03	0.04
	Indium (In) (ppm)	0.065	0.035	0.024	0.044	0.028
	Iron (Fe) (%)	2.64	2.20	2.04	2.66	2.11
	Lanthanum (La) (ppm)	12.0	18.7	10.3	16.2	15.5
	Lead (Pb) (ppm)	3.4	3.1	3.7	3.5	3.6
	Lithium (Li) (ppm)	3.5	5.0	9.1	5.1	7.0
	Magnesium (Mg) (%)	0.68	0.61	0.77	0.60	0.66
	Manganese (Mn) (ppm)	453	556	558	463	540

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2069236-6 Waste 03-MAR-18 156257	L2069236-7 Waste 04-MAR-18 156258	L2069236-8 Waste 05-MAR-18 156259	L2069236-9 Waste 05-MAR-18 156260	L2069236-10 Waste 05-MAR-18 156261
Grouping	Analyte					
SOIL						
Physical Tests	pH (Unity)	9.1	8.9	9.0	9.1	9.3
Organic / Inorganic Carbon	Carbon (C) (%)	0.28	0.55	0.55	0.52	0.41
Acid Base Accounting	FIZZ RATING (Unity)	2	2	2	2	2
	MPA (tCaCO3/1Kt)	<0.3	11.6	6.9	20.3	2.5
	Neutralization Potential (NP) (tCaCO3/1Kt)	27	33	31	34	31
	NNP (tCaCO3/1Kt)	27	21	24	14	29
	Ratio (NP/MPA) (Unity)	172.80	2.85	4.51	1.67	12.40
	Sulfate Sulfur (carbonate leach) (%)	<0.01	<0.01	<0.01	<0.01	<0.01
	Sulfate Sulfur (HCl leach) (%)	<0.01	0.01	0.01	<0.01	0.01
	Sulfide Sulfur (T minus HCl leach) (%)	<0.01	0.36	0.21	0.65	0.07
	Total Sulfur (combustion) (%)	<0.01	0.37	0.22	0.65	0.08
Total Metals	Aluminum (Al) (%)	1.03	1.05	0.88	1.25	1.15
	Antimony (Sb) (ppm)	<0.05	<0.05	<0.05	<0.05	<0.05
	Arsenic (As) (ppm)	1.1	0.9	0.6	0.5	0.5
	Barium (Ba) (ppm)	110	160	150	240	330
	Beryllium (Be) (ppm)	0.34	0.28	0.29	0.28	0.18
	Bismuth (Bi) (ppm)	0.01	0.11	0.11	0.02	0.02
	Boron (B) (ppm)	<10	<10	<10	<10	<10
	Cadmium (Cd) (ppm)	0.03	0.20	0.07	0.05	0.05
	Calcium (Ca) (%)	1.11	1.03	1.08	1.09	1.00
	Cerium (Ce) (ppm)	22.3	21.9	29.6	31.5	26.8
	Cesium (Cs) (ppm)	0.38	0.35	0.36	0.78	0.55
	Chromium (Cr) (ppm)	5	4	3	3	4
	Cobalt (Co) (ppm)	4.8	7.5	6.3	12.1	5.8
	Copper (Cu) (ppm)	17.9	1800	789	429	93.1
	Gallium (Ga) (ppm)	5.37	5.76	4.54	6.11	4.95
	Germanium (Ge) (ppm)	0.06	0.06	0.05	0.07	0.07
	Gold (Au) (ppm)	<0.02	0.02	<0.02	<0.02	<0.02
	Hafnium (Hf) (ppm)	0.07	0.04	0.04	0.05	0.03
	Indium (In) (ppm)	0.023	0.048	0.038	0.065	0.026
	Iron (Fe) (%)	1.90	2.90	2.27	3.37	2.37
	Lanthanum (La) (ppm)	10.5	11.6	15.7	17.0	13.7
	Lead (Pb) (ppm)	4.1	3.5	3.8	3.8	2.2
	Lithium (Li) (ppm)	5.1	6.5	4.0	4.9	4.1
	Magnesium (Mg) (%)	0.55	0.76	0.58	0.81	0.66
	Manganese (Mn) (ppm)	563	510	421	492	491

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2069236-1 Waste 27-FEB-18 156252	L2069236-2 Waste 28-FEB-18 156253	L2069236-3 Waste 01-MAR-18 156254	L2069236-4 Waste 01-MAR-18 156255	L2069236-5 Waste 02-MAR-18 156256
Grouping	Analyte					
SOIL						
Total Metals	Mercury (Hg) (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01
	Molybdenum (Mo) (ppm)	1.49	0.27	0.50	2.36	1.20
	Nickel (Ni) (ppm)	2.6	2.3	2.5	2.1	2.5
	Niobium (Nb) (ppm)	0.22	0.09	0.07	0.13	0.11
	Phosphorus (P) (ppm)	800	420	590	570	560
	Potassium (K) (%)	0.62	0.35	0.19	0.46	0.41
	Rhenium (Re) (ppm)	0.004	<0.001	0.001	0.011	0.003
	Rubidium (Rb) (ppm)	32.6	17.0	8.1	23.2	19.6
	Scandium (Sc) (ppm)	4.8	6.3	4.7	3.5	5.2
	Selenium (Se) (ppm)	0.3	<0.2	<0.2	1.9	0.2
	Silver (Ag) (ppm)	0.06	0.02	0.02	0.61	0.16
	Sodium (Na) (%)	0.08	0.07	0.09	0.08	0.08
	Strontium (Sr) (ppm)	91.8	81.0	81.4	79.0	94.4
	Sulfur (S) (%)	0.24	0.01	0.02	0.18	0.03
	Tantalum (Ta) (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01
	Tellurium (Te) (ppm)	0.03	<0.01	<0.01	0.10	0.02
	Thallium (Tl) (ppm)	0.26	0.11	0.05	0.15	0.11
	Thorium (Th) (ppm)	3.3	4.5	2.2	4.2	3.3
	Tin (Sn) (ppm)	1.4	0.6	0.5	0.7	0.6
	Titanium (Ti) (%)	0.092	0.051	0.029	0.069	0.056
	Tungsten (W) (ppm)	0.75	0.22	0.33	0.22	0.29
	Uranium (U) (ppm)	0.32	0.22	0.30	0.21	0.21
	Vanadium (V) (ppm)	56	41	38	50	44
	Yttrium (Y) (ppm)	8.05	9.19	6.92	5.51	8.19
	Zinc (Zn) (ppm)	58	66	64	65	65
	Zirconium (Zr) (ppm)	1.1	0.6	0.8	0.8	0.8
Permanent Gases	Carbon Dioxide (CO2) (%)	2.3	1.7	0.9	1.6	1.3
Miscellaneous	Carbon (C) (%)	0.70	0.50	0.30	0.50	0.40

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2069236-6 Waste 03-MAR-18 156257	L2069236-7 Waste 04-MAR-18 156258	L2069236-8 Waste 05-MAR-18 156259	L2069236-9 Waste 05-MAR-18 156260	L2069236-10 Waste 05-MAR-18 156261
Grouping	Analyte					
SOIL						
Total Metals	Mercury (Hg) (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01
	Molybdenum (Mo) (ppm)	0.73	1.96	4.02	9.35	0.62
	Nickel (Ni) (ppm)	2.9	2.3	2.4	2.0	2.3
	Niobium (Nb) (ppm)	0.06	0.09	0.08	0.25	0.20
	Phosphorus (P) (ppm)	530	570	600	670	670
	Potassium (K) (%)	0.25	0.31	0.32	0.78	0.75
	Rhenium (Re) (ppm)	<0.001	0.003	0.020	0.022	0.002
	Rubidium (Rb) (ppm)	11.9	15.1	15.4	44.4	36.2
	Scandium (Sc) (ppm)	4.0	3.6	3.9	5.7	3.8
	Selenium (Se) (ppm)	<0.2	1.8	0.7	0.8	0.2
	Silver (Ag) (ppm)	0.02	0.38	0.19	0.07	0.03
	Sodium (Na) (%)	0.12	0.07	0.07	0.07	0.10
	Strontium (Sr) (ppm)	122.0	113.0	90.0	69.8	75.6
	Sulfur (S) (%)	0.01	0.36	0.22	0.64	0.09
	Tantalum (Ta) (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01
	Tellurium (Te) (ppm)	0.01	0.06	0.05	0.07	0.01
	Thallium (Tl) (ppm)	0.07	0.09	0.11	0.46	0.26
	Thorium (Th) (ppm)	2.1	2.5	4.7	4.5	3.9
	Tin (Sn) (ppm)	0.5	0.9	0.8	2.0	0.8
	Titanium (Ti) (%)	0.036	0.043	0.040	0.123	0.128
	Tungsten (W) (ppm)	0.58	0.14	0.30	0.20	0.58
	Uranium (U) (ppm)	0.24	0.17	0.33	0.44	0.17
	Vanadium (V) (ppm)	38	56	40	67	55
	Yttrium (Y) (ppm)	12.10	6.31	6.91	8.95	6.08
	Zinc (Zn) (ppm)	53	72	50	60	51
	Zirconium (Zr) (ppm)	0.9	1.3	1.1	1.3	0.8
Permanent Gases	Carbon Dioxide (CO2) (%)	1.0	2.0	2.0	1.9	1.5
Miscellaneous	Carbon (C) (%)	0.31	0.59	0.58	0.56	0.45

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ABA-OA-VOL08-AX	Soil	Acid Base Accounting	OA-VOL08
CARBON-C-GAS05-AX	Soil	Carbon, TOC and CO2	C-GAS05
CARBON-C-IR07-AX	Soil	Carbon (C) using LECO analyzer	Total Carbon - Method Code C-IR07
Total Carbon & Sulfur - Method Codes C-IR07 & S-IR08			
A 0.1g sample is heated to approximately 1350°C in an induction furnace while passing a stream of oxygen through the sample. Carbon dioxide & sulfur dioxide released from the sample are measured by an IR detection system (Leco analyzer) and the total carbon & sulfur results are provided.			
ME-MS41-AX	Soil	Aqua Regia ICPMS	Aqua Regia ICPMS
A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences.			
PH-OA-ELE07-AX	Soil	pH	OA-ELE07
SULPHUR-S-CAL06A-AX	Soil	Sulfide Sulfur Calc from HCl Leach	ALS Minerals S-CAL06A
Sulfide Sulfur (as S) is calculated by subtracting the HCl Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion.			
SULPHUR-S-GRA06-AX	Soil	Sulfate Sulfur in Soil (Carbonate Leach)	ALS Minerals S-GRA06
A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).			
SULPHUR-S-GRA06A-AX	Soil	Sulfate Sulfur in Soil (HCl Leach)	ALS Minerals S-GRA06A
A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).			
SULPHUR-S-IR08-AX	Soil	Total Sulfur in Soil by Combustion	ALS Minerals S-IR08
The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
AX	ALS MINERALS - VANCOUVER, B.C., CANADA

Chain of Custody Numbers:

18-10

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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Page: 1
Total # Pages: 2 (A - E)
Plus Appendix Pages
Finalized Date: 10-APR-2018
Account: APN

CERTIFICATE VA18062594

Project: L2069236

This report is for 10 Other samples submitted to our lab in Vancouver, BC, Canada on 21-MAR-2018.

The following have access to data associated with this certificate:

CASDG ALSE

ALSEV DATASUBLET

SHANE STACK

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI-21	Received Sample Weight
SPL-21	Split sample - riffle splitter
LOG-22	Sample login - Rcd w/o BarCode
PUL-31	Pulverize split to 85% <75 um

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	
C-GAS05	Inorganic Carbon (CO2)	
C-IR07	Total Carbon (Leco)	LECO
S-GRA06	Sulfate Sulfur - carbonate leach	WST-SEQ
ME-MS41	Ultra Trace Aqua Regia ICP-MS	
OA-VOL08m	Modified NP	
S-IR08	Total Sulphur (Leco)	LECO
OA-ELE07	Paste pH	
S-CAL06a	Sulfide Sulfur (calculated*)	
S-GRA06a	Sulfate Sulfur (HCl leachable)	WST-SEQ

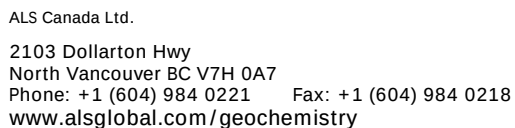
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***** See Appendix Page for comments regarding this certificate *****

Signature:

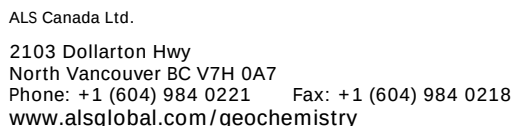
Colin Ramshaw, Vancouver Laboratory Manager



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CERTIFICATE OF ANALYSIS VA18062594

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CERTIFICATE OF ANALYSIS VA18062594

Sample Description	Method Analyte Units LOR	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
		Ga	Ge	Hf	Hg	In	K	La	Li	Mg	Mn	Mo	Na	Nb	Ni
		ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	ppm	%	ppm	ppm
		0.05	0.05	0.02	0.01	0.005	0.01	0.2	0.1	0.01	5	0.05	0.01	0.05	0.2
L2069236-1 156252		4.89	0.05	0.04	<0.01	0.065	0.62	12.0	3.5	0.68	453	1.49	0.08	0.22	2.6
L2069236-2 156253		5.12	0.07	0.03	<0.01	0.035	0.35	18.7	5.0	0.61	556	0.27	0.07	0.09	2.3
L2069236-3 156254		6.04	0.06	0.05	<0.01	0.024	0.19	10.3	9.1	0.77	558	0.50	0.09	0.07	2.5
L2069236-4 156255		5.49	0.06	0.03	<0.01	0.044	0.46	16.2	5.1	0.60	463	2.36	0.08	0.13	2.1
L2069236-5 156256		5.88	0.06	0.04	<0.01	0.028	0.41	15.5	7.0	0.66	540	1.20	0.08	0.11	2.5
L2069236-6 156257		5.37	0.06	0.07	<0.01	0.023	0.25	10.5	5.1	0.55	563	0.73	0.12	0.06	2.9
L2069236-7 156258		5.76	0.06	0.04	<0.01	0.048	0.31	11.6	6.5	0.76	510	1.96	0.07	0.09	2.3
L2069236-8 156259		4.54	0.05	0.04	<0.01	0.038	0.32	15.7	4.0	0.58	421	4.02	0.07	0.08	2.4
L2069236-9 156260		6.11	0.07	0.05	<0.01	0.065	0.78	17.0	4.9	0.81	492	9.35	0.07	0.25	2.0
L2069236-10 156261		4.95	0.07	0.03	<0.01	0.026	0.75	13.7	4.1	0.66	491	0.62	0.10	0.20	2.3



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CERTIFICATE OF ANALYSIS VA18062594

Sample Description	Method Analyte Units LOR	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
		Pb	Rb	Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl
		ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm
		0.2	0.1	0.001	0.01	0.05	0.1	0.2	0.2	0.2	0.01	0.01	0.2	0.005	0.02
L2069236-1 156252		3.4	32.6	0.004	0.24	<0.05	4.8	0.3	1.4	91.8	<0.01	0.03	3.3	0.092	0.26
L2069236-2 156253		3.1	17.0	<0.001	0.01	<0.05	6.3	<0.2	0.6	81.0	<0.01	<0.01	4.5	0.051	0.11
L2069236-3 156254		3.7	8.1	0.001	0.02	<0.05	4.7	<0.2	0.5	81.4	<0.01	<0.01	2.2	0.029	0.05
L2069236-4 156255		3.5	23.2	0.011	0.18	<0.05	3.5	1.9	0.7	79.0	<0.01	0.10	4.2	0.069	0.15
L2069236-5 156256		3.6	19.6	0.003	0.03	<0.05	5.2	0.2	0.6	94.4	<0.01	0.02	3.3	0.056	0.11
L2069236-6 156257		4.1	11.9	<0.001	0.01	<0.05	4.0	<0.2	0.5	122.0	<0.01	0.01	2.1	0.036	0.07
L2069236-7 156258		3.5	15.1	0.003	0.36	<0.05	3.6	1.8	0.9	113.0	<0.01	0.06	2.5	0.043	0.09
L2069236-8 156259		3.8	15.4	0.020	0.22	<0.05	3.9	0.7	0.8	90.0	<0.01	0.05	4.7	0.040	0.11
L2069236-9 156260		3.8	44.4	0.022	0.64	<0.05	5.7	0.8	2.0	69.8	<0.01	0.07	4.5	0.123	0.46
L2069236-10 156261		2.2	36.2	0.002	0.09	<0.05	3.8	0.2	0.8	75.6	<0.01	0.01	3.9	0.128	0.26



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CERTIFICATE OF ANALYSIS VA18062594

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

C-GAS05	C-IR07	LOG-22	ME-MS41
OA-ELE07	OA-VOL08m	PUL-31	S-CAL06a
S-GRA06	S-GRA06a	S-IR08	SPL-21
WEI-21			



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QC CERTIFICATE VA18062594

Project: L2069236

This report is for 10 Other samples submitted to our lab in Vancouver, BC, Canada on 21-MAR-2018.

The following have access to data associated with this certificate:

CASDG ALSE

ALSEV DATASUBLET

SHANE STACK

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI-21	Received Sample Weight
SPL-21	Split sample - riffle splitter
LOG-22	Sample login - Rcd w/o BarCode
PUL-31	Pulverize split to 85% <75 um

ANALYTICAL PROCEDURES

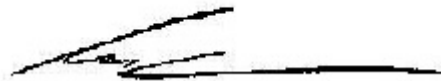
ALS CODE	DESCRIPTION	
C-GAS05	Inorganic Carbon (CO2)	
C-IR07	Total Carbon (Leco)	LECO
S-GRA06	Sulfate Sulfur - carbonate leach	WST-SEQ
ME-MS41	Ultra Trace Aqua Regia ICP-MS	
OA-VOL08m	Modified NP	
S-IR08	Total Sulphur (Leco)	LECO
OA-ELE07	Paste pH	
S-CAL06a	Sulfide Sulfur (calculated*)	
S-GRA06a	Sulfate Sulfur (HCl leachable)	WST-SEQ

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Signature:


Colin Ramshaw, Vancouver Laboratory Manager



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QC CERTIFICATE OF ANALYSIS VA18062594

Sample Description	Method Analyte Units LOR	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-ELE07	S-IR08	C-GAS05	C-GAS05	S-GRA06a	C-IR07	S-GRA06	ME-MS41	ME-MS41	ME-MS41
		FIZZ RAT	MPA	NNP	NP	Ratio (N	pH	S	C	CO2	S	C	S	Ag	Al	As
		Unity	tCaCO3/1Kt	tCaCO3/1Kt	tCaCO3/1Kt	Unity	Unity	%	%	%	%	%	%	ppm	%	ppm
		1	0.3	1	1	0.01	0.1	0.01	0.05	0.2	0.01	0.01	0.01	0.01	0.01	0.1
STANDARDS																
Buffer pH6							6.0									
Buffer pH6							6.1									
Target Range - Lower Bound							5.3									
Upper Bound							6.7									
CO-ASSAY									0.50	1.8						
Target Range - Lower Bound									0.42	1.5						
Upper Bound									0.64	2.4						
GS310-10								0.28				1.06				
Target Range - Lower Bound								0.25				1.03				
Upper Bound								0.29				1.13				
KZK-1		2	25.0	31	56	2.24										
KZK-1		2	25.0	31	56	2.24										
Target Range - Lower Bound		<1	22.9	30	54	2.18										
Upper Bound		>4	27.1	38	64	2.53										
MA-1b								1.17				2.39				
Target Range - Lower Bound								1.12				2.34				
Upper Bound								1.22				2.54				
MRGeo08														4.25	2.57	32.5
Target Range - Lower Bound														4.00	2.44	29.6
Upper Bound														4.92	3.00	36.4
OREAS 905														0.49	0.76	32.3
Target Range - Lower Bound														0.45	0.73	28.4
Upper Bound														0.58	0.91	35.0
UTS-1													0.89			
Target Range - Lower Bound													0.83			
Upper Bound													0.93			
UTS-1											0.92					
Target Range - Lower Bound											0.81					
Upper Bound											0.95					
UTS-4													1.76			
Target Range - Lower Bound													1.64			
Upper Bound													1.84			
UTS-4											1.77					
Target Range - Lower Bound											1.61					
Upper Bound											1.87					



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QC CERTIFICATE OF ANALYSIS VA18062594

Sample Description	Method Analyte Units LOR	ME-MS41 Au ppm 0.02	ME-MS41 B ppm 10	ME-MS41 Ba ppm 10	ME-MS41 Be ppm 0.05	ME-MS41 Bi ppm 0.01	ME-MS41 Ca % 0.01	ME-MS41 Cd ppm 0.01	ME-MS41 Ce ppm 0.02	ME-MS41 Co ppm 0.1	ME-MS41 Cr ppm 1	ME-MS41 Cs ppm 0.05	ME-MS41 Cu ppm 0.2	ME-MS41 Fe % 0.01	ME-MS41 Ga ppm 0.05	ME-MS41 Ge ppm 0.05
STANDARDS																
Buffer pH6																
Buffer pH6																
Target Range - Lower Bound																
Upper Bound																
CO - ASSAY																
Target Range - Lower Bound																
Upper Bound																
GS310-10																
Target Range - Lower Bound																
Upper Bound																
KZK-1																
KZK-1																
Target Range - Lower Bound																
Upper Bound																
MA-1b																
Target Range - Lower Bound																
Upper Bound																
MRGeo08		<0.02	<10	410	0.71	0.61	1.03	2.14	70.8	17.5	83	10.30	624	3.36	8.91	0.14
Target Range - Lower Bound		<0.02	<10	370	0.67	0.60	1.00	2.01	66.2	17.0	81	9.40	587	3.22	8.73	0.07
Upper Bound		0.04	20	530	0.95	0.76	1.24	2.47	81.0	21.0	102	11.60	675	3.96	10.80	0.29
OREAS 905		0.36	<10	220	0.80	5.38	0.31	0.33	76.4	13.0	15	1.13	1520	3.16	5.76	0.08
Target Range - Lower Bound		0.33	<10	200	0.78	5.16	0.29	0.30	69.7	12.4	15	1.05	1450	3.14	5.45	<0.05
Upper Bound		0.45	20	300	1.08	6.32	0.38	0.38	85.3	15.4	20	1.39	1670	3.86	6.77	0.22
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18062594

Sample Description	Method Analyte Units LOR	ME-MS41 Hf ppm 0.02	ME-MS41 Hg ppm 0.01	ME-MS41 In ppm 0.005	ME-MS41 K % 0.01	ME-MS41 La ppm 0.2	ME-MS41 Li ppm 0.1	ME-MS41 Mg % 0.01	ME-MS41 Mn ppm 5	ME-MS41 Mo ppm 0.05	ME-MS41 Na % 0.01	ME-MS41 Nb ppm 0.05	ME-MS41 Ni ppm 0.2	ME-MS41 P ppm 10	ME-MS41 Pb ppm 0.2	ME-MS41 Rb ppm 0.1
STANDARDS																
Buffer pH6																
Buffer pH6																
Target Range - Lower Bound																
Upper Bound																
CO - ASSAY																
Target Range - Lower Bound																
Upper Bound																
GS310-10																
Target Range - Lower Bound																
Upper Bound																
KZK-1																
KZK-1																
Target Range - Lower Bound																
Upper Bound																
MA-1b																
Target Range - Lower Bound																
Upper Bound																
MRGeo08		0.70	0.06	0.149	1.19	35.3	32.4	1.11	384	13.55	0.32	1.02	672	940	1005	135.0
Target Range - Lower Bound		0.64	0.04	0.137	1.12	33.2	29.6	1.03	378	13.10	0.30	0.79	622	900	959	132.0
Upper Bound		0.83	0.10	0.179	1.40	41.0	36.4	1.29	473	16.10	0.39	1.09	760	1130	1175	162.0
OREAS 905		1.09	0.01	0.549	0.29	38.4	3.9	0.14	311	2.69	0.09	0.24	8.4	220	15.2	17.0
Target Range - Lower Bound		1.02	<0.01	0.517	0.28	34.7	4.0	0.13	310	2.65	0.07	0.19	7.8		14.4	16.3
Upper Bound		1.29	0.04	0.643	0.36	42.9	5.2	0.19	390	3.35	0.12	0.43	10.0		18.0	20.1
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18062594

Sample Description	Method Analyte Units LOR	ME-MS41 Re ppm	ME-MS41 S %	ME-MS41 Sb ppm	ME-MS41 Sc ppm	ME-MS41 Se ppm	ME-MS41 Sn ppm	ME-MS41 Sr ppm	ME-MS41 Ta ppm	ME-MS41 Te ppm	ME-MS41 Th ppm	ME-MS41 Ti %	ME-MS41 Tl ppm	ME-MS41 U ppm	ME-MS41 V ppm	ME-MS41 W ppm
		0.001	0.01	0.05	0.1	0.2	0.2	0.2	0.01	0.01	0.2	0.005	0.02	0.05	1	0.05
STANDARDS																
Buffer pH6																
Buffer pH6																
Target Range - Lower Bound																
Upper Bound																
CO - ASSAY																
Target Range - Lower Bound																
Upper Bound																
GS310-10																
Target Range - Lower Bound																
Upper Bound																
KZK-1																
KZK-1																
Target Range - Lower Bound																
Upper Bound																
MA-1b																
Target Range - Lower Bound																
Upper Bound																
MRGeo08		0.007	0.29	2.90	7.0	0.9	3.2	74.5	0.01	0.02	20.3	0.358	0.73	5.09	93	2.75
Target Range - Lower Bound		0.006	0.27	2.80	6.7	0.9	2.8	72.1	<0.01	<0.01	19.1	0.338	0.64	4.93	90	2.44
Upper Bound		0.010	0.35	3.90	8.4	1.9	4.0	88.5	0.03	0.04	23.7	0.424	0.92	6.13	112	3.42
OREAS 905		<0.001	0.07	0.90	1.6	2.4	1.2	11.8	<0.01	0.07	8.1	0.018	0.10	2.06	5	0.50
Target Range - Lower Bound		<0.001	0.04	0.83	1.5	1.8	0.8	10.9	<0.01	0.04	7.4	0.008	0.06	1.92	4	0.41
Upper Bound		0.002	0.09	1.23	2.0	2.8	1.7	13.7	0.02	0.09	9.4	0.030	0.16	2.46	8	0.73
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18062594

Sample Description	Method Analyte Units LOR	ME-MS41 Y ppm 0.05	ME-MS41 Zn ppm 2	ME-MS41 Zr ppm 0.5
STANDARDS				
Buffer pH6				
Buffer pH6				
Target Range - Lower Bound				
Upper Bound				
CO - ASSAY				
Target Range - Lower Bound				
Upper Bound				
GS310-10				
Target Range - Lower Bound				
Upper Bound				
KZK-1				
KZK-1				
Target Range - Lower Bound				
Upper Bound				
MA-1b				
Target Range - Lower Bound				
Upper Bound				
MRGeo08		18.45	720	22.5
Target Range - Lower Bound		17.50	708	18.1
Upper Bound		21.5	870	25.7
OREAS 905		6.74	59	44.0
Target Range - Lower Bound		6.32	56	39.9
Upper Bound		7.84	72	55.1
UTS-1				
Target Range - Lower Bound				
Upper Bound				
UTS-1				
Target Range - Lower Bound				
Upper Bound				
UTS-4				
Target Range - Lower Bound				
Upper Bound				
UTS-4				
Target Range - Lower Bound				
Upper Bound				



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QC CERTIFICATE OF ANALYSIS VA18062594

Method Analyte Units LOR	OA-VOL08m FIZZ RAT Unity	OA-VOL08m MPA tCaCO3/1Kt	OA-VOL08m NNP tCaCO3/1Kt	OA-VOL08m NP tCaCO3/1Kt	OA-VOL08m Ratio (N) Unity	OA-ELE07 pH Unity	S-IR08 S %	C-GAS05 C %	C-GAS05 CO2 %	S-GRA06a S %	C-IR07 C %	S-GRA06 S %	ME-MS41 Ag ppm	ME-MS41 Al %	ME-MS41 As ppm
Sample Description	1	0.3	1	1	0.01	0.1	0.01	0.05	0.2	0.01	0.01	0.01	0.01	0.01	0.1
BLANK	BLANKS														
Target Range - Lower Bound								<0.05	<0.2						
Upper Bound								<0.05	<0.2						
BLANK								0.10	0.4						
Target Range - Lower Bound													<0.01	<0.01	<0.1
Upper Bound													<0.01	<0.01	<0.1
BLANK						6.3									
Target Range - Lower Bound						5.5									
Upper Bound						6.9									
BLANK												<0.01			
Target Range - Lower Bound												<0.01			
Upper Bound												0.02			
BLANK									<0.01						
Target Range - Lower Bound									<0.01						
Upper Bound									0.02						
BLANK							<0.01				0.01				
Target Range - Lower Bound							<0.01				<0.01				
Upper Bound							0.02				0.02				
DUPLICATES															
ORIGINAL													0.08	0.40	1.3
DUP													0.08	0.45	1.4
Target Range - Lower Bound													0.07	0.39	1.2
Upper Bound													0.09	0.46	1.5
ORIGINAL										<0.01					
DUP										0.02					
Target Range - Lower Bound										<0.01					
Upper Bound										0.02					
L2069235 - 8 149500													<0.01		
DUP													<0.01		
Target Range - Lower Bound													<0.01		
Upper Bound													0.02		



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QC CERTIFICATE OF ANALYSIS VA18062594

Sample Description	Method Analyte Units LOR	ME-MS41 Au ppm 0.02	ME-MS41 B ppm 10	ME-MS41 Ba ppm 10	ME-MS41 Be ppm 0.05	ME-MS41 Bi ppm 0.01	ME-MS41 Ca % 0.01	ME-MS41 Cd ppm 0.01	ME-MS41 Ce ppm 0.02	ME-MS41 Co ppm 0.1	ME-MS41 Cr ppm 1	ME-MS41 Cs ppm 0.05	ME-MS41 Cu ppm 0.2	ME-MS41 Fe % 0.01	ME-MS41 Ga ppm 0.05	ME-MS41 Ge ppm 0.05
BLANKS																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK		<0.02	<10	<10	<0.05	<0.01	<0.01	<0.01	<0.02	<0.1	<1	<0.05	<0.2	<0.01	<0.05	<0.05
Target Range - Lower Bound		<0.02	<10	<10	<0.05	<0.01	<0.01	<0.01	<0.02	<0.1	<1	<0.05	<0.2	<0.01	<0.05	<0.05
Upper Bound		0.04	20	20	0.10	0.02	0.02	0.02	0.04	0.2	2	0.10	0.4	0.02	0.10	0.10
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
DUPLICATES																
ORIGINAL		<0.02	<10	<10	<0.05	1.25	0.03	<0.01	1.76	0.9	3	<0.05	3.3	0.42	1.71	<0.05
DUP		<0.02	<10	10	<0.05	1.28	0.05	0.01	1.97	0.9	3	<0.05	3.3	0.42	1.88	<0.05
Target Range - Lower Bound		<0.02	<10	<10	<0.05	1.19	0.03	<0.01	1.75	0.8	2	<0.05	3.0	0.39	1.66	<0.05
Upper Bound		0.04	20	20	0.10	1.34	0.05	0.02	1.98	1.0	4	0.10	3.6	0.45	1.93	0.10
ORIGINAL																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2069235 - 8 149500																
DUP																
Target Range - Lower Bound																
Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18062594

Sample Description	Method Analyte Units LOR	ME-MS41 Hf ppm 0.02	ME-MS41 Hg ppm 0.01	ME-MS41 In ppm 0.005	ME-MS41 K % 0.01	ME-MS41 La ppm 0.2	ME-MS41 Li ppm 0.1	ME-MS41 Mg % 0.01	ME-MS41 Mn ppm 5	ME-MS41 Mo ppm 0.05	ME-MS41 Na % 0.01	ME-MS41 Nb ppm 0.05	ME-MS41 Ni ppm 0.2	ME-MS41 P ppm 10	ME-MS41 Pb ppm 0.2	ME-MS41 Rb ppm 0.1
BLANKS																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK		<0.02	<0.01	<0.005	<0.01	<0.2	<0.1	<0.01	<5	<0.05	<0.01	<0.05	<0.2	<10	<0.2	<0.1
Target Range - Lower Bound		<0.02	<0.01	<0.005	<0.01	<0.2	<0.1	<0.01	<5	<0.05	<0.01	<0.05	<0.2	<10	<0.2	<0.1
Upper Bound		0.04	0.02	0.010	0.02	0.4	0.2	0.02	10	0.10	0.02	0.10	0.4	20	0.4	0.2
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
DUPLICATES																
ORIGINAL		0.02	<0.01	0.005	0.07	0.9	0.1	0.01	33	0.95	0.06	<0.05	0.9	50	6.8	0.4
DUP		0.02	<0.01	<0.005	0.08	1.0	<0.1	0.01	33	0.97	0.07	<0.05	0.9	60	7.2	0.4
Target Range - Lower Bound		<0.02	<0.01	<0.005	0.06	0.7	<0.1	<0.01	26	0.86	0.05	<0.05	0.7	40	6.5	0.3
Upper Bound		0.04	0.02	0.010	0.09	1.2	0.2	0.02	40	1.06	0.08	0.10	1.1	70	7.6	0.5
ORIGINAL																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2069235-8 149500																
DUP																
Target Range - Lower Bound																
Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18062594

Sample Description	Method Analyte Units LOR	ME-MS41 Re ppm	ME-MS41 S %	ME-MS41 Sb ppm	ME-MS41 Sc ppm	ME-MS41 Se ppm	ME-MS41 Sn ppm	ME-MS41 Sr ppm	ME-MS41 Ta ppm	ME-MS41 Te ppm	ME-MS41 Th ppm	ME-MS41 Ti %	ME-MS41 Tl ppm	ME-MS41 U ppm	ME-MS41 V ppm	ME-MS41 W ppm
		0.001	0.01	0.05	0.1	0.2	0.2	0.2	0.01	0.01	0.2	0.005	0.02	0.05	1	0.05
BLANKS																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK		<0.001	<0.01	<0.05	<0.1	<0.2	<0.2	<0.2	<0.01	<0.01	<0.2	<0.005	<0.02	<0.05	<1	<0.05
Target Range - Lower Bound		<0.001	<0.01	<0.05	<0.1	<0.2	<0.2	<0.2	<0.01	<0.01	<0.2	<0.005	<0.02	<0.05	<1	<0.05
Upper Bound		0.002	0.02	0.10	0.2	0.4	0.4	0.4	0.02	0.02	0.4	0.010	0.04	0.10	2	0.10
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
DUPLICATES																
ORIGINAL		<0.001	0.35	0.34	0.4	1.2	0.7	20.5	<0.01	0.23	0.2	<0.005	0.03	<0.05	7	<0.05
DUP		<0.001	0.39	0.37	0.4	1.2	0.8	23.1	<0.01	0.25	0.2	<0.005	0.03	<0.05	8	<0.05
Target Range - Lower Bound		<0.001	0.34	0.28	0.3	0.9	0.5	20.5	<0.01	0.22	<0.2	<0.005	<0.02	<0.05	6	<0.05
Upper Bound		0.002	0.40	0.43	0.5	1.5	1.0	23.1	0.02	0.26	0.4	0.010	0.04	0.10	9	0.10
ORIGINAL																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2069235-8 149500																
DUP																
Target Range - Lower Bound																
Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18062594

Sample Description	Method Analyte Units LOR	ME-MS41 Y ppm 0.05	ME-MS41 Zn ppm 2	ME-MS41 Zr ppm 0.5
BLANKS				
BLANK				
Target Range - Lower Bound				
Upper Bound				
BLANK		<0.05	<2	<0.5
Target Range - Lower Bound		<0.05	<2	<0.5
Upper Bound		0.10	4	1.0
BLANK				
Target Range - Lower Bound				
Upper Bound				
BLANK				
Target Range - Lower Bound				
Upper Bound				
BLANK				
Target Range - Lower Bound				
Upper Bound				
BLANK				
Target Range - Lower Bound				
Upper Bound				
DUPLICATES				
ORIGINAL		0.20	2	0.7
DUP		0.20	2	0.7
Target Range - Lower Bound		0.14	<2	<0.5
Upper Bound		0.26	4	1.0
ORIGINAL				
DUP				
Target Range - Lower Bound				
Upper Bound				
L2069235-8 149500				
DUP				
Target Range - Lower Bound				
Upper Bound				



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QC CERTIFICATE OF ANALYSIS VA18062594

Sample Description	Method Analyte Units LOR	OA-VOL08m FIZZ RAT Unity	OA-VOL08m MPA tCaCO3/1Kt	OA-VOL08m NNP tCaCO3/1Kt	OA-VOL08m NP tCaCO3/1Kt	OA-VOL08m Ratio (N) Unity	OA-ELE07 pH Unity	S-IR08 S %	C-GAS05 C %	C-GAS05 CO2 %	S-GRA06a S %	C-IR07 C %	S-GRA06 S %	ME-MS41 Ag ppm	ME-MS41 Al %	ME-MS41 As ppm
		1	0.3	1	1	0.01	0.1	0.01	0.05	0.2	0.01	0.01	0.01	0.01	0.01	0.1
DUPLICATES																
L2069236-1 156252		2	7.2	28	35	4.87	9.0		0.63	2.3						
DUP		2	7.2	27	34	4.73	9.1		0.62	2.3						
Target Range - Lower Bound		<1	6.5	25	32	4.55	8.5		0.54	2.0						
Upper Bound		3	7.9	30	37	5.05	9.6		0.71	2.6						
ORIGINAL								0.01				0.05				
DUP								<0.01				0.05				
Target Range - Lower Bound								<0.01				0.04				
Upper Bound								0.02				0.06				



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QC CERTIFICATE OF ANALYSIS VA18062594

Sample Description	Method Analyte Units LOR	ME-MS41 Au ppm 0.02	ME-MS41 B ppm 10	ME-MS41 Ba ppm 10	ME-MS41 Be ppm 0.05	ME-MS41 Bi ppm 0.01	ME-MS41 Ca % 0.01	ME-MS41 Cd ppm 0.01	ME-MS41 Ce ppm 0.02	ME-MS41 Co ppm 0.1	ME-MS41 Cr ppm 1	ME-MS41 Cs ppm 0.05	ME-MS41 Cu ppm 0.2	ME-MS41 Fe % 0.01	ME-MS41 Ga ppm 0.05	ME-MS41 Ge ppm 0.05
L2069236-1 156252 DUP Target Range - Lower Bound Upper Bound		DUPLICATES														
ORIGINAL DUP Target Range - Lower Bound Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18062594

Sample Description	Method Analyte Units LOR	ME-MS41 Hf ppm 0.02	ME-MS41 Hg ppm 0.01	ME-MS41 In ppm 0.005	ME-MS41 K % 0.01	ME-MS41 La ppm 0.2	ME-MS41 Li ppm 0.1	ME-MS41 Mg % 0.01	ME-MS41 Mn ppm 5	ME-MS41 Mo ppm 0.05	ME-MS41 Na % 0.01	ME-MS41 Nb ppm 0.05	ME-MS41 Ni ppm 0.2	ME-MS41 P ppm 10	ME-MS41 Pb ppm 0.2	ME-MS41 Rb ppm 0.1
L2069236-1 156252 DUP Target Range - Lower Bound Upper Bound		DUPLICATES														
ORIGINAL DUP Target Range - Lower Bound Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18062594

Sample Description	Method Analyte Units LOR	ME-MS41 Re ppm 0.001	ME-MS41 S % 0.01	ME-MS41 Sb ppm 0.05	ME-MS41 Sc ppm 0.1	ME-MS41 Se ppm 0.2	ME-MS41 Sn ppm 0.2	ME-MS41 Sr ppm 0.2	ME-MS41 Ta ppm 0.01	ME-MS41 Te ppm 0.01	ME-MS41 Th ppm 0.2	ME-MS41 Ti % 0.005	ME-MS41 Tl ppm 0.02	ME-MS41 U ppm 0.05	ME-MS41 V ppm 1	ME-MS41 W ppm 0.05
L2069236-1 156252 DUP Target Range - Lower Bound Upper Bound		DUPLICATES														
ORIGINAL DUP Target Range - Lower Bound Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18062594

Sample Description	Method Analyte Units LOR	ME-MS41 Y ppm 0.05	ME-MS41 Zn ppm 2	ME-MS41 Zr ppm 0.5
L2069236-1 156252 DUP Target Range - Lower Bound Upper Bound		DUPLICATES		
ORIGINAL DUP Target Range - Lower Bound Upper Bound				



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QC CERTIFICATE OF ANALYSIS VA18062594

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

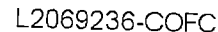
LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

C-GAS05	C-IR07	LOG-22	ME-MS41
OA-ELE07	OA-VOL08m	PUL-31	S-CAL06a
S-GRA06	S-GRA06a	S-IR08	SPL-21
WEI-21			



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1. If any water samples are taken from a Regulated Drinking Water (DW) System please submit using an Authorized DW COC form.

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Date Received: 23-MAR-18
Report Date: 24-APR-18 14:25 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2072113

Project P.O. #: 229850

Job Reference:

C of C Numbers: 18-11

Legal Site Desc:

Comments: Please note, the ALS Minerals version of the finalized report and QC can be found at the end of the attachment.

Shane Stack
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2072113-1 Waste 06-MAR-18 156262	L2072113-2 Waste 10-MAR-18 156263	L2072113-3 Tails JAN TAL 2018	L2072113-4 Waste 10-MAR-18 156264	L2072113-5 Waste 14-MAR-18 156265
Grouping	Analyte					
SOIL						
Physical Tests	pH (Unity)	9.3	9.0	8.1	9.1	9.0
Organic / Inorganic Carbon	Carbon (C) (%)	0.19	0.58	0.25	0.77	0.50
Acid Base Accounting	FIZZ RATING (Unity)	2	2	2	2	2
	MPA (tCaCO3/1Kt)	3.1	3.8	3.4	3.4	1.3
	Neutralization Potential (NP) (tCaCO3/1Kt)	20	39	22	55	34
	NNP (tCaCO3/1Kt)	17	35	19	52	33
	Ratio (NP/MPA) (Unity)	6.40	10.40	6.40	16.00	27.20
	Sulfate Sulfur (carbonate leach) (%)	0.01	<0.01	0.03	<0.01	0.01
	Sulfate Sulfur (HCl leach) (%)	<0.01	0.01	0.06	0.01	0.02
	Sulfide Sulfur (T minus HCl leach) (%)	0.10	0.11	0.05	0.10	0.02
	Total Sulfur (combustion) (%)	0.10	0.12	0.11	0.11	0.04
Total Metals	Aluminum (Al) (%)	1.18	1.04	1.08	0.78	1.16
	Antimony (Sb) (ppm)	<0.05	<0.05	<0.05	<0.05	<0.05
	Arsenic (As) (ppm)	0.8	1.7	1.8	1.4	1.0
	Barium (Ba) (ppm)	310	190	200	170	350
	Beryllium (Be) (ppm)	0.18	0.33	0.22	0.34	0.31
	Bismuth (Bi) (ppm)	0.10	0.23	0.39	0.11	0.10
	Boron (B) (ppm)	<10	<10	<10	<10	<10
	Cadmium (Cd) (ppm)	0.03	0.09	0.30	0.11	0.14
	Calcium (Ca) (%)	0.74	1.32	0.85	1.53	1.18
	Cerium (Ce) (ppm)	50.5	23.9	18.70	23.9	34.8
	Cesium (Cs) (ppm)	0.39	0.61	0.49	0.62	0.45
	Chromium (Cr) (ppm)	6	4	6	4	7
	Cobalt (Co) (ppm)	5.0	5.8	7.6	5.3	7.5
	Copper (Cu) (ppm)	1240	1770	2090	1155	608
	Gallium (Ga) (ppm)	5.25	5.26	7.89	4.14	5.59
	Germanium (Ge) (ppm)	0.10	0.10	0.10	0.10	0.11
	Gold (Au) (ppm)	0.27	0.04	0.11	0.03	<0.02
	Hafnium (Hf) (ppm)	0.02	0.05	0.05	0.04	0.06
	Indium (In) (ppm)	0.027	0.068	0.082	0.049	0.040
	Iron (Fe) (%)	2.29	2.56	4.53	2.31	3.04
	Lanthanum (La) (ppm)	27.1	12.8	10.0	12.3	18.5
	Lead (Pb) (ppm)	2.3	4.1	3.1	3.8	2.9
	Lithium (Li) (ppm)	5.4	4.8	5.0	3.3	4.6
	Magnesium (Mg) (%)	0.59	0.73	0.61	0.77	0.73
	Manganese (Mn) (ppm)	459	584	671	580	727

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2072113-6 Waste 14-MAR-18 156266	L2072113-7 Waste 16-MAR-18 156267	L2072113-8 Waste 18-MAR-18 156268	L2072113-9 Waste 18-MAR-18 156269	L2072113-10 Waste 18-MAR-18 156270
Grouping	Analyte					
SOIL						
Physical Tests	pH (Unity)	9.1	9.0	8.9	8.8	9.1
Organic / Inorganic Carbon	Carbon (C) (%)	0.18	0.63	0.50	0.55	0.41
Acid Base Accounting	FIZZ RATING (Unity)	2	2	2	2	2
	MPA (tCaCO3/1Kt)	1.3	4.1	1.3	20.3	2.8
	Neutralization Potential (NP) (tCaCO3/1Kt)	28	44	47	36	33
	NNP (tCaCO3/1Kt)	27	40	46	16	30
	Ratio (NP/MPA) (Unity)	22.40	10.83	37.60	1.77	11.73
	Sulfate Sulfur (carbonate leach) (%)	<0.01	<0.01	0.01	<0.01	<0.01
	Sulfate Sulfur (HCl leach) (%)	0.01	0.01	0.01	0.01	0.02
	Sulfide Sulfur (T minus HCl leach) (%)	0.03	0.12	0.03	0.64	0.07
	Total Sulfur (combustion) (%)	0.04	0.13	0.04	0.65	0.09
Total Metals	Aluminum (Al) (%)	1.72	0.81	1.25	1.26	1.10
	Antimony (Sb) (ppm)	<0.05	<0.05	<0.05	<0.05	<0.05
	Arsenic (As) (ppm)	3.6	1.5	1.1	0.9	0.9
	Barium (Ba) (ppm)	140	130	90	160	190
	Beryllium (Be) (ppm)	0.50	0.34	0.42	0.36	0.28
	Bismuth (Bi) (ppm)	0.04	0.26	0.06	0.05	0.04
	Boron (B) (ppm)	10	<10	<10	<10	<10
	Cadmium (Cd) (ppm)	0.04	0.14	0.07	0.14	0.08
	Calcium (Ca) (%)	1.63	1.35	1.83	1.33	1.18
	Cerium (Ce) (ppm)	26.7	24.9	26.1	36.4	31.7
	Cesium (Cs) (ppm)	0.27	0.35	0.35	0.51	0.41
	Chromium (Cr) (ppm)	16	4	5	4	4
	Cobalt (Co) (ppm)	9.4	5.8	5.8	14.3	6.4
	Copper (Cu) (ppm)	21.1	1940	385	1180	273
	Gallium (Ga) (ppm)	7.13	4.58	6.13	7.21	5.65
	Germanium (Ge) (ppm)	0.11	0.08	0.09	0.11	0.09
	Gold (Au) (ppm)	<0.02	0.05	<0.02	<0.02	<0.02
	Hafnium (Hf) (ppm)	0.38	0.05	0.04	0.07	0.04
	Indium (In) (ppm)	0.023	0.051	0.033	0.089	0.031
	Iron (Fe) (%)	2.68	2.40	2.63	3.89	2.54
	Lanthanum (La) (ppm)	14.2	13.1	14.0	19.3	17.5
	Lead (Pb) (ppm)	8.8	5.8	3.8	6.6	3.5
	Lithium (Li) (ppm)	11.6	4.3	7.5	7.5	5.3
	Magnesium (Mg) (%)	1.49	0.64	0.79	0.83	0.60
	Manganese (Mn) (ppm)	580	605	691	700	463

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2072113-1 Waste 06-MAR-18 156262	L2072113-2 Waste 10-MAR-18 156263	L2072113-3 Tails JAN TAL 2018	L2072113-4 Waste 10-MAR-18 156264	L2072113-5 Waste 14-MAR-18 156265
Grouping	Analyte					
SOIL						
Total Metals	Mercury (Hg) (ppm)	0.01	<0.01	0.03	<0.01	<0.01
	Molybdenum (Mo) (ppm)	1.41	6.96	2.99	2.45	14.30
	Nickel (Ni) (ppm)	2.8	3.5	3.8	3.5	4.8
	Niobium (Nb) (ppm)	0.23	0.19	0.25	0.20	0.13
	Phosphorus (P) (ppm)	620	720	670	690	810
	Potassium (K) (%)	0.71	0.54	0.55	0.42	0.72
	Rhenium (Re) (ppm)	0.003	0.013	0.003	0.006	0.011
	Rubidium (Rb) (ppm)	34.2	28.0	29.6	22.2	34.6
	Scandium (Sc) (ppm)	1.8	4.3	4.4	4.4	5.1
	Selenium (Se) (ppm)	1.0	1.3	1.5	1.2	0.3
	Silver (Ag) (ppm)	0.48	0.49	0.69	0.35	0.36
	Sodium (Na) (%)	0.09	0.07	0.06	0.07	0.07
	Strontium (Sr) (ppm)	45.3	108.5	69.2	162.0	94.5
	Sulfur (S) (%)	0.11	0.14	0.13	0.11	0.05
	Tantalum (Ta) (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01
	Tellurium (Te) (ppm)	0.10	0.10	0.41	0.09	0.05
	Thallium (Tl) (ppm)	0.23	0.18	0.21	0.16	0.20
	Thorium (Th) (ppm)	8.3	3.2	3.4	3.6	4.5
	Tin (Sn) (ppm)	0.6	0.7	1.0	0.7	0.7
	Titanium (Ti) (%)	0.122	0.079	0.099	0.059	0.117
	Tungsten (W) (ppm)	1.63	0.63	0.10	0.92	0.81
	Uranium (U) (ppm)	0.33	0.25	0.25	0.28	0.44
	Vanadium (V) (ppm)	48	52	72	48	67
	Yttrium (Y) (ppm)	4.63	7.33	5.94	10.90	9.77
	Zinc (Zn) (ppm)	68	77	110	59	104
	Zirconium (Zr) (ppm)	0.5	1.3	1.2	1.2	1.3
Permanent Gases	Carbon Dioxide (CO2) (%)	0.7	2.1	0.9	2.8	1.8
Miscellaneous	Carbon (C) (%)	0.27	0.67	0.29	0.91	0.63

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2072113-6 Waste 14-MAR-18 156266	L2072113-7 Waste 16-MAR-18 156267	L2072113-8 Waste 18-MAR-18 156268	L2072113-9 Waste 18-MAR-18 156269	L2072113-10 Waste 18-MAR-18 156270
Grouping	Analyte					
SOIL						
Total Metals	Mercury (Hg) (ppm)	0.01	0.01	<0.01	0.01	0.01
	Molybdenum (Mo) (ppm)	0.84	0.77	0.43	2.11	1.24
	Nickel (Ni) (ppm)	36.9	5.0	2.5	2.5	2.3
	Niobium (Nb) (ppm)	0.24	0.12	<0.05	0.15	0.19
	Phosphorus (P) (ppm)	990	560	680	1050	600
	Potassium (K) (%)	0.17	0.29	0.17	0.36	0.50
	Rhenium (Re) (ppm)	0.001	0.001	<0.001	0.006	0.003
	Rubidium (Rb) (ppm)	6.7	14.6	9.1	21.3	24.5
	Scandium (Sc) (ppm)	5.0	4.3	4.9	5.9	3.4
	Selenium (Se) (ppm)	0.2	1.0	0.3	0.9	0.4
	Silver (Ag) (ppm)	0.04	0.45	0.13	0.23	0.12
	Sodium (Na) (%)	0.18	0.07	0.06	0.06	0.08
	Strontium (Sr) (ppm)	115.5	128.0	114.5	74.1	76.0
	Sulfur (S) (%)	0.03	0.15	0.04	0.74	0.10
	Tantalum (Ta) (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01
	Tellurium (Te) (ppm)	<0.01	0.09	0.03	0.07	0.03
	Thallium (Tl) (ppm)	0.05	0.11	0.05	0.22	0.18
	Thorium (Th) (ppm)	2.9	4.9	3.3	5.6	4.8
	Tin (Sn) (ppm)	0.6	0.5	0.6	2.2	0.9
	Titanium (Ti) (%)	0.180	0.029	0.013	0.055	0.076
	Tungsten (W) (ppm)	1.07	0.72	0.23	0.45	0.46
	Uranium (U) (ppm)	0.94	0.40	0.33	0.59	0.48
	Vanadium (V) (ppm)	61	37	47	68	51
	Yttrium (Y) (ppm)	7.91	6.45	9.29	12.00	6.25
	Zinc (Zn) (ppm)	70	83	71	90	59
	Zirconium (Zr) (ppm)	12.8	1.5	0.8	1.6	0.9
Permanent Gases	Carbon Dioxide (CO2) (%)	0.7	2.3	1.8	2.0	1.5
Miscellaneous	Carbon (C) (%)	0.30	0.77	0.60	0.67	0.51

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ABA-OA-VOL08-AX	Soil	Acid Base Accounting	OA-VOL08
CARBON-C-GAS05-AX	Soil	Carbon, TOC and CO ₂	C-GAS05
CARBON-C-IR07-AX	Soil	Carbon (C) using LECO analyzer	Total Carbon - Method Code C-IR07
Total Carbon & Sulfur - Method Codes C-IR07 & S-IR08			
A 0.1g sample is heated to approximately 1350°C in an induction furnace while passing a stream of oxygen through the sample. Carbon dioxide & sulfur dioxide released from the sample are measured by an IR detection system (Leco analyzer) and the total carbon & sulfur results are provided.			
ME-MS41-AX	Soil	Aqua Regia ICPMS	Aqua Regia ICPMS
A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences.			
PH-OA-ELE07-AX	Soil	pH	OA-ELE07
SULPHUR-S-CAL06A-AX	Soil	Sulfide Sulfur Calc from HCl Leach	ALS Minerals S-CAL06A
Sulfide Sulfur (as S) is calculated by subtracting the HCl Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion.			
SULPHUR-S-GRA06-AX	Soil	Sulfate Sulfur in Soil (Carbonate Leach)	ALS Minerals S-GRA06
A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).			
SULPHUR-S-GRA06A-AX	Soil	Sulfate Sulfur in Soil (HCl Leach)	ALS Minerals S-GRA06A
A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).			
SULPHUR-S-IR08-AX	Soil	Total Sulfur in Soil by Combustion	ALS Minerals S-IR08
The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
AX	ALS MINERALS - VANCOUVER, B.C., CANADA

Chain of Custody Numbers:

18-11

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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Plus Appendix Pages
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Account: **APN**

CERTIFICATE VA18072656

Project: L2072113

This report is for 10 Crushed Rock samples submitted to our lab in Vancouver, BC, Canada on 29-MAR-2018.

The following have access to data associated with this certificate:

CASDG ALSE

ALSEV DATASUBLET

SHANE STACK

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI-21	Received Sample Weight
SPL-21	Split sample - riffle splitter
LOG-22	Sample login - Rcd w/o BarCode
PUL-31	Pulverize split to 85% <75 um

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	
C-GAS05	Inorganic Carbon (CO2)	
C-IR07	Total Carbon (Leco)	LECO
S-GRA06	Sulfate Sulfur - carbonate leach	WST-SEQ
ME-MS41	Ultra Trace Aqua Regia ICP-MS	
OA-VOL08m	Modified NP	
S-IR08	Total Sulphur (Leco)	LECO
OA-ELE07	Paste pH	
S-CAL06a	Sulfide Sulfur (calculated*)	
S-GRA06a	Sulfate Sulfur (HCl leachable)	WST-SEQ

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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature:

Colin Ramshaw, Vancouver Laboratory Manager



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CERTIFICATE OF ANALYSIS VA18072656

Sample Description	Method Analyte Units LOR	WEI-21	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-ELE07	S-IR08	S-CAL06a	C-GAS05	C-GAS05	S-GRA06a	C-IR07	S-GRA06	ME-MS41
		Recvd Wt.	FIZZ RAT	MPA	NNP	NP	Ratio (N	pH	S	S	C	CO2	S	C	S	Ag
		kg	Unity	tCaCO3/1Kt	tCaCO3/1Kt	tCaCO3/1Kt	Unity	Unity	%	%	%	%	%	%	%	ppm
		0.02	1	0.3	1	1	0.01	0.1	0.01	0.01	0.05	0.2	0.01	0.01	0.01	0.01
L2072113-1 156262		1.00	2	3.1	17	20	6.40	9.3	0.10	0.10	0.19	0.7	<0.01	0.27	0.01	0.48
L2072113-2 156263		1.20	2	3.8	35	39	10.40	9.0	0.12	0.11	0.58	2.1	0.01	0.67	<0.01	0.49
L2072113-3 JAN TAL 2018		1.10	2	3.4	19	22	6.40	8.1	0.11	0.05	0.25	0.9	0.06	0.29	0.03	0.69
L2072113-4 156264		1.10	2	3.4	52	55	16.00	9.1	0.11	0.10	0.77	2.8	0.01	0.91	<0.01	0.35
L2072113-5 156265		1.08	2	1.3	33	34	27.20	9.0	0.04	0.02	0.50	1.8	0.02	0.63	0.01	0.36
L2072113-6 156266		0.94	2	1.3	27	28	22.40	9.1	0.04	0.03	0.18	0.7	0.01	0.30	<0.01	0.04
L2072113-7 156267		1.08	2	4.1	40	44	10.83	9.0	0.13	0.12	0.63	2.3	0.01	0.77	<0.01	0.45
L2072113-8 156268		1.06	2	1.3	46	47	37.60	8.9	0.04	0.03	0.50	1.8	0.01	0.60	0.01	0.13
L2072113-9 156269		1.04	2	20.3	16	36	1.77	8.8	0.65	0.64	0.55	2.0	0.01	0.67	<0.01	0.23
L2072113-10 156270		1.06	2	2.8	30	33	11.73	9.1	0.09	0.07	0.41	1.5	0.02	0.51	<0.01	0.12



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CERTIFICATE OF ANALYSIS VA18072656

Sample Description	Method Analyte Units LOR	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
		Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu
		%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm
		0.01	0.1	0.02	10	10	0.05	0.01	0.01	0.01	0.02	0.1	1	0.05	0.2
L2072113-1 156262		1.18	0.8	0.27	<10	310	0.18	0.10	0.74	0.03	50.5	5.0	6	0.39	1240
L2072113-2 156263		1.04	1.7	0.04	<10	190	0.33	0.23	1.32	0.09	23.9	5.8	4	0.61	1770
L2072113-3 JAN TAL 2018		1.08	1.8	0.11	<10	200	0.22	0.39	0.85	0.30	18.70	7.6	6	0.49	2090
L2072113-4 156264		0.78	1.4	0.03	<10	170	0.34	0.11	1.53	0.11	23.9	5.3	4	0.62	1155
L2072113-5 156265		1.16	1.0	<0.02	<10	350	0.31	0.10	1.18	0.14	34.8	7.5	7	0.45	608
L2072113-6 156266		1.72	3.6	<0.02	10	140	0.50	0.04	1.63	0.04	26.7	9.4	16	0.27	21.1
L2072113-7 156267		0.81	1.5	0.05	<10	130	0.34	0.26	1.35	0.14	24.9	5.8	4	0.35	1940
L2072113-8 156268		1.25	1.1	<0.02	<10	90	0.42	0.06	1.83	0.07	26.1	5.8	5	0.35	385
L2072113-9 156269		1.26	0.9	<0.02	<10	160	0.36	0.05	1.33	0.14	36.4	14.3	4	0.51	1180
L2072113-10 156270		1.10	0.9	<0.02	<10	190	0.28	0.04	1.18	0.08	31.7	6.4	4	0.41	273



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CERTIFICATE OF ANALYSIS VA18072656

Sample Description	Method Analyte Units LOR	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
		Ga	Ge	Hf	Hg	In	K	La	Li	Mg	Mn	Mo	Na	Nb	Ni
		ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	ppm	%	ppm	ppm
		0.05	0.05	0.02	0.01	0.005	0.01	0.2	0.1	0.01	5	0.05	0.01	0.05	0.2
L2072113-1 156262		5.25	0.10	0.02	0.01	0.027	0.71	27.1	5.4	0.59	459	1.41	0.09	0.23	2.8
L2072113-2 156263		5.26	0.10	0.05	<0.01	0.068	0.54	12.8	4.8	0.73	584	6.96	0.07	0.19	3.5
L2072113-3 JAN TAL 2018		7.89	0.10	0.05	0.03	0.082	0.55	10.0	5.0	0.61	671	2.99	0.06	0.25	3.8
L2072113-4 156264		4.14	0.10	0.04	<0.01	0.049	0.42	12.3	3.3	0.77	580	2.45	0.07	0.20	3.5
L2072113-5 156265		5.59	0.11	0.06	<0.01	0.040	0.72	18.5	4.6	0.73	727	14.30	0.07	0.13	4.8
L2072113-6 156266		7.13	0.11	0.38	0.01	0.023	0.17	14.2	11.6	1.49	580	0.84	0.18	0.24	36.9
L2072113-7 156267		4.58	0.08	0.05	0.01	0.051	0.29	13.1	4.3	0.64	605	0.77	0.07	0.12	5.0
L2072113-8 156268		6.13	0.09	0.04	<0.01	0.033	0.17	14.0	7.5	0.79	691	0.43	0.06	<0.05	2.5
L2072113-9 156269		7.21	0.11	0.07	0.01	0.089	0.36	19.3	7.5	0.83	700	2.11	0.06	0.15	2.5
L2072113-10 156270		5.65	0.09	0.04	0.01	0.031	0.50	17.5	5.3	0.60	463	1.24	0.08	0.19	2.3



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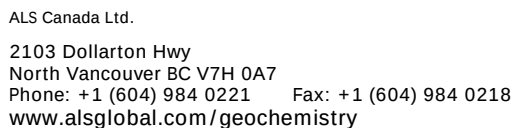
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CERTIFICATE OF ANALYSIS VA18072656

Sample Description	Method Analyte Units LOR	ME-MS41 Pb ppm 0.2	ME-MS41 Rb ppm 0.1	ME-MS41 Re ppm 0.001	ME-MS41 S % 0.01	ME-MS41 Sb ppm 0.05	ME-MS41 Sc ppm 0.1	ME-MS41 Se ppm 0.2	ME-MS41 Sn ppm 0.2	ME-MS41 Sr ppm 0.2	ME-MS41 Ta ppm 0.01	ME-MS41 Te ppm 0.01	ME-MS41 Th ppm 0.2	ME-MS41 Ti % 0.005	ME-MS41 Tl ppm 0.02	ME-MS41 U ppm 0.05
L2072113-1 156262		2.3	34.2	0.003	0.11	<0.05	1.8	1.0	0.6	45.3	<0.01	0.10	8.3	0.122	0.23	0.33
L2072113-2 156263		4.1	28.0	0.013	0.14	<0.05	4.3	1.3	0.7	108.5	<0.01	0.10	3.2	0.079	0.18	0.25
L2072113-3 JAN TAL 2018		3.1	29.6	0.003	0.13	<0.05	4.4	1.5	1.0	69.2	<0.01	0.41	3.4	0.099	0.21	0.25
L2072113-4 156264		3.8	22.2	0.006	0.11	<0.05	4.4	1.2	0.7	162.0	<0.01	0.09	3.6	0.059	0.16	0.28
L2072113-5 156265		2.9	34.6	0.011	0.05	<0.05	5.1	0.3	0.7	94.5	<0.01	0.05	4.5	0.117	0.20	0.44
L2072113-6 156266		8.8	6.7	0.001	0.03	<0.05	5.0	0.2	0.6	115.5	<0.01	<0.01	2.9	0.180	0.05	0.94
L2072113-7 156267		5.8	14.6	0.001	0.15	<0.05	4.3	1.0	0.5	128.0	<0.01	0.09	4.9	0.029	0.11	0.40
L2072113-8 156268		3.8	9.1	<0.001	0.04	<0.05	4.9	0.3	0.6	114.5	<0.01	0.03	3.3	0.013	0.05	0.33
L2072113-9 156269		6.6	21.3	0.006	0.74	<0.05	5.9	0.9	2.2	74.1	<0.01	0.07	5.6	0.055	0.22	0.59
L2072113-10 156270		3.5	24.5	0.003	0.10	<0.05	3.4	0.4	0.9	76.0	<0.01	0.03	4.8	0.076	0.18	0.48



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CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

C-GAS05	C-IR07	LOG-22	ME-MS41
OA-ELE07	OA-VOL08m	PUL-31	S-CAL06a
S-GRA06	S-GRA06a	S-IR08	SPL-21
WEI-21			



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QC CERTIFICATE VA18072656

Project: L2072113

This report is for 10 Crushed Rock samples submitted to our lab in Vancouver, BC, Canada on 29-MAR-2018.

The following have access to data associated with this certificate:

CASDG ALSE

ALSEV DATASUBLET

SHANE STACK

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI-21	Received Sample Weight
SPL-21	Split sample - riffle splitter
LOG-22	Sample login - Rcd w/o BarCode
PUL-31	Pulverize split to 85% <75 um

ANALYTICAL PROCEDURES

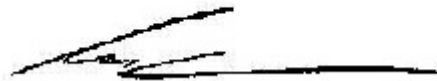
ALS CODE	DESCRIPTION	
C-GAS05	Inorganic Carbon (CO2)	
C-IR07	Total Carbon (Leco)	LECO
S-GRA06	Sulfate Sulfur - carbonate leach	WST-SEQ
ME-MS41	Ultra Trace Aqua Regia ICP-MS	
OA-VOL08m	Modified NP	
S-IR08	Total Sulphur (Leco)	LECO
OA-ELE07	Paste pH	
S-CAL06a	Sulfide Sulfur (calculated*)	
S-GRA06a	Sulfate Sulfur (HCl leachable)	WST-SEQ

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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature:


Colin Ramshaw, Vancouver Laboratory Manager



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Sample Description	Method Analyte Units LOR	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-ELE07	S-IR08	C-GAS05	C-GAS05	S-GRA06a	C-IR07	S-GRA06	ME-MS41	ME-MS41	ME-MS41
		FIZZ RAT	MPA	NNP	NP	Ratio (N)	pH	S	C	CO2	S	C	S	Ag	Al	As
		Unity	tCaCO3/1Kt	tCaCO3/1Kt	tCaCO3/1Kt	Unity	Unity	%	%	%	%	%	%	ppm	%	ppm
		1	0.3	1	1	0.01	0.1	0.01	0.05	0.2	0.01	0.01	0.01	0.01	0.01	0.1
STANDARDS																
Buffer pH6							6.1									
Buffer pH6							6.1									
Target Range - Lower Bound							5.3									
Upper Bound							6.7									
DS-1								2.62				3.16				
Target Range - Lower Bound								2.51				3.01				
Upper Bound								2.71				3.25				
GS313-8								1.21				0.95				
Target Range - Lower Bound								1.19				0.90				
Upper Bound								1.29				0.98				
KZK-1		2	25.0	30	55	2.20										
KZK-1		2	25.0	32	57	2.28										
Target Range - Lower Bound		<1	22.9	30	54	2.18										
Upper Bound		>4	27.1	38	64	2.53										
MA-3a									2.34	8.6						
Target Range - Lower Bound									2.31	8.4						
Upper Bound									2.77	10.2						
MRGeo08														4.23	2.75	33.4
MRGeo08														4.37	2.63	33.3
Target Range - Lower Bound														4.00	2.44	29.6
Upper Bound														4.92	3.00	36.4
OREAS 905														0.62	0.80	32.9
OREAS 905														0.50	0.76	32.1
Target Range - Lower Bound														0.45	0.73	28.4
Upper Bound														0.58	0.91	35.0
SY-4									0.89	3.3						
Target Range - Lower Bound									0.84	3.0						
Upper Bound									1.08	4.0						
UTS-1													0.88			
Target Range - Lower Bound													0.83			
Upper Bound													0.93			
UTS-1											0.90					
Target Range - Lower Bound											0.81					
Upper Bound											0.95					
UTS-4													1.73			
Target Range - Lower Bound													1.64			
Upper Bound													1.84			
UTS-4											1.76					
Target Range - Lower Bound											1.61					
Upper Bound											1.87					

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QC CERTIFICATE OF ANALYSIS VA18072656

Sample Description	Method Analyte Units LOR	ME-MS41 Au ppm 0.02	ME-MS41 B ppm 10	ME-MS41 Ba ppm 10	ME-MS41 Be ppm 0.05	ME-MS41 Bi ppm 0.01	ME-MS41 Ca % 0.01	ME-MS41 Cd ppm 0.01	ME-MS41 Ce ppm 0.02	ME-MS41 Co ppm 0.1	ME-MS41 Cr ppm 1	ME-MS41 Cs ppm 0.05	ME-MS41 Cu ppm 0.2	ME-MS41 Fe % 0.01	ME-MS41 Ga ppm 0.05	ME-MS41 Ge ppm 0.05
STANDARDS																
Buffer pH6																
Buffer pH6																
Target Range - Lower Bound																
Upper Bound																
DS-1																
Target Range - Lower Bound																
Upper Bound																
GS313-8																
Target Range - Lower Bound																
Upper Bound																
KZK-1																
KZK-1																
Target Range - Lower Bound																
Upper Bound																
MA-3a																
Target Range - Lower Bound																
Upper Bound																
MRGeo08		<0.02	<10	450	0.85	0.66	1.10	2.23	72.1	18.8	92	10.65	647	3.67	8.94	0.18
MRGeo08		<0.02	10	460	0.83	0.62	1.05	2.22	71.7	18.3	89	10.60	614	3.55	8.86	0.15
Target Range - Lower Bound		<0.02	<10	370	0.67	0.60	1.00	2.01	66.2	17.0	81	9.40	587	3.22	8.73	0.07
Upper Bound		0.04	20	530	0.95	0.76	1.24	2.47	81.0	21.0	102	11.60	675	3.96	10.80	0.29
OREAS 905		0.39	<10	240	0.94	5.75	0.33	0.36	76.1	13.5	22	1.19	1570	3.43	5.57	0.11
OREAS 905		0.39	<10	250	0.88	5.25	0.32	0.37	76.4	13.2	17	1.14	1515	3.33	5.58	0.08
Target Range - Lower Bound		0.33	<10	200	0.78	5.16	0.29	0.30	69.7	12.4	15	1.05	1450	3.14	5.45	<0.05
Upper Bound		0.45	20	300	1.08	6.32	0.38	0.38	85.3	15.4	20	1.39	1670	3.86	6.77	0.22
SY-4																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18072656

Sample Description	Method Analyte Units LOR	ME-MS41 Hf ppm 0.02	ME-MS41 Hg ppm 0.01	ME-MS41 In ppm 0.005	ME-MS41 K % 0.01	ME-MS41 La ppm 0.2	ME-MS41 Li ppm 0.1	ME-MS41 Mg % 0.01	ME-MS41 Mn ppm 5	ME-MS41 Mo ppm 0.05	ME-MS41 Na % 0.01	ME-MS41 Nb ppm 0.05	ME-MS41 Ni ppm 0.2	ME-MS41 P ppm 10	ME-MS41 Pb ppm 0.2	ME-MS41 Rb ppm 0.1
STANDARDS																
Buffer pH6																
Buffer pH6																
Target Range - Lower Bound																
Upper Bound																
DS-1																
Target Range - Lower Bound																
Upper Bound																
GS313-8																
Target Range - Lower Bound																
Upper Bound																
KZK-1																
KZK-1																
Target Range - Lower Bound																
Upper Bound																
MA-3a																
Target Range - Lower Bound																
Upper Bound																
MRGeo08		0.75	0.05	0.153	1.29	36.4	31.5	1.17	430	14.00	0.34	0.89	722	1020	1080	141.5
MRGeo08		0.69	0.06	0.151	1.25	35.5	31.5	1.12	410	13.55	0.33	0.97	695	1010	1045	139.5
Target Range - Lower Bound		0.64	0.04	0.137	1.12	33.2	29.6	1.03	378	13.10	0.30	0.79	622	900	959	132.0
Upper Bound		0.83	0.10	0.179	1.40	41.0	36.4	1.29	473	16.10	0.39	1.09	760	1130	1175	162.0
OREAS 905		1.17	0.01	0.571	0.31	38.8	4.5	0.15	350	3.03	0.09	0.32	10.2	230	16.1	17.7
OREAS 905		1.06	0.02	0.570	0.29	38.5	4.1	0.14	335	2.84	0.08	0.31	8.2	230	17.8	17.5
Target Range - Lower Bound		1.02	<0.01	0.517	0.28	34.7	4.0	0.13	310	2.65	0.07	0.19	7.8		14.4	16.3
Upper Bound		1.29	0.04	0.643	0.36	42.9	5.2	0.19	390	3.35	0.12	0.43	10.0		18.0	20.1
SY-4																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																



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Sample Description	Method Analyte Units LOR	ME-MS41 Re ppm	ME-MS41 S %	ME-MS41 Sb ppm	ME-MS41 Sc ppm	ME-MS41 Se ppm	ME-MS41 Sn ppm	ME-MS41 Sr ppm	ME-MS41 Ta ppm	ME-MS41 Te ppm	ME-MS41 Th ppm	ME-MS41 Ti %	ME-MS41 Tl ppm	ME-MS41 U ppm	ME-MS41 V ppm	ME-MS41 W ppm
		0.001	0.01	0.05	0.1	0.2	0.2	0.2	0.01	0.01	0.2	0.005	0.02	0.05	1	0.05
STANDARDS																
Buffer pH6																
Buffer pH6																
Target Range - Lower Bound																
Upper Bound																
DS-1																
Target Range - Lower Bound																
Upper Bound																
GS313-8																
Target Range - Lower Bound																
Upper Bound																
KZK-1																
KZK-1																
Target Range - Lower Bound																
Upper Bound																
MA-3a																
Target Range - Lower Bound																
Upper Bound																
MRGeo08		0.007	0.32	3.20	7.2	0.8	3.3	79.7	0.02	0.05	21.7	0.389	0.81	5.59	101	2.96
MRGeo08		0.007	0.31	3.29	7.3	1.0	3.4	77.8	0.02	0.02	20.6	0.380	0.74	5.23	99	2.66
Target Range - Lower Bound		0.006	0.27	2.80	6.7	0.9	2.8	72.1	<0.01	<0.01	19.1	0.338	0.64	4.93	90	2.44
Upper Bound		0.010	0.35	3.90	8.4	1.9	4.0	88.5	0.03	0.04	23.7	0.424	0.92	6.13	112	3.42
OREAS 905		<0.001	0.08	1.12	1.6	2.4	1.3	12.3	<0.01	0.07	8.6	0.020	0.12	2.29	5	0.60
OREAS 905		<0.001	0.07	1.23	1.6	2.5	1.3	12.3	<0.01	0.08	8.5	0.019	0.11	2.13	5	0.58
Target Range - Lower Bound		<0.001	0.04	0.83	1.5	1.8	0.8	10.9	<0.01	0.04	7.4	0.008	0.06	1.92	4	0.41
Upper Bound		0.002	0.09	1.23	2.0	2.8	1.7	13.7	0.02	0.09	9.4	0.030	0.16	2.46	8	0.73
SY-4																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18072656

Sample Description	Method Analyte Units LOR	ME-MS41 Y ppm 0.05	ME-MS41 Zn ppm 2	ME-MS41 Zr ppm 0.5
STANDARDS				
Buffer pH6				
Buffer pH6				
Target Range - Lower Bound				
Upper Bound				
DS-1				
Target Range - Lower Bound				
Upper Bound				
GS313-8				
Target Range - Lower Bound				
Upper Bound				
KZK-1				
KZK-1				
Target Range - Lower Bound				
Upper Bound				
MA-3a				
Target Range - Lower Bound				
Upper Bound				
MRGeo08		19.25	797	22.3
MRGeo08		19.00	760	21.0
Target Range - Lower Bound		17.50	708	18.1
Upper Bound		21.5	870	25.7
OREAS 905		6.66	65	44.2
OREAS 905		6.84	70	40.7
Target Range - Lower Bound		6.32	56	39.9
Upper Bound		7.84	72	55.1
SY-4				
Target Range - Lower Bound				
Upper Bound				
UTS-1				
Target Range - Lower Bound				
Upper Bound				
UTS-1				
Target Range - Lower Bound				
Upper Bound				
UTS-4				
Target Range - Lower Bound				
Upper Bound				
UTS-4				
Target Range - Lower Bound				
Upper Bound				



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Sample Description	Method Analyte Units LOR	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-ELE07	S-IR08	C-GAS05	C-GAS05	S-GRA06a	C-IR07	S-GRA06	ME-MS41	ME-MS41	ME-MS41
		FIZZ RAT	MPA	NNP	NP	Ratio (N	pH	S	C	CO2	S	C	S	Ag	Al	As
		Unity	tCaCO3/1Kt	tCaCO3/1Kt	tCaCO3/1Kt	Unity	Unity	%	%	%	%	%	%	ppm	%	ppm
		1	0.3	1	1	0.01	0.1	0.01	0.05	0.2	0.01	0.01	0.01	0.01	0.01	0.1
BLANKS																
BLANK									<0.05	<0.2						
Target Range - Lower Bound									<0.05	<0.2						
Upper Bound									0.10	0.4						
BLANK														<0.01	<0.01	<0.1
BLANK														<0.01	<0.01	0.1
Target Range - Lower Bound														<0.01	<0.01	<0.1
Upper Bound														0.02	0.02	0.2
BLANK							6.2									
Target Range - Lower Bound							5.5									
Upper Bound							6.9									
BLANK													<0.01			
Target Range - Lower Bound													<0.01			
Upper Bound													0.02			
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK								0.02								
Target Range - Lower Bound							<0.01						<0.01			
Upper Bound							0.02						0.02			
DUPLICATES																
ORIGINAL														1.03	1.43	8.0
DUP														1.00	1.44	8.1
Target Range - Lower Bound														0.95	1.35	7.5
Upper Bound														1.08	1.52	8.6
L2072113-6 156266							9.1									
DUP							9.1									
Target Range - Lower Bound							8.5									
Upper Bound							9.7									
L2072113-8 156268													0.01			
DUP													0.01			
Target Range - Lower Bound													<0.01			
Upper Bound													0.02			



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QC CERTIFICATE OF ANALYSIS VA18072656

Sample Description	Method Analyte Units LOR	ME-MS41 Au ppm 0.02	ME-MS41 B ppm 10	ME-MS41 Ba ppm 10	ME-MS41 Be ppm 0.05	ME-MS41 Bi ppm 0.01	ME-MS41 Ca % 0.01	ME-MS41 Cd ppm 0.01	ME-MS41 Ce ppm 0.02	ME-MS41 Co ppm 0.1	ME-MS41 Cr ppm 1	ME-MS41 Cs ppm 0.05	ME-MS41 Cu ppm 0.2	ME-MS41 Fe % 0.01	ME-MS41 Ga ppm 0.05	ME-MS41 Ge ppm 0.05
BLANKS																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK		<0.02	<10	<10	<0.05	0.01	<0.01	0.01	<0.02	<0.1	<1	<0.05	<0.2	<0.01	<0.05	0.05
BLANK		<0.02	<10	<10	<0.05	<0.01	<0.01	<0.01	<0.02	<0.1	<1	<0.05	<0.2	<0.01	<0.05	<0.05
Target Range - Lower Bound		<0.02	<10	<10	<0.05	<0.01	<0.01	<0.01	<0.02	<0.1	<1	<0.05	<0.2	<0.01	<0.05	<0.05
Upper Bound		0.04	20	20	0.10	0.02	0.02	0.02	0.04	0.2	2	0.10	0.4	0.02	0.10	0.10
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
DUPLICATES																
ORIGINAL		<0.02	<10	180	0.09	0.01	0.69	0.05	15.30	11.4	30	1.35	31.1	2.39	4.38	0.08
DUP		<0.02	<10	180	0.10	0.01	0.69	0.04	14.05	11.4	29	1.35	29.7	2.39	4.38	0.08
Target Range - Lower Bound		<0.02	<10	160	<0.05	<0.01	0.65	0.03	13.90	10.7	27	1.23	29.1	2.26	4.11	<0.05
Upper Bound		0.04	20	200	0.10	0.02	0.73	0.06	15.45	12.1	32	1.47	31.7	2.52	4.65	0.10
L2072113-6 156266																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2072113-8 156268																
DUP																
Target Range - Lower Bound																
Upper Bound																



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Project: L2072113

QC CERTIFICATE OF ANALYSIS VA18072656

Sample Description	Method Analyte Units LOR	ME-MS41 Hf ppm 0.02	ME-MS41 Hg ppm 0.01	ME-MS41 In ppm 0.005	ME-MS41 K % 0.01	ME-MS41 La ppm 0.2	ME-MS41 Li ppm 0.1	ME-MS41 Mg % 0.01	ME-MS41 Mn ppm 5	ME-MS41 Mo ppm 0.05	ME-MS41 Na % 0.01	ME-MS41 Nb ppm 0.05	ME-MS41 Ni ppm 0.2	ME-MS41 P ppm 10	ME-MS41 Pb ppm 0.2	ME-MS41 Rb ppm 0.1
BLANKS																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK		<0.02	0.01	<0.005	<0.01	<0.2	0.1	<0.01	<5	<0.05	<0.01	<0.05	<0.2	<10	<0.2	<0.1
BLANK		<0.02	0.01	<0.005	<0.01	<0.2	<0.1	<0.01	<5	<0.05	<0.01	<0.05	<0.2	<10	<0.2	<0.1
Target Range - Lower Bound		<0.02	<0.01	<0.005	<0.01	<0.2	<0.1	<0.01	<5	<0.05	<0.01	<0.05	<0.2	<10	<0.2	<0.1
Upper Bound		0.04	0.02	0.010	0.02	0.4	0.2	0.02	10	0.10	0.02	0.10	0.4	20	0.4	0.2
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
DUPLICATES																
ORIGINAL		0.07	0.02	0.007	0.42	7.8	14.8	0.82	382	1.37	0.04	0.17	14.7	510	32.6	18.0
DUP		0.08	0.01	0.007	0.42	6.8	15.5	0.82	382	1.49	0.04	0.18	15.3	500	31.2	18.2
Target Range - Lower Bound		0.05	<0.01	<0.005	0.39	6.7	14.3	0.77	358	1.31	0.03	0.12	14.1	470	30.1	17.1
Upper Bound		0.10	0.02	0.010	0.45	7.9	16.0	0.87	406	1.55	0.05	0.23	16.0	540	33.7	19.1
L2072113-6 156266																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2072113-8 156268																
DUP																
Target Range - Lower Bound																
Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18072656

Sample Description	Method Analyte Units LOR	ME-MS41 Re ppm	ME-MS41 S %	ME-MS41 Sb ppm	ME-MS41 Sc ppm	ME-MS41 Se ppm	ME-MS41 Sn ppm	ME-MS41 Sr ppm	ME-MS41 Ta ppm	ME-MS41 Te ppm	ME-MS41 Th ppm	ME-MS41 Ti %	ME-MS41 Tl ppm	ME-MS41 U ppm	ME-MS41 V ppm	ME-MS41 W ppm
		0.001	0.01	0.05	0.1	0.2	0.2	0.2	0.01	0.01	0.2	0.005	0.02	0.05	1	0.05
BLANKS																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK		0.001	0.01	<0.05	<0.1	<0.2	<0.2	<0.2	<0.01	<0.01	<0.2	<0.005	<0.02	<0.05	<1	<0.05
BLANK		<0.001	<0.01	<0.05	<0.1	0.2	<0.2	<0.2	<0.01	<0.01	<0.2	<0.005	<0.02	<0.05	<1	<0.05
Target Range - Lower Bound		<0.001	<0.01	<0.05	<0.1	<0.2	<0.2	<0.2	<0.01	<0.01	<0.2	<0.005	<0.02	<0.05	<1	<0.05
Upper Bound		0.002	0.02	0.10	0.2	0.4	0.4	0.4	0.02	0.02	0.4	0.010	0.04	0.10	2	0.10
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
DUPLICATES																
ORIGINAL		<0.001	0.02	0.36	2.6	0.3	0.2	21.0	<0.01	0.01	1.7	0.130	0.32	0.49	47	0.22
DUP		<0.001	0.02	0.38	2.6	<0.2	0.2	20.8	<0.01	0.01	1.4	0.133	0.31	0.41	47	0.22
Target Range - Lower Bound		<0.001	<0.01	0.29	2.4	<0.2	<0.2	19.7	<0.01	<0.01	1.3	0.120	0.27	0.38	44	0.15
Upper Bound		0.002	0.03	0.45	2.8	0.4	0.4	22.1	0.02	0.02	1.8	0.143	0.36	0.52	50	0.29
L2072113-6 156266																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2072113-8 156268																
DUP																
Target Range - Lower Bound																
Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18072656

Sample Description	Method Analyte Units LOR	ME-MS41 Y ppm 0.05	ME-MS41 Zn ppm 2	ME-MS41 Zr ppm 0.5
BLANKS				
BLANK				
Target Range - Lower Bound				
Upper Bound				
BLANK		<0.05	<2	<0.5
BLANK		<0.05	<2	<0.5
Target Range - Lower Bound		<0.05	<2	<0.5
Upper Bound		0.10	4	1.0
BLANK				
Target Range - Lower Bound				
Upper Bound				
BLANK				
Target Range - Lower Bound				
Upper Bound				
BLANK				
Target Range - Lower Bound				
Upper Bound				
BLANK				
Target Range - Lower Bound				
Upper Bound				
DUPLICATES				
ORIGINAL		4.21	57	1.6
DUP		4.16	56	1.5
Target Range - Lower Bound		3.93	52	0.9
Upper Bound		4.44	61	2.2
L2072113-6 156266				
DUP				
Target Range - Lower Bound				
Upper Bound				
L2072113-8 156268				
DUP				
Target Range - Lower Bound				
Upper Bound				



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QC CERTIFICATE OF ANALYSIS VA18072656

Sample Description	Method Analyte Units LOR	OA-VOL08m FIZZ RAT Unity	OA-VOL08m MPA tCaCO3/1Kt	OA-VOL08m NNP tCaCO3/1Kt	OA-VOL08m NP tCaCO3/1Kt	OA-VOL08m Ratio (N) Unity	OA-ELE07 pH Unity	S-IR08 S %	C-GAS05 C %	C-GAS05 CO2 %	S-GRA06a S %	C-IR07 C %	S-GRA06 S %	ME-MS41 Ag ppm	ME-MS41 Al %	ME-MS41 As ppm
		1	0.3	1	1	0.01	0.1	0.01	0.05	0.2	0.01	0.01	0.01	0.01	0.01	0.1
DUPLICATES																
L2072113-10 156270		2	2.8	30	33	11.73			0.41	1.5	0.02					
DUP		2	2.8	30	33	11.73			0.43	1.6	0.02					
Target Range - Lower Bound		<1	2.4	28	30	11.13			0.35	1.3	<0.01					
Upper Bound		3	3.2	33	36	12.33			0.49	1.8	0.03					
ORIGINAL														0.42	1.32	1.7
DUP														0.41	1.33	1.3
Target Range - Lower Bound														0.38	1.25	1.3
Upper Bound														0.45	1.40	1.7
ORIGINAL								0.02				0.03				
DUP								0.01				0.04				
Target Range - Lower Bound								<0.01				0.02				
Upper Bound								0.02				0.05				



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QC CERTIFICATE OF ANALYSIS VA18072656

Sample Description	Method Analyte Units LOR	ME-MS41 Au ppm 0.02	ME-MS41 B ppm 10	ME-MS41 Ba ppm 10	ME-MS41 Be ppm 0.05	ME-MS41 Bi ppm 0.01	ME-MS41 Ca % 0.01	ME-MS41 Cd ppm 0.01	ME-MS41 Ce ppm 0.02	ME-MS41 Co ppm 0.1	ME-MS41 Cr ppm 1	ME-MS41 Cs ppm 0.05	ME-MS41 Cu ppm 0.2	ME-MS41 Fe % 0.01	ME-MS41 Ga ppm 0.05	ME-MS41 Ge ppm 0.05
L2072113-10 156270 DUP Target Range - Lower Bound Upper Bound		DUPLICATES														
ORIGINAL DUP Target Range - Lower Bound Upper Bound		0.13 0.10 0.09 0.14	<10 <10 <10 20	140 130 110 160	0.67 0.63 0.57 0.73	0.86 0.80 0.78 0.88	1.76 1.76 1.66 1.86	0.12 0.16 0.12 0.16	41.4 41.2 39.2 43.4	17.8 17.6 16.7 18.7	138 138 130 146	1.54 1.57 1.43 1.68	48.4 48.1 46.4 50.1	3.07 3.06 2.90 3.23	6.66 6.77 6.33 7.10	0.14 0.13 0.08 0.19
ORIGINAL DUP Target Range - Lower Bound Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18072656

Sample Description	Method Analyte Units LOR	ME-MS41 Hf ppm 0.02	ME-MS41 Hg ppm 0.01	ME-MS41 In ppm 0.005	ME-MS41 K % 0.01	ME-MS41 La ppm 0.2	ME-MS41 Li ppm 0.1	ME-MS41 Mg % 0.01	ME-MS41 Mn ppm 5	ME-MS41 Mo ppm 0.05	ME-MS41 Na % 0.01	ME-MS41 Nb ppm 0.05	ME-MS41 Ni ppm 0.2	ME-MS41 P ppm 10	ME-MS41 Pb ppm 0.2	ME-MS41 Rb ppm 0.1
L2072113-10 156270 DUP Target Range - Lower Bound Upper Bound		DUPLICATES														
ORIGINAL DUP Target Range - Lower Bound Upper Bound		0.63 0.62 0.57 0.68	<0.01 0.01 <0.01 0.02	0.021 0.018 0.014 0.025	0.90 0.90 0.85 0.96	20.1 20.3 19.0 21.4	14.8 14.6 13.9 15.5	1.35 1.35 1.27 1.43	433 429 404 458	6.32 5.80 5.71 6.41	0.03 0.03 0.02 0.04	0.10 0.10 <0.05 0.16	62.9 61.8 59.0 65.7	680 680 640 720	18.3 17.5 16.8 19.0	41.9 42.2 39.8 44.3
ORIGINAL DUP Target Range - Lower Bound Upper Bound																



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Sample Description	Method Analyte Units LOR	ME-MS41 Re ppm	ME-MS41 S %	ME-MS41 Sb ppm	ME-MS41 Sc ppm	ME-MS41 Se ppm	ME-MS41 Sn ppm	ME-MS41 Sr ppm	ME-MS41 Ta ppm	ME-MS41 Te ppm	ME-MS41 Th ppm	ME-MS41 Ti %	ME-MS41 Tl ppm	ME-MS41 U ppm	ME-MS41 V ppm	ME-MS41 W ppm
		0.001	0.01	0.05	0.1	0.2	0.2	0.2	0.01	0.01	0.2	0.005	0.02	0.05	1	0.05
L2072113-10 156270 DUP Target Range - Lower Bound Upper Bound		DUPLICATES														
ORIGINAL DUP Target Range - Lower Bound Upper Bound		0.002 0.001 <0.001 0.002	1.40 1.38 1.31 1.47	0.05 0.09 <0.05 0.10	6.0 5.9 5.6 6.3	0.4 0.4 <0.2 0.6	0.4 0.4 <0.2 0.6	193.0 186.0 180.0 199.0	<0.01 <0.01 <0.01 0.02	2.03 2.09 1.95 2.17	4.6 4.5 4.1 5.0	0.126 0.125 0.114 0.137	0.30 0.30 0.26 0.34	1.12 1.17 1.04 1.25	57 56 53 60	7.22 7.67 6.84 8.05
ORIGINAL DUP Target Range - Lower Bound Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18072656

Sample Description	Method Analyte Units LOR	ME-MS41 Y ppm 0.05	ME-MS41 Zn ppm 2	ME-MS41 Zr ppm 0.5
L2072113-10 156270 DUP Target Range - Lower Bound Upper Bound		DUPLICATES		
ORIGINAL DUP Target Range - Lower Bound Upper Bound		6.49 6.54 6.14 6.89	71 72 66 77	22.8 23.4 20.9 25.3
ORIGINAL DUP Target Range - Lower Bound Upper Bound				



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QC CERTIFICATE OF ANALYSIS VA18072656

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

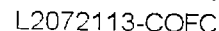
LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

C-GAS05	C-IR07	LOG-22	ME-MS41
OA-ELE07	OA-VOL08m	PUL-31	S-CAL06a
S-GRA06	S-GRA06a	S-IR08	SPL-21
WEI-21			



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Date Received: 06-JUL-18
Report Date: 31-JUL-18 18:16 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2125146

Project P.O. #: 229850

Job Reference:

C of C Numbers: 18-12

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Comments: Please note, the ALS Minerals version of the finalized report and QC can be found at the end of the attachment.

Shane Stack
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

31-JUL-18 18:16 (MT)

Version: FINAL

Sample ID Description Sampled Date Sampled Time Client ID		L2125146-1 Waste 18-MAR-18 156271	L2125146-2 Waste 23-MAR-18 156272	L2125146-3 Tails 01-MAR-18 MARCH TAL 2018	L2125146-4 Waste 12-APR-18 159901	L2125146-5 Tails 01-APR-18 APRIL TAL 2018
Grouping	Analyte					
SOIL						
Physical Tests	pH (Unity)	9.1	8.5	8.0	8.1	7.9
Organic / Inorganic Carbon	Carbon (C) (%)	0.31	0.64	0.48	0.17	0.39
Acid Base Accounting	FIZZ RATING (Unity)	2	2	2	2	2
	MPA (tCaCO3/1Kt)	0.3	2.2	3.8	8.1	3.8
	Neutralization Potential (NP) (tCaCO3/1Kt)	27	38	28	17	29
	NNP (tCaCO3/1Kt)	27	36	24	9	25
	Ratio (NP/MPA) (Unity)	86.40	17.37	7.47	2.09	7.73
	Sulfate Sulfur (carbonate leach) (%)	<0.01	0.01	0.07	0.14	0.07
	Sulfate Sulfur (HCl leach) (%)	0.01	0.01	0.05	0.13	0.08
	Sulfide Sulfur (T minus HCl leach) (%)	<0.01	0.06	0.07	0.13	0.04
	Total Sulfur (combustion) (%)	0.01	0.07	0.12	0.26	0.12
Total Metals	Aluminum (Al) (%)	0.97	0.38	1.02	1.07	1.00
	Antimony (Sb) (ppm)	<0.05	<0.05	<0.05	0.05	<0.05
	Arsenic (As) (ppm)	0.5	0.6	0.8	1.1	1.2
	Barium (Ba) (ppm)	200	90	180	130	210
	Beryllium (Be) (ppm)	0.27	0.27	0.22	0.26	0.28
	Bismuth (Bi) (ppm)	0.01	0.28	0.26	2.20	0.32
	Boron (B) (ppm)	<10	<10	<10	<10	<10
	Cadmium (Cd) (ppm)	0.02	0.08	0.29	0.12	0.34
	Calcium (Ca) (%)	1.12	1.34	1.10	1.18	1.24
	Cerium (Ce) (ppm)	24.1	13.00	17.40	23.9	21.4
	Cesium (Cs) (ppm)	0.36	0.22	0.56	0.30	0.48
	Chromium (Cr) (ppm)	4	3	6	7	6
	Cobalt (Co) (ppm)	4.7	3.2	6.4	5.9	6.7
	Copper (Cu) (ppm)	31.7	1190	1200	1560	1950
	Gallium (Ga) (ppm)	4.66	2.50	7.13	5.48	7.10
	Germanium (Ge) (ppm)	0.13	0.10	0.13	0.14	0.13
	Gold (Au) (ppm)	<0.02	0.03	0.10	0.04	0.07
	Hafnium (Hf) (ppm)	0.04	0.02	0.04	0.07	0.04
	Indium (In) (ppm)	0.021	0.021	0.070	0.027	0.079
	Iron (Fe) (%)	2.06	1.60	3.97	2.49	3.59
	Lanthanum (La) (ppm)	13.1	6.6	9.3	13.0	10.9
	Lead (Pb) (ppm)	2.8	4.2	3.2	6.5	3.6
	Lithium (Li) (ppm)	5.6	2.1	4.8	5.6	5.2
	Magnesium (Mg) (%)	0.61	0.39	0.71	0.64	0.60
	Manganese (Mn) (ppm)	509	408	714	621	698

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2125146-6 Tails 01-MAY-18 MAY TAL 2018				
Grouping	Analyte					
SOIL						
Physical Tests	pH (Unity)	7.9				
Organic / Inorganic Carbon	Carbon (C) (%)	0.43				
Acid Base Accounting	FIZZ RATING (Unity)	2				
	MPA (tCaCO3/1Kt)	3.8				
	Neutralization Potential (NP) (tCaCO3/1Kt)	27				
	NNP (tCaCO3/1Kt)	23				
	Ratio (NP/MPA) (Unity)	7.20				
	Sulfate Sulfur (carbonate leach) (%)	0.08				
	Sulfate Sulfur (HCl leach) (%)	0.09				
	Sulfide Sulfur (T minus HCl leach) (%)	0.03				
	Total Sulfur (combustion) (%)	0.12				
Total Metals	Aluminum (Al) (%)	0.97				
	Antimony (Sb) (ppm)	<0.05				
	Arsenic (As) (ppm)	0.9				
	Barium (Ba) (ppm)	170				
	Beryllium (Be) (ppm)	0.23				
	Bismuth (Bi) (ppm)	0.24				
	Boron (B) (ppm)	<10				
	Cadmium (Cd) (ppm)	0.30				
	Calcium (Ca) (%)	1.07				
	Cerium (Ce) (ppm)	19.95				
	Cesium (Cs) (ppm)	0.58				
	Chromium (Cr) (ppm)	6				
	Cobalt (Co) (ppm)	6.5				
	Copper (Cu) (ppm)	1180				
	Gallium (Ga) (ppm)	6.90				
	Germanium (Ge) (ppm)	0.13				
	Gold (Au) (ppm)	0.19				
	Hafnium (Hf) (ppm)	0.04				
	Indium (In) (ppm)	0.078				
	Iron (Fe) (%)	3.72				
	Lanthanum (La) (ppm)	10.5				
	Lead (Pb) (ppm)	3.3				
	Lithium (Li) (ppm)	4.8				
	Magnesium (Mg) (%)	0.66				
	Manganese (Mn) (ppm)	686				

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2125146-1 Waste 18-MAR-18 156271	L2125146-2 Waste 23-MAR-18 156272	L2125146-3 Tails 01-MAR-18 MARCH TAL 2018	L2125146-4 Waste 12-APR-18 159901	L2125146-5 Tails 01-APR-18 APRIL TAL 2018
Grouping	Analyte					
SOIL						
Total Metals	Mercury (Hg) (ppm)	<0.01	<0.01	0.01	0.01	0.02
	Molybdenum (Mo) (ppm)	0.35	0.32	1.35	0.53	2.30
	Nickel (Ni) (ppm)	2.1	1.5	3.4	1.9	2.6
	Niobium (Nb) (ppm)	0.14	0.06	0.24	0.22	0.22
	Phosphorus (P) (ppm)	570	360	700	750	710
	Potassium (K) (%)	0.51	0.13	0.59	0.41	0.42
	Rhenium (Re) (ppm)	<0.001	<0.001	0.002	<0.001	0.002
	Rubidium (Rb) (ppm)	23.7	6.7	30.7	21.2	24.5
	Scandium (Sc) (ppm)	2.9	1.2	3.6	3.0	3.9
	Selenium (Se) (ppm)	0.3	0.9	1.1	1.9	1.6
	Silver (Ag) (ppm)	0.02	0.50	0.50	10.75	0.65
	Sodium (Na) (%)	0.08	0.05	0.06	0.08	0.06
	Strontium (Sr) (ppm)	81.9	99.6	78.8	73.0	76.2
	Sulfur (S) (%)	0.02	0.09	0.15	0.30	0.14
	Tantalum (Ta) (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01
	Tellurium (Te) (ppm)	0.01	0.09	0.18	5.42	0.20
	Thallium (Tl) (ppm)	0.14	0.04	0.25	0.11	0.19
	Thorium (Th) (ppm)	2.4	1.7	3.5	3.6	3.3
	Tin (Sn) (ppm)	0.4	0.2	0.8	0.4	0.8
	Titanium (Ti) (%)	0.087	0.010	0.106	0.114	0.076
	Tungsten (W) (ppm)	0.58	0.44	0.08	0.13	0.08
	Uranium (U) (ppm)	0.22	0.16	0.25	0.40	0.30
	Vanadium (V) (ppm)	43	25	65	57	61
	Yttrium (Y) (ppm)	8.75	2.93	5.11	6.39	6.90
	Zinc (Zn) (ppm)	60	48	110	93	109
	Zirconium (Zr) (ppm)	0.6	0.6	1.0	1.2	1.0
Permanent Gases	Carbon Dioxide (CO2) (%)	1.1	2.4	1.8	0.6	1.4
Miscellaneous	Carbon (C) (%)	0.36	0.77	0.54	0.19	0.44

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2125146-6 Tails 01-MAY-18 MAY TAL 2018				
Grouping	Analyte					
SOIL						
Total Metals	Mercury (Hg) (ppm)	0.01				
	Molybdenum (Mo) (ppm)	1.99				
	Nickel (Ni) (ppm)	3.2				
	Niobium (Nb) (ppm)	0.26				
	Phosphorus (P) (ppm)	710				
	Potassium (K) (%)	0.53				
	Rhenium (Re) (ppm)	0.002				
	Rubidium (Rb) (ppm)	30.1				
	Scandium (Sc) (ppm)	3.9				
	Selenium (Se) (ppm)	1.1				
	Silver (Ag) (ppm)	0.51				
	Sodium (Na) (%)	0.05				
	Strontium (Sr) (ppm)	78.7				
	Sulfur (S) (%)	0.14				
	Tantalum (Ta) (ppm)	<0.01				
	Tellurium (Te) (ppm)	0.21				
	Thallium (Tl) (ppm)	0.25				
	Thorium (Th) (ppm)	3.5				
	Tin (Sn) (ppm)	0.9				
	Titanium (Ti) (%)	0.098				
	Tungsten (W) (ppm)	0.10				
	Uranium (U) (ppm)	0.29				
	Vanadium (V) (ppm)	64				
	Yttrium (Y) (ppm)	5.91				
	Zinc (Zn) (ppm)	108				
	Zirconium (Zr) (ppm)	1.0				
Permanent Gases	Carbon Dioxide (CO2) (%)	1.6				
Miscellaneous	Carbon (C) (%)	0.50				

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ABA-OA-VOL08-AX	Soil	Acid Base Accounting	OA-VOL08
CARBON-C-GAS05-AX	Soil	Carbon, TOC and CO ₂	C-GAS05
CARBON-C-IR07-AX	Soil	Carbon (C) using LECO analyzer	Total Carbon - Method Code C-IR07
Total Carbon & Sulfur - Method Codes C-IR07 & S-IR08			
A 0.1g sample is heated to approximately 1350°C in an induction furnace while passing a stream of oxygen through the sample. Carbon dioxide & sulfur dioxide released from the sample are measured by an IR detection system (Leco analyzer) and the total carbon & sulfur results are provided.			
ME-MS41-AX	Soil	Aqua Regia ICPMS	Aqua Regia ICPMS
A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences.			
PH-OA-ELE07-AX	Soil	pH	OA-ELE07
SULPHUR-S-CAL06A-AX	Soil	Sulfide Sulfur Calc from HCl Leach	ALS Minerals S-CAL06A
Sulfide Sulfur (as S) is calculated by subtracting the HCl Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion.			
SULPHUR-S-GRA06-AX	Soil	Sulfate Sulfur in Soil (Carbonate Leach)	ALS Minerals S-GRA06
A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).			
SULPHUR-S-GRA06A-AX	Soil	Sulfate Sulfur in Soil (HCl Leach)	ALS Minerals S-GRA06A
A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).			
SULPHUR-S-IR08-AX	Soil	Total Sulfur in Soil by Combustion	ALS Minerals S-IR08
The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
AX	ALS MINERALS - VANCOUVER, B.C., CANADA

Chain of Custody Numbers:

18-12

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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BURNABY BC V5A 1W9

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Plus Appendix Pages
Finalized Date: **31-JUL-2018**
Account: **APN**

CERTIFICATE VA18164990

Project: L2125146

This report is for 6 Other samples submitted to our lab in Vancouver, BC, Canada on 9-JUL-2018.

The following have access to data associated with this certificate:

CASDG ALSE

ALSEV DATASUBLET

SHANE STACK

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI-21	Received Sample Weight
SPL-21	Split sample - riffle splitter
LOG-22	Sample login - Rcd w/o BarCode
PUL-31	Pulverize split to 85% <75 um

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	
C-GAS05	Inorganic Carbon (CO2)	
C-IR07	Total Carbon (Leco)	LECO
S-GRA06	Sulfate Sulfur - carbonate leach	WST-SEQ
ME-MS41	Ultra Trace Aqua Regia ICP-MS	
OA-VOL08m	Modified NP	
S-IR08	Total Sulphur (Leco)	LECO
OA-ELE07	Paste pH	
S-CAL06a	Sulfide Sulfur (calculated*)	
S-GRA06a	Sulfate Sulfur (HCl leachable)	WST-SEQ

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature:

Colin Ramshaw, Vancouver Laboratory Manager



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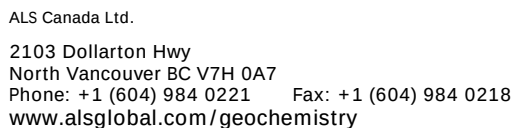
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CERTIFICATE OF ANALYSIS VA18164990

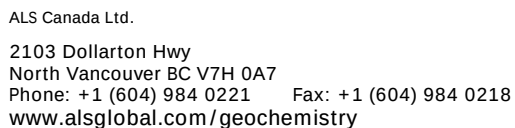
Sample Description	Method Analyte Units LOD	WEI-21	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-ELE07	S-IR08	S-CAL06a	C-GAS05	C-GAS05	S-GRA06a	C-IR07	S-GRA06	ME-MS41
		Recvd Wt.	FIZZ RAT	MPA	NNP	NP	Ratio (N	pH	S	S	C	CO2	S	C	S	Ag
		kg	Unity	tCaCO3/1Kt	tCaCO3/1Kt	tCaCO3/1Kt	Unity	Unity	%	%	%	%	%	%	%	ppm
		0.02	1	0.3	1	1	0.01	0.1	0.01	0.01	0.05	0.2	0.01	0.01	0.01	0.01
L2125146-1 156271		0.96	2	0.3	27	27	86.40	9.1	0.01	<0.01	0.31	1.1	0.01	0.36	<0.01	0.02
L2125146-2 156272		0.96	2	2.2	36	38	17.37	8.5	0.07	0.06	0.64	2.4	0.01	0.77	0.01	0.50
L2125146-3 MARCH TAL 2018		1.12	2	3.8	24	28	7.47	8.0	0.12	0.07	0.48	1.8	0.05	0.54	0.07	0.50
L2125146-4 159901		1.18	2	8.1	9	17	2.09	8.1	0.26	0.13	0.17	0.6	0.13	0.19	0.14	10.75
L2125146-5 APRIL TAL 2018		1.24	2	3.8	25	29	7.73	7.9	0.12	0.04	0.39	1.4	0.08	0.44	0.07	0.65
L2125146-6 MAY TAL 2018		1.34	2	3.8	23	27	7.20	7.9	0.12	0.03	0.43	1.6	0.09	0.50	0.08	0.51



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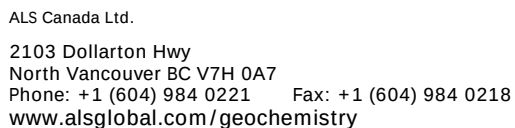
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Project: L2125146

CERTIFICATE OF ANALYSIS VA18164990

Sample Description	Method Analyte Units LOD	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
		V	W	Y	Zn	Zr
		ppm	ppm	ppm	ppm	ppm
		1	0.05	0.05	2	0.5
L2125146-1 156271		43	0.58	8.75	60	0.6
L2125146-2 156272		25	0.44	2.93	48	0.6
L2125146-3 MARCH TAL 2018		65	0.08	5.11	110	1.0
L2125146-4 159901		57	0.13	6.39	93	1.2
L2125146-5 APRIL TAL 2018		61	0.08	6.90	109	1.0
L2125146-6 MAY TAL 2018		64	0.10	5.91	108	1.0



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CERTIFICATE OF ANALYSIS VA18164990

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

C-GAS05	C-IR07	LOG-22	ME-MS41
OA-ELE07	OA-VOL08m	PUL-31	S-CAL06a
S-GRA06	S-GRA06a	S-IR08	SPL-21
WEI-21			



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QC CERTIFICATE VA18164990

Project: L2125146

This report is for 6 Other samples submitted to our lab in Vancouver, BC, Canada on 9-JUL-2018.

The following have access to data associated with this certificate:

CASDG ALSE

ALSEV DATASUBLET

SHANE STACK

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI-21	Received Sample Weight
SPL-21	Split sample - riffle splitter
LOG-22	Sample login - Rcd w/o BarCode
PUL-31	Pulverize split to 85% <75 um

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	
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C-IR07	Total Carbon (Leco)	LECO
S-GRA06	Sulfate Sulfur - carbonate leach	WST-SEQ
ME-MS41	Ultra Trace Aqua Regia ICP-MS	
OA-VOL08m	Modified NP	
S-IR08	Total Sulphur (Leco)	LECO
OA-ELE07	Paste pH	
S-CAL06a	Sulfide Sulfur (calculated*)	
S-GRA06a	Sulfate Sulfur (HCl leachable)	WST-SEQ

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature:

Colin Ramshaw, Vancouver Laboratory Manager



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QC CERTIFICATE OF ANALYSIS VA18164990

Sample Description	Method Analyte Units LOD	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-ELE07	S-IR08	C-GAS05	C-GAS05	S-GRA06a	C-IR07	S-GRA06	ME-MS41	ME-MS41	ME-MS41
		FIZZ RAT	MPA	NNP	NP	Ratio (N	pH	S	C	CO2	S	C	S	Ag	Al	As
		Unity	tCaCO3/1Kt	tCaCO3/1Kt	tCaCO3/1Kt	Unity	Unity	%	%	%	%	%	%	ppm	%	ppm
		1	0.3	1	1	0.01	0.1	0.01	0.05	0.2	0.01	0.01	0.01	0.01	0.01	0.1
STANDARDS																
Buffer pH6							6.0									
Buffer pH6							6.0									
Target Range - Lower Bound							5.3									
Upper Bound							6.7									
GS310-10								0.25				1.11				
Target Range - Lower Bound								0.25				1.03				
Upper Bound								0.29				1.13				
KZK-1		2	25.0	30	55	2.20										
KZK-1		2	25.0	31	56	2.24										
Target Range - Lower Bound		<1	22.9	30	54	2.18										
Upper Bound		>4	27.1	38	64	2.53										
MA-1b								1.15				2.48				
Target Range - Lower Bound								1.12				2.34				
Upper Bound								1.22				2.54				
MA-3a									2.38	8.7						
Target Range - Lower Bound									2.31	8.4						
Upper Bound									2.77	10.2						
MRGeo08														4.16	2.68	31.3
Target Range - Lower Bound														4.00	2.44	29.6
Upper Bound														4.92	3.00	36.4
OREAS 905														0.49	0.79	32.1
Target Range - Lower Bound														0.45	0.73	28.4
Upper Bound														0.58	0.91	35.0
SY-4									0.90	3.3						
Target Range - Lower Bound									0.84	3.0						
Upper Bound									1.08	4.0						
UTS-1													0.92			
UTS-1													0.90			
Target Range - Lower Bound													0.83			
Upper Bound													0.93			
UTS-1											0.92					
UTS-1											0.88					
Target Range - Lower Bound											0.81					
Upper Bound											0.95					
UTS-4											1.75					
UTS-4											1.72					
Target Range - Lower Bound											1.61					
Upper Bound											1.87					



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Total # Pages: 4 (A - E)
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Project: L2125146

QC CERTIFICATE OF ANALYSIS VA18164990

Sample Description	Method Analyte Units LOD	ME-MS41 Au ppm 0.02	ME-MS41 B ppm 10	ME-MS41 Ba ppm 10	ME-MS41 Be ppm 0.05	ME-MS41 Bi ppm 0.01	ME-MS41 Ca % 0.01	ME-MS41 Cd ppm 0.01	ME-MS41 Ce ppm 0.02	ME-MS41 Co ppm 0.1	ME-MS41 Cr ppm 1	ME-MS41 Cs ppm 0.05	ME-MS41 Cu ppm 0.2	ME-MS41 Fe % 0.01	ME-MS41 Ga ppm 0.05	ME-MS41 Ge ppm 0.05
STANDARDS																
Buffer pH6																
Buffer pH6																
Target Range - Lower Bound																
Upper Bound																
GS310-10																
Target Range - Lower Bound																
Upper Bound																
KZK-1																
KZK-1																
Target Range - Lower Bound																
Upper Bound																
MA-1b																
Target Range - Lower Bound																
Upper Bound																
MA-3a																
Target Range - Lower Bound																
Upper Bound																
MRGeo08		<0.02	<10	430	0.70	0.64	1.09	2.22	76.8	18.0	89	11.20	630	3.57	9.31	0.19
Target Range - Lower Bound		<0.02	<10	370	0.67	0.60	1.00	2.01	66.2	17.0	81	9.40	587	3.22	8.73	0.07
Upper Bound		0.04	20	530	0.95	0.76	1.24	2.47	81.0	21.0	102	11.60	675	3.96	10.80	0.29
OREAS 905		0.36	<10	230	0.92	5.38	0.33	0.36	82.3	13.6	16	1.22	1550	3.35	6.17	0.16
Target Range - Lower Bound		0.33	<10	200	0.78	5.16	0.29	0.30	69.7	12.4	15	1.05	1450	3.14	5.45	<0.05
Upper Bound		0.45	20	300	1.08	6.32	0.38	0.38	85.3	15.4	20	1.39	1670	3.86	6.77	0.22
SY-4																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
UTS-4																
Target Range - Lower Bound																
Upper Bound																



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Sample Description	Method Analyte Units LOD	ME-MS41 Hf ppm 0.02	ME-MS41 Hg ppm 0.01	ME-MS41 In ppm 0.005	ME-MS41 K % 0.01	ME-MS41 La ppm 0.2	ME-MS41 Li ppm 0.1	ME-MS41 Mg % 0.01	ME-MS41 Mn ppm 5	ME-MS41 Mo ppm 0.05	ME-MS41 Na % 0.01	ME-MS41 Nb ppm 0.05	ME-MS41 Ni ppm 0.2	ME-MS41 P ppm 10	ME-MS41 Pb ppm 0.2	ME-MS41 Rb ppm 0.1
STANDARDS																
Buffer pH6																
Buffer pH6																
Target Range - Lower Bound																
Upper Bound																
GS310-10																
Target Range - Lower Bound																
Upper Bound																
KZK-1																
KZK-1																
Target Range - Lower Bound																
Upper Bound																
MA-1b																
Target Range - Lower Bound																
Upper Bound																
MA-3a																
Target Range - Lower Bound																
Upper Bound																
MRGeo08		0.72	0.06	0.160	1.24	38.3	29.8	1.13	413	13.70	0.36	0.86	694	980	1055	139.0
Target Range - Lower Bound		0.64	0.04	0.137	1.12	33.2	29.6	1.03	378	13.10	0.30	0.79	622	900	959	132.0
Upper Bound		0.83	0.10	0.179	1.40	41.0	36.4	1.29	473	16.10	0.39	1.09	760	1130	1175	162.0
OREAS 905		1.21	0.01	0.612	0.30	41.4	4.9	0.14	330	2.96	0.10	0.30	8.4	220	15.9	18.8
Target Range - Lower Bound		1.02	<0.01	0.517	0.28	34.7	4.0	0.13	310	2.65	0.07	0.19	7.8		14.4	16.3
Upper Bound		1.29	0.04	0.643	0.36	42.9	5.2	0.19	390	3.35	0.12	0.43	10.0		18.0	20.1
SY-4																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
UTS-4																
Target Range - Lower Bound																
Upper Bound																



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Sample Description	Method Analyte Units LOD	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
		Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V
		ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm
		0.001	0.01	0.05	0.1	0.2	0.2	0.2	0.01	0.01	0.2	0.005	0.02	0.05	1
		0.05													
STANDARDS															
Buffer pH6															
Buffer pH6															
Target Range - Lower Bound															
Upper Bound															
GS310-10															
Target Range - Lower Bound															
Upper Bound															
KZK-1															
KZK-1															
Target Range - Lower Bound															
Upper Bound															
MA-1b															
Target Range - Lower Bound															
Upper Bound															
MA-3a															
Target Range - Lower Bound															
Upper Bound															
MRGeo08		0.007	0.31	3.07	6.8	0.7	3.3	78.0	0.01	0.04	21.6	0.373	0.75	5.36	98
Target Range - Lower Bound		0.006	0.27	2.80	6.7	0.6	2.8	72.1	<0.01	<0.01	19.1	0.338	0.64	4.93	90
Upper Bound		0.010	0.35	3.90	8.4	1.5	4.0	88.5	0.03	0.04	23.7	0.424	0.92	6.13	112
OREAS 905		<0.001	0.08	1.07	1.5	2.6	1.3	12.8	<0.01	0.08	8.2	0.019	0.12	2.26	5
Target Range - Lower Bound		<0.001	0.04	0.83	1.5	1.8	0.8	10.9	<0.01	0.04	7.4	0.008	0.06	1.92	4
Upper Bound		0.002	0.09	1.23	2.0	2.8	1.7	13.7	0.02	0.09	9.4	0.030	0.16	2.46	8
SY-4															
Target Range - Lower Bound															
Upper Bound															
UTS-1															
UTS-1															
Target Range - Lower Bound															
Upper Bound															
UTS-1															
UTS-1															
Target Range - Lower Bound															
Upper Bound															
UTS-4															
UTS-4															
Target Range - Lower Bound															
Upper Bound															



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Sample Description	Method Analyte Units LOD	ME-MS41 Y ppm 0.05	ME-MS41 Zn ppm 2	ME-MS41 Zr ppm 0.5
STANDARDS				
Buffer pH6				
Buffer pH6				
Target Range - Lower Bound				
Upper Bound				
GS310-10				
Target Range - Lower Bound				
Upper Bound				
KZK-1				
KZK-1				
Target Range - Lower Bound				
Upper Bound				
MA-1b				
Target Range - Lower Bound				
Upper Bound				
MA-3a				
Target Range - Lower Bound				
Upper Bound				
MRGeo08		18.85	771	20.5
Target Range - Lower Bound		17.50	708	18.1
Upper Bound		21.5	870	25.7
OREAS 905		7.14	62	44.2
Target Range - Lower Bound		6.32	56	39.9
Upper Bound		7.84	72	55.1
SY-4				
Target Range - Lower Bound				
Upper Bound				
UTS-1				
UTS-1				
Target Range - Lower Bound				
Upper Bound				
UTS-1				
UTS-1				
Target Range - Lower Bound				
Upper Bound				
UTS-4				
UTS-4				
Target Range - Lower Bound				
Upper Bound				



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Method Analyte Units LOD	OA-VOL08m FIZZ RAT Unity	OA-VOL08m MPA tCaCO3/1Kt	OA-VOL08m NNP tCaCO3/1Kt	OA-VOL08m NP tCaCO3/1Kt	OA-VOL08m Ratio (N) Unity	OA-ELE07 pH Unity	S-IR08 S %	C-GAS05 C %	C-GAS05 CO2 %	S-GRA06a S %	C-IR07 C %	S-GRA06 S %	ME-MS41 Ag ppm	ME-MS41 Al %	ME-MS41 As ppm
Sample Description	1	0.3	1	1	0.01	0.1	0.01	0.05	0.2	0.01	0.01	0.01	0.01	0.01	0.1
BLANKS															
BLANK								<0.05	<0.2						
Target Range - Lower Bound								<0.05	<0.2						
Upper Bound								0.10	0.4						
BLANK													<0.01	<0.01	0.2
Target Range - Lower Bound													<0.01	<0.01	<0.1
Upper Bound													0.02	0.02	0.2
BLANK						5.9									
Target Range - Lower Bound						5.5									
Upper Bound						6.9									
BLANK												<0.01			
Target Range - Lower Bound												<0.01			
Upper Bound												0.02			
BLANK															
BLANK															
Target Range - Lower Bound															
Upper Bound															
BLANK							<0.01								
Target Range - Lower Bound							<0.01					<0.01			
Upper Bound							0.02					0.02			
DUPLICATES															
L2125146-2 156272													0.01		
DUP													0.01		
Target Range - Lower Bound													<0.01		
Upper Bound													0.02		
L2125146-3 MARCH TAL 2018						8.0		0.48	1.8						
DUP						8.1		0.48	1.8						
Target Range - Lower Bound						7.5		0.41	1.5						
Upper Bound						8.6		0.55	2.1						
L2125146-6 MAY TAL 2018	2	3.8	23	27	7.20		0.12				0.50	0.08			
DUP	2	3.8	23	27	7.20		0.12				0.50	0.08			
Target Range - Lower Bound	<1	3.3	21	25	6.83		0.11				0.48	0.07			
Upper Bound	3	4.3	25	29	7.57		0.13				0.52	0.09			



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Sample Description	Method Analyte Units LOD	ME-MS41 Au ppm 0.02	ME-MS41 B ppm 10	ME-MS41 Ba ppm 10	ME-MS41 Be ppm 0.05	ME-MS41 Bi ppm 0.01	ME-MS41 Ca % 0.01	ME-MS41 Cd ppm 0.01	ME-MS41 Ce ppm 0.02	ME-MS41 Co ppm 0.1	ME-MS41 Cr ppm 1	ME-MS41 Cs ppm 0.05	ME-MS41 Cu ppm 0.2	ME-MS41 Fe % 0.01	ME-MS41 Ga ppm 0.05	ME-MS41 Ge ppm 0.05
BLANKS																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK		<0.02	<10	<10	<0.05	<0.01	<0.01	<0.01	<0.02	<0.1	<1	<0.05	<0.2	<0.01	<0.05	0.08
Target Range - Lower Bound		<0.02	<10	<10	<0.05	<0.01	<0.01	<0.01	<0.02	<0.1	<1	<0.05	<0.2	<0.01	<0.05	<0.05
Upper Bound		0.04	20	20	0.10	0.02	0.02	0.02	0.04	0.2	2	0.10	0.4	0.02	0.10	0.10
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
DUPLICATES																
L2125146-2 156272																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2125146-3 MARCH TAL 2018																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2125146-6 MAY TAL 2018																
DUP																
Target Range - Lower Bound																
Upper Bound																



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Sample Description	Method Analyte Units LOD	ME-MS41 Hf ppm 0.02	ME-MS41 Hg ppm 0.01	ME-MS41 In ppm 0.005	ME-MS41 K % 0.01	ME-MS41 La ppm 0.2	ME-MS41 Li ppm 0.1	ME-MS41 Mg % 0.01	ME-MS41 Mn ppm 5	ME-MS41 Mo ppm 0.05	ME-MS41 Na % 0.01	ME-MS41 Nb ppm 0.05	ME-MS41 Ni ppm 0.2	ME-MS41 P ppm 10	ME-MS41 Pb ppm 0.2	ME-MS41 Rb ppm 0.1
BLANKS																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK		<0.02	<0.01	0.006	<0.01	<0.2	0.1	<0.01	<5	<0.05	0.02	<0.05	<0.2	<10	<0.2	<0.1
Target Range - Lower Bound		<0.02	<0.01	<0.005	<0.01	<0.2	<0.1	<0.01	<5	<0.05	<0.01	<0.05	<0.2	<10	<0.2	<0.1
Upper Bound		0.04	0.02	0.010	0.02	0.4	0.2	0.02	10	0.10	0.02	0.10	0.4	20	0.4	0.2
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
DUPLICATES																
L2125146-2 156272																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2125146-3 MARCH TAL 2018																
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Target Range - Lower Bound																
Upper Bound																
L2125146-6 MAY TAL 2018																
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Target Range - Lower Bound																
Upper Bound																



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Sample Description	Method Analyte Units LOD	ME-MS41 Re ppm 0.001	ME-MS41 S % 0.01	ME-MS41 Sb ppm 0.05	ME-MS41 Sc ppm 0.1	ME-MS41 Se ppm 0.2	ME-MS41 Sn ppm 0.2	ME-MS41 Sr ppm 0.2	ME-MS41 Ta ppm 0.01	ME-MS41 Te ppm 0.01	ME-MS41 Th ppm 0.2	ME-MS41 Ti % 0.005	ME-MS41 Tl ppm 0.02	ME-MS41 U ppm 0.05	ME-MS41 V ppm 1	ME-MS41 W ppm 0.05
BLANKS																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK		<0.001	0.01	<0.05	<0.1	<0.2	<0.2	<0.2	<0.01	0.01	<0.2	<0.005	<0.02	<0.05	<1	<0.05
Target Range - Lower Bound		<0.001	<0.01	<0.05	<0.1	<0.2	<0.2	<0.2	<0.01	<0.01	<0.2	<0.005	<0.02	<0.05	<1	<0.05
Upper Bound		0.002	0.02	0.10	0.2	0.4	0.4	0.4	0.02	0.02	0.4	0.010	0.04	0.10	2	0.10
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
DUPLICATES																
L2125146-2 156272																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2125146-3 MARCH TAL 2018																
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Target Range - Lower Bound																
Upper Bound																
L2125146-6 MAY TAL 2018																
DUP																
Target Range - Lower Bound																
Upper Bound																



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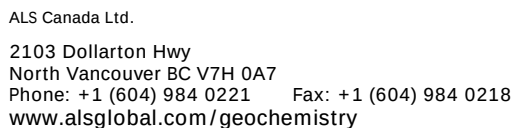
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Sample Description	Method Analyte Units LOD	ME-MS41 Y ppm 0.05	ME-MS41 Zn ppm 2	ME-MS41 Zr ppm 0.5
BLANKS				
BLANK				
Target Range - Lower Bound				
Upper Bound				
BLANK		<0.05	<2	<0.5
Target Range - Lower Bound		<0.05	<2	<0.5
Upper Bound		0.10	4	1.0
BLANK				
Target Range - Lower Bound				
Upper Bound				
BLANK				
Target Range - Lower Bound				
Upper Bound				
BLANK				
BLANK				
Target Range - Lower Bound				
Upper Bound				
BLANK				
Target Range - Lower Bound				
Upper Bound				
DUPLICATES				
L2125146-2 156272				
DUP				
Target Range - Lower Bound				
Upper Bound				
L2125146-3 MARCH TAL 2018				
DUP				
Target Range - Lower Bound				
Upper Bound				
L2125146-6 MAY TAL 2018				
DUP				
Target Range - Lower Bound				
Upper Bound				



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L2130074-2 JUNE TAL DUP Target Range - Lower Bound Upper Bound		DUPLICATES														
ORIGINAL DUP Target Range - Lower Bound Upper Bound		<0.02 <0.02 <0.02 0.04	<10 <10 <10 20	80 80 60 100	0.45 0.40 0.35 0.50	0.16 0.16 0.14 0.18	0.19 0.20 0.18 0.21	0.14 0.14 0.12 0.16	24.7 27.6 24.8 27.5	8.6 8.5 8.0 9.1	29 29 27 31	2.50 2.67 2.41 2.76	13.1 13.7 12.7 14.1	3.57 3.59 3.39 3.77	6.31 6.72 6.14 6.89	0.11 0.12 0.06 0.17



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L2130074-2 JUNE TAL DUP Target Range - Lower Bound Upper Bound		DUPLICATES														
ORIGINAL DUP Target Range - Lower Bound Upper Bound		0.03 0.03 <0.02 0.04	0.02 0.01 <0.01 0.02	0.028 0.027 0.021 0.034	0.09 0.10 0.08 0.11	11.9 13.6 11.9 13.6	15.6 16.0 14.9 16.7	0.42 0.43 0.39 0.46	282 286 265 303	1.00 1.06 0.93 1.13	0.03 0.03 0.02 0.04	2.12 2.14 1.97 2.29	20.3 20.9 19.4 21.8	520 520 480 560	15.9 15.6 14.8 16.7	15.8 16.5 15.2 17.1



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Project: L2125146

QC CERTIFICATE OF ANALYSIS VA18164990

Sample Description	Method Analyte Units LOD	ME-MS41 Re ppm 0.001	ME-MS41 S % 0.01	ME-MS41 Sb ppm 0.05	ME-MS41 Sc ppm 0.1	ME-MS41 Se ppm 0.2	ME-MS41 Sn ppm 0.2	ME-MS41 Sr ppm 0.2	ME-MS41 Ta ppm 0.01	ME-MS41 Te ppm 0.01	ME-MS41 Th ppm 0.2	ME-MS41 Ti % 0.005	ME-MS41 Tl ppm 0.02	ME-MS41 U ppm 0.05	ME-MS41 V ppm 1	ME-MS41 W ppm 0.05
L2130074-2 JUNE TAL DUP Target Range - Lower Bound Upper Bound		DUPLICATES														
ORIGINAL DUP Target Range - Lower Bound Upper Bound		<0.001 <0.001 <0.001 0.002	0.03 0.03 0.02 0.04	0.77 0.83 0.69 0.91	2.6 2.8 2.5 2.9	0.2 0.3 <0.2 0.4	0.5 0.6 0.3 0.8	16.7 17.9 16.2 18.4	<0.01 <0.01 <0.01 0.02	0.05 0.05 0.04 0.06	3.2 3.4 2.9 3.7	0.102 0.106 0.094 0.114	0.14 0.13 0.10 0.17	0.57 0.62 0.52 0.67	59 60 56 63	0.28 0.20 0.17 0.31



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To: **ALS ENVIRONMENTAL**
100 - 8081 LOUGHEED HWY.
BURNABY BC V5A 1W9

Page: 4 - E
Total # Pages: 4 (A - E)
Plus Appendix Pages
Finalized Date: 31 - JUL - 2018
Account: APN

Project: L2125146

QC CERTIFICATE OF ANALYSIS VA18164990

Sample Description	Method Analyte Units LOD	ME-MS41 Y ppm 0.05	ME-MS41 Zn ppm 2	ME-MS41 Zr ppm 0.5
L2130074-2 JUNE TAL DUP Target Range - Lower Bound Upper Bound		DUPLICATES		
ORIGINAL DUP Target Range - Lower Bound Upper Bound		3.36 3.55 3.23 3.68	49 49 45 53	1.4 1.5 0.8 2.1



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Page: Appendix 1
Total # Appendix Pages: 1
Finalized Date: 31 - JUL - 2018
Account: APN

Project: L2125146

QC CERTIFICATE OF ANALYSIS VA18164990

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

C-GAS05	C-IR07	LOG-22	ME-MS41
OA-ELE07	OA-VOL08m	PUL-31	S-CAL06a
S-GRA06	S-GRA06a	S-IR08	SPL-21
WEI-21			



ALS Environmental

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Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2125146-COFC

COC Number: 15-18-12

Page of

Report To Contact and company name below will appear on the final report		Report Format / Distribution		Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply													
Company:	Minto Explorations Ltd.	Select Report Format: ☒ PDF ☐ EXCEL ☒ EDD (DIGITAL)		Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply													
Contact:	Minto Environment - Coordinator	Quality Control (QC) Report with Report ☒ YES ☐ NO		PRIORITY (Business Days)		4 day [P4] ☐		3 day [P3] ☐		2 day [P2] ☐		EMERGENCY		1 Business day [E1] ☐		Same Day, Weekend or Statutory holiday [E0] ☐	
Phone:	1-604-759-4659	☒ Compare Results to Criteria on Report - provide details below if box checked		Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX		Date and Time Required for all E&P TATs: 10/06/18 10:40 AM											
Company address below will appear on the final report		Email 1 or Fax minto_environment@mintomine.com		For tests that can not be performed according to the service level selected, you will be contacted.													
Street:	2100-510 West Georgia St.	Email 2		Analysis Request													
City/Province:	Vancouver, British Columbia	Email 3		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below													
Postal Code:	V6B 0M3																
Invoice To	Same as Report To ☐ YES ☒ NO	Invoice Distribution															
	Copy of Invoice with Report ☐ YES ☒ NO	Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX															
Company:	Minto Explorations Ltd.	Email 1 or Fax ap@mintomine.com															
Contact:	Ruth Cayetano	Email 2															
Project Information		Oil and Gas Required Fields (client use)															
ALS Account # / Quote #:		AFE/Cost Center:		PO#													
Job #:		Major/Minor Code:		Routing Code:													
PO / AFE:	TBD	Requisitioner:															
LSD:		Location:															
ALS Lab Work Order # (lab use only)		ALS Contact:		Sampler:													
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)		Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Total Metals - Aqua regia digestion (ICP)	Paste pH	% Inorganic Carbonate	Total Carbon/Sulphur (Leco)	AP - determination by % sulphide sulphur	Modified NP - (MEND 1991)					Number of Containers	
					Composite	R	R	R	R	R	R						
	156271		18-MAR-18		WASTE	X	X	X	X	X	X						
	156272		23-MAR-18		WASTE	X	X	X	X	X	X						
	MARCH TAL 2018		MAR. 2018		TAILS	X	X	X	X	X	X						
	159901		12-APR-18		WASTE	X	X	X	X	X	X						
	APRIL TAL 2018		APR. 2018		TAILS	X	X	X	X	X	X						
	MAY TAL 2018		MAY 2018		TAILS	X	X	X	X	X	X						
Drinking Water (DW) Samples¹ (client use)			Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)			SAMPLE CONDITION AS RECEIVED (lab use only)											
Are samples taken from a Regulated DW System? ☐ YES ☒ NO			501			Frozen ☐ SIF Observations Yes ☐ No ☐											
Are samples for human drinking water use? ☐ YES ☒ NO						Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐											
						Cooling initiated ☐											
SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)											
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:											
JOEY	JUNE 28/18		VD	JUL 06/18	12:40	JL JUL - 7 2018 12:15pm											

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1-If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 PRINT



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 24-SEP-18
Report Date: 24-OCT-18 18:05 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2169464
Project P.O. #: TBD
Job Reference:
C of C Numbers: 1018-14
Legal Site Desc:

Comments: Please note, the ALS Minerals version of the finalized report and QC can be found at the end of the attachment.

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2169464-1 TAILS 30-JUL-18 JULY TAL 2018	L2169464-2 TAILS 20-AUG-18 AUGUST TAL 2018	L2169464-3 WASTE 01-SEP-18 13346	L2169464-4 WASTE 07-SEP-18 168978	L2169464-5 WASTE 15-SEP-18 170264
Grouping	Analyte					
SOIL						
Physical Tests	pH (Unity)	8.5	8.1	8.5	8.4	8.2
Organic / Inorganic Carbon	Carbon (C) (%)	0.48	0.44	<0.05	0.09	0.19
Acid Base Accounting	FIZZ RATING (Unity)	2	2	1	1	1
	MPA (tCaCO3/1Kt)	1.9	2.5	7.8	4.1	13.8
	Neutralization Potential (NP) (tCaCO3/1Kt)	29	31	8	13	20
	NNP (tCaCO3/1Kt)	27	29	0	9	6
	Ratio (NP/MPA) (Unity)	15.47	12.40	1.02	3.20	1.45
	Sulfate Sulfur (carbonate leach) (%)	0.02	0.04	0.15	0.06	0.25
	Sulfate Sulfur (HCl leach) (%)	0.01	0.04	0.19	0.12	0.26
	Sulfide Sulfur (T minus HCl leach) (%)	0.05	0.04	0.06	0.01	0.18
	Total Sulfur (combustion) (%)	0.06	0.08	0.25	0.13	0.44
Total Metals	Aluminum (Al) (%)	0.99	0.97	1.10	1.16	1.12
	Antimony (Sb) (ppm)	<0.05	0.06	<0.05	0.08	<0.05
	Arsenic (As) (ppm)	0.8	0.9	0.4	0.9	0.7
	Barium (Ba) (ppm)	180	170	200	170	210
	Beryllium (Be) (ppm)	0.28	0.34	0.22	0.28	0.28
	Bismuth (Bi) (ppm)	0.15	0.16	0.43	0.04	0.64
	Boron (B) (ppm)	<10	<10	<10	<10	<10
	Cadmium (Cd) (ppm)	0.41	0.24	0.10	0.08	0.28
	Calcium (Ca) (%)	1.12	1.27	0.74	0.94	1.30
	Cerium (Ce) (ppm)	17.50	19.80	16.55	18.90	19.45
	Cesium (Cs) (ppm)	0.51	0.49	0.37	0.29	0.39
	Chromium (Cr) (ppm)	7	10	8	9	6
	Cobalt (Co) (ppm)	7.1	6.4	5.1	5.8	6.3
	Copper (Cu) (ppm)	739	474	1330	359	3150
	Gallium (Ga) (ppm)	7.86	7.52	5.92	5.49	5.99
	Germanium (Ge) (ppm)	0.11	0.14	0.12	0.08	0.08
	Gold (Au) (ppm)	0.14	0.11	0.06	<0.02	0.13
	Hafnium (Hf) (ppm)	0.04	0.04	0.04	0.06	0.05
	Indium (In) (ppm)	0.069	0.057	0.018	0.019	0.035
	Iron (Fe) (%)	4.39	3.60	2.54	2.52	2.81
	Lanthanum (La) (ppm)	9.4	10.7	8.9	10.6	10.8
	Lead (Pb) (ppm)	2.2	3.2	2.7	2.8	4.7
	Lithium (Li) (ppm)	5.1	5.6	5.3	6.0	5.6
	Magnesium (Mg) (%)	0.65	0.66	0.62	0.69	0.65
	Manganese (Mn) (ppm)	680	646	456	605	558

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2169464-1 TAILS 30-JUL-18 JULY TAL 2018	L2169464-2 TAILS 20-AUG-18 AUGUST TAL 2018	L2169464-3 WASTE 01-SEP-18 13346	L2169464-4 WASTE 07-SEP-18 168978	L2169464-5 WASTE 15-SEP-18 170264
Grouping	Analyte					
SOIL						
Total Metals	Mercury (Hg) (ppm)	0.01	0.01	0.01	0.01	0.05
	Molybdenum (Mo) (ppm)	1.13	1.53	0.28	0.23	1.38
	Nickel (Ni) (ppm)	3.6	4.5	1.9	2.1	2.0
	Niobium (Nb) (ppm)	0.76	1.22	0.88	0.21	0.20
	Phosphorus (P) (ppm)	610	670	660	750	680
	Potassium (K) (%)	0.47	0.40	0.63	0.48	0.53
	Rhenium (Re) (ppm)	0.001	0.002	<0.001	<0.001	0.006
	Rubidium (Rb) (ppm)	26.8	26.0	35.4	25.2	28.8
	Scandium (Sc) (ppm)	4.5	5.0	4.0	3.2	3.0
	Selenium (Se) (ppm)	0.7	0.4	1.2	0.3	3.0
	Silver (Ag) (ppm)	0.39	0.38	0.84	0.14	1.81
	Sodium (Na) (%)	0.04	0.03	0.07	0.08	0.04
	Strontium (Sr) (ppm)	86.9	99.4	77.8	58.1	70.5
	Sulfur (S) (%)	0.06	0.09	0.27	0.15	0.46
	Tantalum (Ta) (ppm)	0.02	0.05	0.02	<0.01	<0.01
	Tellurium (Te) (ppm)	0.09	0.08	0.20	0.02	0.52
	Thallium (Tl) (ppm)	0.19	0.17	0.19	0.13	0.16
	Thorium (Th) (ppm)	3.2	3.3	3.6	3.0	2.7
	Tin (Sn) (ppm)	1.0	1.1	0.4	0.4	0.5
	Titanium (Ti) (%)	0.077	0.068	0.143	0.126	0.110
	Tungsten (W) (ppm)	0.15	0.26	0.06	0.05	0.08
	Uranium (U) (ppm)	0.26	0.28	0.48	0.29	0.35
	Vanadium (V) (ppm)	68	59	54	55	58
	Yttrium (Y) (ppm)	5.26	5.92	4.59	4.70	5.22
	Zinc (Zn) (ppm)	111	101	74	91	86
	Zirconium (Zr) (ppm)	1.1	1.2	0.9	1.0	0.8
Permanent Gases	Carbon Dioxide (CO2) (%)	1.8	1.6	<0.2	0.3	0.7
Miscellaneous	Carbon (C) (%)	0.56	0.54	0.04	0.11	0.26

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ABA-OA-VOL08-AX	Soil	Acid Base Accounting	OA-VOL08
CARBON-C-GAS05-AX	Soil	Carbon, TOC and CO2	C-GAS05
CARBON-C-IR07-AX	Soil	Carbon (C) using LECO analyzer	Total Carbon - Method Code C-IR07
Total Carbon & Sulfur - Method Codes C-IR07 & S-IR08			
A 0.1g sample is heated to approximately 1350°C in an induction furnace while passing a stream of oxygen through the sample. Carbon dioxide & sulfur dioxide released from the sample are measured by an IR detection system (Leco analyzer) and the total carbon & sulfur results are provided.			
ME-MS41-AX	Soil	Aqua Regia ICPMS	Aqua Regia ICPMS
A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences.			
PH-OA-ELE07-AX	Soil	pH	OA-ELE07
SULPHUR-S-CAL06A-AX	Soil	Sulfide Sulfur Calc from HCl Leach	ALS Minerals S-CAL06A
Sulfide Sulfur (as S) is calculated by subtracting the HCl Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion.			
SULPHUR-S-GRA06-AX	Soil	Sulfate Sulfur in Soil (Carbonate Leach)	ALS Minerals S-GRA06
A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).			
SULPHUR-S-GRA06A-AX	Soil	Sulfate Sulfur in Soil (HCl Leach)	ALS Minerals S-GRA06A
A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).			
SULPHUR-S-IR08-AX	Soil	Total Sulfur in Soil by Combustion	ALS Minerals S-IR08
The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
AX	ALS MINERALS - VANCOUVER, B.C., CANADA

Chain of Custody Numbers:

1018-14

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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Page: **1**
Total # Pages: **2 (A - E)**
Plus Appendix Pages
Finalized Date: **23 - OCT - 2018**
Account: **APN**

CERTIFICATE VA18241695

Project: L2169464

This report is for 5 Crushed Rock samples submitted to our lab in Vancouver, BC, Canada on 26-SEP-2018.

The following have access to data associated with this certificate:

ALSE VANCOUVER WEBTRIEVE
SHANE STACK

ALSEV DATASUBLET

SOFTWARE DEVELOPMENT GROUP

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI-21	Received Sample Weight
LOG-22	Sample login - Rcd w/o BarCode
PUL-QC	Pulverizing QC Test
PUL-31	Pulverize split to 85% <75 um
SPL-21	Split sample - riffle splitter

ANALYTICAL PROCEDURES

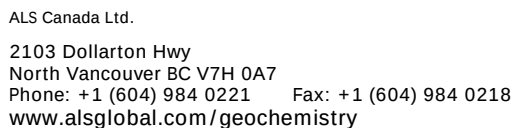
ALS CODE	DESCRIPTION	
C-GAS05	Inorganic Carbon (CO2)	
C-IR07	Total Carbon (Leco)	LECO
S-GRA06	Sulfate Sulfur - carbonate leach	WST-SEQ
ME-MS41	Ultra Trace Aqua Regia ICP-MS	
OA-VOL08m	Modified NP	
S-IR08	Total Sulphur (Leco)	LECO
OA-ELE07	Paste pH	
S-CAL06a	Sulfide Sulfur (calculated*)	
S-GRA06a	Sulfate Sulfur (HCl leachable)	WST-SEQ

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature:

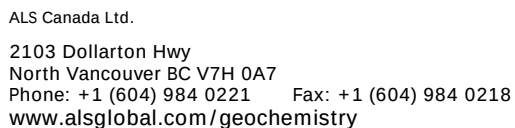
Colin Ramshaw, Vancouver Laboratory Manager



Page: 2 - A
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CERTIFICATE OF ANALYSIS VA18241695

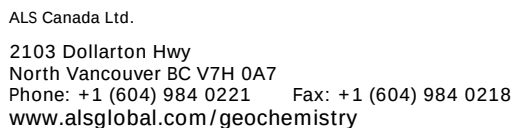
***** See Appendix Page for comments regarding this certificate *****



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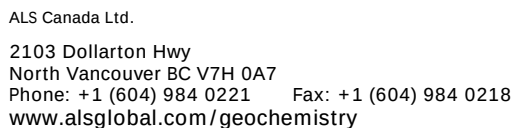
***** See Appendix Page for comments regarding this certificate *****



Page: 2 - C
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CERTIFICATE OF ANALYSIS VA18241695

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CERTIFICATE OF ANALYSIS VA18241695

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To: **ALS ENVIRONMENTAL**
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BURNABY BC V5A 1W9

Page: Appendix 1
Total # Appendix Pages: 1
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Project: L2169464

CERTIFICATE OF ANALYSIS VA18241695

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

C - GAS05	C - IR07	LOG - 22	ME - MS41
OA - ELE07	OA - VOL08m	PUL - 31	PUL - QC
S - CAL06a	S - GRA06	S - GRA06a	S - IR08
SPL - 21	WEI - 21		



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QC CERTIFICATE VA18241695

Project: L2169464

This report is for 5 Crushed Rock samples submitted to our lab in Vancouver, BC, Canada on 26-SEP-2018.

The following have access to data associated with this certificate:

ALSE VANCOUVER WEBTRIEVE
SHANE STACK

ALSEV DATASUBLET

SOFTWARE DEVELOPMENT GROUP

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI-21	Received Sample Weight
LOG-22	Sample login - Rcd w/o BarCode
PUL-QC	Pulverizing QC Test
PUL-31	Pulverize split to 85% <75 um
SPL-21	Split sample - riffle splitter

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	
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C-IR07	Total Carbon (Leco)	LECO
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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature:

Colin Ramshaw, Vancouver Laboratory Manager



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100 - 8081 LOUGHEED HWY.
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QC CERTIFICATE OF ANALYSIS VA18241695

Sample Description	Method Analyte Units LOD	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-ELE07	S-IR08	C-GAS05	C-GAS05	S-GRA06a	C-IR07	S-GRA06	ME-MS41	ME-MS41	ME-MS41
		FIZZ RAT	MPA	NNP	NP	Ratio (N	pH	S	C	CO2	S	C	S	Ag	Al	As
		Unity	tCaCO3/1Kt	tCaCO3/1Kt	tCaCO3/1Kt	Unity	Unity	%	%	%	%	%	%	ppm	%	ppm
		1	0.3	1	1	0.01	0.1	0.01	0.05	0.2	0.01	0.01	0.01	0.01	0.01	0.1
STANDARDS																
Buffer pH6							6.0									
Buffer pH6							6.0									
Target Range - Lower Bound							5.3									
Upper Bound							6.7									
CO-ASSAY									0.48	1.8						
Target Range - Lower Bound									0.42	1.5						
Upper Bound									0.64	2.4						
GS310-10								0.26				1.10				
Target Range - Lower Bound								0.25				1.03				
Upper Bound								0.29				1.13				
KZK-1		2	25.0	31	56	2.24										
KZK-1		2	25.0	32	57	2.28										
Target Range - Lower Bound		<1	22.9	30	54	2.18										
Upper Bound		>4	27.1	38	64	2.53										
MA-1b								1.17				2.45				
Target Range - Lower Bound								1.12				2.34				
Upper Bound								1.22				2.54				
MA-3a									2.33	8.5						
Target Range - Lower Bound									2.31	8.4						
Upper Bound									2.77	10.2						
OREAS 920														0.19	2.49	5.0
Target Range - Lower Bound														0.07	2.18	4.2
Upper Bound														0.12	2.68	5.3
UTS-1													0.87			
UTS-1													0.86			
UTS-1													0.85			
Target Range - Lower Bound													0.83			
Upper Bound													0.93			
UTS-1											0.91					
UTS-1											0.90					
Target Range - Lower Bound											0.81					
Upper Bound											0.95					
UTS-4													1.77			
Target Range - Lower Bound													1.64			
Upper Bound													1.84			
UTS-4											1.75					
UTS-4											1.75					
Target Range - Lower Bound											1.61					
Upper Bound											1.87					



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QC CERTIFICATE OF ANALYSIS VA18241695

Sample Description	Method Analyte Units LOD	ME-MS41 Au ppm 0.02	ME-MS41 B ppm 10	ME-MS41 Ba ppm 10	ME-MS41 Be ppm 0.05	ME-MS41 Bi ppm 0.01	ME-MS41 Ca % 0.01	ME-MS41 Cd ppm 0.01	ME-MS41 Ce ppm 0.02	ME-MS41 Co ppm 0.1	ME-MS41 Cr ppm 1	ME-MS41 Cs ppm 0.05	ME-MS41 Cu ppm 0.2	ME-MS41 Fe % 0.01	ME-MS41 Ga ppm 0.05	ME-MS41 Ge ppm 0.05
STANDARDS																
Buffer pH6																
Buffer pH6																
Target Range - Lower Bound																
Upper Bound																
CO - ASSAY																
Target Range - Lower Bound																
Upper Bound																
GS310-10																
Target Range - Lower Bound																
Upper Bound																
KZK-1																
KZK-1																
Target Range - Lower Bound																
Upper Bound																
MA-1b																
Target Range - Lower Bound																
Upper Bound																
MA-3a																
Target Range - Lower Bound																
Upper Bound																
OREAS 920		<0.02	<10	80	0.72	0.62	0.34	0.07	75.2	15.4	42	2.02	116.0	3.62	6.50	0.09
Target Range - Lower Bound		<0.02	<10	50	0.59	0.60	0.28	0.04	64.8	13.4	37	1.84	102.0	3.26	6.12	<0.05
Upper Bound		0.04	20	110	0.87	0.76	0.37	0.08	79.2	16.6	48	2.36	118.0	4.00	7.60	0.22
UTS-1																
UTS-1																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
UTS-4																
Target Range - Lower Bound																
Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18241695

Sample Description	Method Analyte Units LOD	ME-MS41 Hf ppm 0.02	ME-MS41 Hg ppm 0.01	ME-MS41 In ppm 0.005	ME-MS41 K % 0.01	ME-MS41 La ppm 0.2	ME-MS41 Li ppm 0.1	ME-MS41 Mg % 0.01	ME-MS41 Mn ppm 5	ME-MS41 Mo ppm 0.05	ME-MS41 Na % 0.01	ME-MS41 Nb ppm 0.05	ME-MS41 Ni ppm 0.2	ME-MS41 P ppm 10	ME-MS41 Pb ppm 0.2	ME-MS41 Rb ppm 0.1
STANDARDS																
Buffer pH6																
Buffer pH6																
Target Range - Lower Bound																
Upper Bound																
CO - ASSAY																
Target Range - Lower Bound																
Upper Bound																
GS310-10																
Target Range - Lower Bound																
Upper Bound																
KZK-1																
KZK-1																
Target Range - Lower Bound																
Upper Bound																
MA-1b																
Target Range - Lower Bound																
Upper Bound																
MA-3a																
Target Range - Lower Bound																
Upper Bound																
OREAS 920		0.48	<0.01	0.033	0.39	38.2	21.0	1.13	525	0.35	0.01	0.26	39.8	750	23.2	23.0
Target Range - Lower Bound		0.48	<0.01	0.019	0.37	33.3	19.0	0.93	454	0.26	<0.01	0.22	34.4		19.2	22.2
Upper Bound		0.63	0.02	0.043	0.47	41.1	23.4	1.15	566	0.50	0.02	0.46	42.4		23.9	27.4
UTS-1																
UTS-1																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
UTS-4																
Target Range - Lower Bound																
Upper Bound																



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Sample Description	Method Analyte Units LOD	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
		Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V	W
		ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm
		0.001	0.01	0.05	0.1	0.2	0.2	0.2	0.01	0.01	0.2	0.005	0.02	0.05	1	0.05
STANDARDS																
Buffer pH6																
Buffer pH6																
Target Range - Lower Bound																
Upper Bound																
CO- ASSAY																
Target Range - Lower Bound																
Upper Bound																
GS310-10																
Target Range - Lower Bound																
Upper Bound																
KZK-1																
KZK-1																
Target Range - Lower Bound																
Upper Bound																
MA-1b																
Target Range - Lower Bound																
Upper Bound																
MA-3a																
Target Range - Lower Bound																
Upper Bound																
OREAS 920		<0.001	0.03	0.60	2.7	0.3	1.0	16.6	0.01	0.02	16.2	0.113	0.15	2.04	25	0.41
Target Range - Lower Bound		<0.001	<0.01	0.45	2.5	<0.2	0.6	15.0	<0.01	<0.01	13.6	0.106	0.09	1.89	21	0.31
Upper Bound		0.002	0.05	0.77	3.3	0.7	1.6	18.8	0.02	0.04	17.0	0.140	0.20	2.42	28	0.61
UTS-1																
UTS-1																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
UTS-4																
Target Range - Lower Bound																
Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18241695

Sample Description	Method Analyte Units LOD	ME-MS41 Y ppm 0.05	ME-MS41 Zn ppm 2	ME-MS41 Zr ppm 0.5
STANDARDS				
Buffer pH6				
Buffer pH6				
Target Range - Lower Bound				
Upper Bound				
CO-ASSAY				
Target Range - Lower Bound				
Upper Bound				
GS310-10				
Target Range - Lower Bound				
Upper Bound				
KZK-1				
KZK-1				
Target Range - Lower Bound				
Upper Bound				
MA-1b				
Target Range - Lower Bound				
Upper Bound				
MA-3a				
Target Range - Lower Bound				
Upper Bound				
OREAS 920		17.45	111	18.9
Target Range - Lower Bound		15.80	93	17.6
Upper Bound		19.40	119	25.0
UTS-1				
UTS-1				
UTS-1				
Target Range - Lower Bound				
Upper Bound				
UTS-1				
UTS-1				
Target Range - Lower Bound				
Upper Bound				
UTS-4				
Target Range - Lower Bound				
Upper Bound				
UTS-4				
UTS-4				
Target Range - Lower Bound				
Upper Bound				



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Sample Description	Method Analyte Units LOD	OA-VOL08m FIZZ RAT Unity	OA-VOL08m MPA tCaCO3/1Kt	OA-VOL08m NNP tCaCO3/1Kt	OA-VOL08m NP tCaCO3/1Kt	OA-VOL08m Ratio (N) Unity	OA-ELE07 pH Unity	S-IR08 S %	C-GAS05 C %	C-GAS05 CO2 %	S-GRA06a S %	C-IR07 C %	S-GRA06 S %	ME-MS41 Ag ppm	ME-MS41 Al %	ME-MS41 As ppm
		1	0.3	1	1	0.01	0.1	0.01	0.05	0.2	0.01	0.01	0.01	0.01	0.01	0.1
BLANKS																
BLANK									<0.05	<0.2						
BLANK									<0.05	<0.2						
Target Range - Lower Bound									<0.05	<0.2						
Upper Bound									0.10	0.4						
BLANK														<0.01	<0.01	<0.1
Target Range - Lower Bound														<0.01	<0.01	<0.1
Upper Bound														0.02	0.02	0.2
BLANK						6.0										
Target Range - Lower Bound						5.5										
Upper Bound						6.9										
BLANK													<0.01			
BLANK													<0.01			
Target Range - Lower Bound													<0.01			
Upper Bound													0.02			
BLANK											<0.01					
BLANK											<0.01					
Target Range - Lower Bound											<0.01					
Upper Bound											0.02					
BLANK								<0.01				<0.01				
Target Range - Lower Bound								<0.01				<0.01				
Upper Bound								0.02				0.02				
DUPLICATES																
ORIGINAL								0.50				1.91				
DUP								0.54				1.92				
Target Range - Lower Bound								0.50				1.86				
Upper Bound								0.54				1.97				
L2169464-2-AUGUST TAL 2018									0.44	1.6						
DUP									0.45	1.6						
Target Range - Lower Bound									0.37	1.3						
Upper Bound									0.52	1.9						



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QC CERTIFICATE OF ANALYSIS VA18241695

Sample Description	Method Analyte Units LOD	ME-MS41 Au ppm 0.02	ME-MS41 B ppm 10	ME-MS41 Ba ppm 10	ME-MS41 Be ppm 0.05	ME-MS41 Bi ppm 0.01	ME-MS41 Ca % 0.01	ME-MS41 Cd ppm 0.01	ME-MS41 Ce ppm 0.02	ME-MS41 Co ppm 0.1	ME-MS41 Cr ppm 1	ME-MS41 Cs ppm 0.05	ME-MS41 Cu ppm 0.2	ME-MS41 Fe % 0.01	ME-MS41 Ga ppm 0.05	ME-MS41 Ge ppm 0.05
BLANKS																
BLANK																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK		<0.02	<10	<10	<0.05	<0.01	<0.01	<0.01	<0.02	<0.1	<1	<0.05	<0.2	<0.01	<0.05	<0.05
Target Range - Lower Bound		<0.02	<10	<10	<0.05	<0.01	<0.01	<0.01	<0.02	<0.1	<1	<0.05	<0.2	<0.01	<0.05	<0.05
Upper Bound		0.04	20	20	0.10	0.02	0.02	0.02	0.04	0.2	2	0.10	0.4	0.02	0.10	0.10
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
DUPLICATES																
ORIGINAL																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2169464-2-AUGUST TAL 2018																
DUP																
Target Range - Lower Bound																
Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18241695

Sample Description	Method Analyte Units LOD	ME-MS41 Hf ppm 0.02	ME-MS41 Hg ppm 0.01	ME-MS41 In ppm 0.005	ME-MS41 K % 0.01	ME-MS41 La ppm 0.2	ME-MS41 Li ppm 0.1	ME-MS41 Mg % 0.01	ME-MS41 Mn ppm 5	ME-MS41 Mo ppm 0.05	ME-MS41 Na % 0.01	ME-MS41 Nb ppm 0.05	ME-MS41 Ni ppm 0.2	ME-MS41 P ppm 10	ME-MS41 Pb ppm 0.2	ME-MS41 Rb ppm 0.1
BLANKS																
BLANK																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK		<0.02	<0.01	<0.005	<0.01	<0.2	<0.1	<0.01	<5	<0.05	<0.01	<0.05	<0.2	<10	<0.2	<0.1
Target Range - Lower Bound		<0.02	<0.01	<0.005	<0.01	<0.2	<0.1	<0.01	<5	<0.05	<0.01	<0.05	<0.2	<10	<0.2	<0.1
Upper Bound		0.04	0.02	0.010	0.02	0.4	0.2	0.02	10	0.10	0.02	0.10	0.4	20	0.4	0.2
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
DUPLICATES																
ORIGINAL																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2169464-2-AUGUST TAL 2018																
DUP																
Target Range - Lower Bound																
Upper Bound																



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Sample Description	Method Analyte Units LOD	ME-MS41 Re ppm 0.001	ME-MS41 S % 0.01	ME-MS41 Sb ppm 0.05	ME-MS41 Sc ppm 0.1	ME-MS41 Se ppm 0.2	ME-MS41 Sn ppm 0.2	ME-MS41 Sr ppm 0.2	ME-MS41 Ta ppm 0.01	ME-MS41 Te ppm 0.01	ME-MS41 Th ppm 0.2	ME-MS41 Ti % 0.005	ME-MS41 Tl ppm 0.02	ME-MS41 U ppm 0.05	ME-MS41 V ppm 1	ME-MS41 W ppm 0.05
BLANKS																
BLANK																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK		<0.001	<0.01	<0.05	<0.1	<0.2	<0.2	<0.2	<0.01	<0.01	<0.2	<0.005	<0.02	<0.05	<1	<0.05
Target Range - Lower Bound		<0.001	<0.01	<0.05	<0.1	<0.2	<0.2	<0.2	<0.01	<0.01	<0.2	<0.005	<0.02	<0.05	<1	<0.05
Upper Bound		0.002	0.02	0.10	0.2	0.4	0.4	0.4	0.02	0.02	0.4	0.010	0.04	0.10	2	0.10
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
DUPLICATES																
ORIGINAL																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2169464-2-AUGUST TAL 2018																
DUP																
Target Range - Lower Bound																
Upper Bound																



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Sample Description	Method Analyte Units LOD	ME-MS41 Y ppm 0.05	ME-MS41 Zn ppm 2	ME-MS41 Zr ppm 0.5
BLANKS				
BLANK				
BLANK				
Target Range - Lower Bound				
Upper Bound				
BLANK		<0.05	<2	<0.5
Target Range - Lower Bound		<0.05	<2	<0.5
Upper Bound		0.10	4	1.0
BLANK				
Target Range - Lower Bound				
Upper Bound				
BLANK				
BLANK				
Target Range - Lower Bound				
Upper Bound				
BLANK				
BLANK				
Target Range - Lower Bound				
Upper Bound				
BLANK				
Target Range - Lower Bound				
Upper Bound				
DUPLICATES				
ORIGINAL				
DUP				
Target Range - Lower Bound				
Upper Bound				
L2169464-2-AUGUST TAL 2018				
DUP				
Target Range - Lower Bound				
Upper Bound				



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Sample Description	Method Analyte Units LOD	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-VOL08m	OA-ELE07	S-IR08	C-GAS05	C-GAS05	S-GRA06a	C-IR07	S-GRA06	ME-MS41	ME-MS41	ME-MS41
		FIZZ RAT	MPA	NNP	NP	Ratio (N	pH	S	C	CO2	S	C	S	Ag	Al	As
		Unity	tCaCO3/1Kt	tCaCO3/1Kt	tCaCO3/1Kt	Unity	Unity	%	%	%	%	%	%	ppm	%	ppm
		1	0.3	1	1	0.01	0.1	0.01	0.05	0.2	0.01	0.01	0.01	0.01	0.01	0.1
DUPLICATES																
L2169464-4-198978											0.12		0.06	0.14	1.16	0.9
DUP											0.12		0.08	0.38	1.18	1.3
Target Range - Lower Bound											0.10		0.06	0.24	1.10	0.9
Upper Bound											0.14		0.08	0.28	1.24	1.3
L2169464-5-170264		1	13.8	6	20	1.45										
DUP		1	13.8	5	19	1.38										
Target Range - Lower Bound		<1	12.8	4	18	1.33										
Upper Bound		2	14.8	7	21	1.50										
L2169819-5 (H353008) 30 AUG-2018 TP#5							8.6		<0.05	0.2			0.02			
DUP							8.6		<0.05	<0.2			0.01			
Target Range - Lower Bound							8.1		<0.05	<0.2			<0.01			
Upper Bound							9.1		0.10	0.4			0.02			
L2169819-13 (H353008) 30 AUG-2018 TP#13											0.01					
DUP											0.01					
Target Range - Lower Bound											<0.01					
Upper Bound											0.02					



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Account: APN

Project: L2169464

QC CERTIFICATE OF ANALYSIS VA18241695

Sample Description	Method Analyte Units LOD	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
		Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga
		ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm
		0.02	10	10	0.05	0.01	0.01	0.01	0.02	0.1	1	0.05	0.2	0.01	0.05
		DUPLICATES													
L2169464-4-198978		<0.02	<10	170	0.28	0.04	0.94	0.08	18.90	5.8	9	0.29	359	2.52	5.49
DUP		<0.02	<10	170	0.27	0.04	0.95	0.09	19.90	5.7	9	0.30	352	2.54	5.62
Target Range - Lower Bound		<0.02	<10	150	0.21	0.03	0.89	0.07	18.40	5.4	8	0.23	343	2.39	5.23
Upper Bound		0.04	20	190	0.34	0.05	1.00	0.10	20.4	6.1	10	0.36	368	2.67	5.88
L2169464-5-170264															
DUP															
Target Range - Lower Bound															
Upper Bound															
L2169819-5 (H353008) 30 AUG-2018 TP#5															
DUP															
Target Range - Lower Bound															
Upper Bound															
L2169819-13 (H353008) 30 AUG-2018 TP#13															
DUP															
Target Range - Lower Bound															
Upper Bound															



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QC CERTIFICATE OF ANALYSIS VA18241695

Sample Description	Method Analyte Units LOD	ME-MS41 Hf ppm 0.02	ME-MS41 Hg ppm 0.01	ME-MS41 In ppm 0.005	ME-MS41 K % 0.01	ME-MS41 La ppm 0.2	ME-MS41 Li ppm 0.1	ME-MS41 Mg % 0.01	ME-MS41 Mn ppm 5	ME-MS41 Mo ppm 0.05	ME-MS41 Na % 0.01	ME-MS41 Nb ppm 0.05	ME-MS41 Ni ppm 0.2	ME-MS41 P ppm 10	ME-MS41 Pb ppm 0.2	ME-MS41 Rb ppm 0.1
DUPLICATES																
L2169464-4-198978		0.06	0.01	0.019	0.48	10.6	6.0	0.69	605	0.23	0.08	0.21	2.1	750	2.8	25.2
DUP		0.07	<0.01	0.019	0.49	11.1	5.8	0.69	608	0.26	0.08	0.34	2.0	740	14.5	25.7
Target Range - Lower Bound		0.04	<0.01	0.013	0.45	10.1	5.5	0.65	571	0.18	0.07	0.21	1.7	700	8.0	24.1
Upper Bound		0.09	0.02	0.025	0.52	11.6	6.3	0.73	642	0.31	0.09	0.34	2.4	790	9.3	26.8
L2169464-5-170264																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2169819-5 (H353008) 30 AUG-2018 TP#5																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2169819-13 (H353008) 30 AUG-2018 TP#13																
DUP																
Target Range - Lower Bound																
Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18241695

Sample Description	Method Analyte Units LOD	ME-MS41 Re ppm 0.001	ME-MS41 S % 0.01	ME-MS41 Sb ppm 0.05	ME-MS41 Sc ppm 0.1	ME-MS41 Se ppm 0.2	ME-MS41 Sn ppm 0.2	ME-MS41 Sr ppm 0.2	ME-MS41 Ta ppm 0.01	ME-MS41 Te ppm 0.01	ME-MS41 Th ppm 0.2	ME-MS41 Ti % 0.005	ME-MS41 Tl ppm 0.02	ME-MS41 U ppm 0.05	ME-MS41 V ppm 1	ME-MS41 W ppm 0.05
DUPLICATES																
L2169464-4-198978		<0.001	0.15	0.08	3.2	0.3	0.4	58.1	<0.01	0.02	3.0	0.126	0.13	0.29	55	0.05
DUP		<0.001	0.15	0.23	3.5	0.3	0.4	63.3	0.01	0.03	3.1	0.128	0.14	0.31	55	0.05
Target Range - Lower Bound		<0.001	0.13	0.09	3.1	<0.2	<0.2	57.5	<0.01	<0.01	2.7	0.116	0.10	0.24	51	<0.05
Upper Bound		0.002	0.17	0.22	3.6	0.4	0.6	63.9	0.02	0.04	3.4	0.138	0.17	0.37	59	0.10
L2169464-5-170264																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2169819-5 (H353008) 30 AUG-2018 TP#5																
DUP																
Target Range - Lower Bound																
Upper Bound																
L2169819-13 (H353008) 30 AUG-2018 TP#13																
DUP																
Target Range - Lower Bound																
Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18241695

Sample Description	Method Analyte Units LOD	ME-MS41 Y ppm 0.05	ME-MS41 Zn ppm 2	ME-MS41 Zr ppm 0.5
L2169464-4-198978 DUP Target Range - Lower Bound Upper Bound		4.70 4.82 4.47 5.05	91 108 93 106	1.0 1.1 <0.5 1.6
L2169464-5-170264 DUP Target Range - Lower Bound Upper Bound				
L2169819-5 (H353008) 30 AUG-2018 TP#5 DUP Target Range - Lower Bound Upper Bound				
L2169819-13 (H353008) 30 AUG-2018 TP#13 DUP Target Range - Lower Bound Upper Bound				



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QC CERTIFICATE OF ANALYSIS VA18241695

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

C - GAS05	C - IR07	LOG - 22	ME - MS41
OA - ELE07	OA - VOL08m	PUL - 31	PUL - QC
S - CAL06a	S - GRA06	S - GRA06a	S - IR08
SPL - 21	WEI - 21		





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Date Received: 12-OCT-18
Report Date: 03-DEC-18 17:57 (MT)
Version: FINAL

Client Phone: 604-759-0860

Certificate of Analysis

Lab Work Order #: L2180845
Project P.O. #: NOT SUBMITTED
Job Reference:
C of C Numbers: 2018-15
Legal Site Desc:

Comments: Please note, the ALS Minerals version of the finalized report and QC can be found at the end of the attachment.

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2180845-1 Waste 21-SEP-18 170265	L2180845-2 Tails 05-SEP-18 SEPT TAL 2018			
Grouping	Analyte					
SOIL						
Physical Tests	pH (Unity)	8.4	8.2			
Organic / Inorganic Carbon	Carbon (C) (%)	0.09	0.41			
Acid Base Accounting	FIZZ RATING (Unity)	1	2			
	MPA (tCaCO3/1Kt)	5.3	3.8			
	Neutralization Potential (NP) (tCaCO3/1Kt)	16	47			
	NNP (tCaCO3/1Kt)	11	43			
	Ratio (NP/MPA) (Unity)	3.01	12.53			
	Sulfate Sulfur (carbonate leach) (%)	0.11	0.04			
	Sulfate Sulfur (HCl leach) (%)	0.13	0.06			
	Sulfide Sulfur (T minus HCl leach) (%)	0.04	0.06			
	Total Sulfur (combustion) (%)	0.17	0.12			
Total Metals	Aluminum (Al) (%)	1.10	1.14			
	Antimony (Sb) (ppm)	<0.05	<0.05			
	Arsenic (As) (ppm)	0.7	0.8			
	Barium (Ba) (ppm)	150	200			
	Beryllium (Be) (ppm)	0.32	0.29			
	Bismuth (Bi) (ppm)	0.25	0.17			
	Boron (B) (ppm)	60	30			
	Cadmium (Cd) (ppm)	0.15	0.37			
	Calcium (Ca) (%)	1.06	1.19			
	Cerium (Ce) (ppm)	20.6	18.40			
	Cesium (Cs) (ppm)	0.28	0.50			
	Chromium (Cr) (ppm)	6	7			
	Cobalt (Co) (ppm)	6.6	8.1			
	Copper (Cu) (ppm)	800	1045			
	Gallium (Ga) (ppm)	5.83	8.43			
	Germanium (Ge) (ppm)	0.09	0.08			
	Gold (Au) (ppm)	0.04	0.13			
	Hafnium (Hf) (ppm)	0.08	0.06			
	Indium (In) (ppm)	0.023	0.073			
	Iron (Fe) (%)	2.38	4.25			
	Lanthanum (La) (ppm)	11.7	9.6			
	Lead (Pb) (ppm)	4.1	3.0			
	Lithium (Li) (ppm)	5.3	5.8			
	Magnesium (Mg) (%)	0.66	0.68			
	Manganese (Mn) (ppm)	664	684			

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2180845-1 Waste 21-SEP-18 170265	L2180845-2 Tails 05-SEP-18 SEPT TAL 2018			
Grouping	Analyte					
SOIL						
Total Metals	Mercury (Hg) (ppm)	<0.01	0.01			
	Molybdenum (Mo) (ppm)	1.16	1.83			
	Nickel (Ni) (ppm)	2.3	4.1			
	Niobium (Nb) (ppm)	0.24	0.19			
	Phosphorus (P) (ppm)	670	650			
	Potassium (K) (%)	0.40	0.54			
	Rhenium (Re) (ppm)	0.002	0.002			
	Rubidium (Rb) (ppm)	19.6	28.2			
	Scandium (Sc) (ppm)	3.8	4.7			
	Selenium (Se) (ppm)	0.8	0.9			
	Silver (Ag) (ppm)	0.54	0.53			
	Sodium (Na) (%)	0.09	0.07			
	Strontium (Sr) (ppm)	79.4	100.0			
	Sulfur (S) (%)	0.19	0.13			
	Tantalum (Ta) (ppm)	<0.01	<0.01			
	Tellurium (Te) (ppm)	0.07	0.14			
	Thallium (Tl) (ppm)	0.11	0.20			
	Thorium (Th) (ppm)	4.2	3.6			
	Tin (Sn) (ppm)	0.4	1.1			
	Titanium (Ti) (%)	0.134	0.086			
	Tungsten (W) (ppm)	0.07	0.08			
	Uranium (U) (ppm)	0.47	0.35			
	Vanadium (V) (ppm)	49	67			
	Yttrium (Y) (ppm)	5.07	5.77			
	Zinc (Zn) (ppm)	101	111			
	Zirconium (Zr) (ppm)	1.3	1.4			
Permanent Gases	Carbon Dioxide (CO2) (%)	0.3	1.5			
Miscellaneous	Carbon (C) (%)	0.10	0.48			

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ABA-OA-VOL08-AX	Soil	Acid Base Accounting	OA-VOL08
CARBON-C-GAS05-AX	Soil	Carbon, TOC and CO2	C-GAS05
CARBON-C-IR07-AX	Soil	Carbon (C) using LECO analyzer	Total Carbon - Method Code C-IR07
Total Carbon & Sulfur - Method Codes C-IR07 & S-IR08			
A 0.1g sample is heated to approximately 1350°C in an induction furnace while passing a stream of oxygen through the sample. Carbon dioxide & sulfur dioxide released from the sample are measured by an IR detection system (Leco analyzer) and the total carbon & sulfur results are provided.			
ME-MS41-AX	Soil	Aqua Regia ICPMS	Aqua Regia ICPMS
A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences.			
PH-OA-ELE07-AX	Soil	pH	OA-ELE07
SULPHUR-S-CAL06A-AX	Soil	Sulfide Sulfur Calc from HCl Leach	ALS Minerals S-CAL06A
Sulfide Sulfur (as S) is calculated by subtracting the HCl Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion.			
SULPHUR-S-GRA06-AX	Soil	Sulfate Sulfur in Soil (Carbonate Leach)	ALS Minerals S-GRA06
A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).			
SULPHUR-S-GRA06A-AX	Soil	Sulfate Sulfur in Soil (HCl Leach)	ALS Minerals S-GRA06A
A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).			
SULPHUR-S-IR08-AX	Soil	Total Sulfur in Soil by Combustion	ALS Minerals S-IR08
The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
AX	ALS MINERALS - VANCOUVER, B.C., CANADA

Chain of Custody Numbers:

2018-15

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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CERTIFICATE VA18261067

Project: L2180845

This report is for 2 Crushed Rock samples submitted to our lab in Vancouver, BC, Canada on 17-OCT-2018.

The following have access to data associated with this certificate:

ALSE VANCOUVER WEBTRIEVE
SHANE STACK

ALSEV DATASUBLET

SOFTWARE DEVELOPMENT GROUP

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI-21	Received Sample Weight
LOG-22	Sample login - Rcd w/o BarCode
PUL-QC	Pulverizing QC Test
PUL-31	Pulverize split to 85% <75 um
SPL-21	Split sample - riffle splitter

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	
C-GAS05	Inorganic Carbon (CO2)	
S-GRA06a	Sulfate Sulfur (HCl leachable)	WST-SEQ
C-IR07	Total Carbon (Leco)	LECO
ME-MS41	Ultra Trace Aqua Regia ICP-MS	
S-CAL06a	Sulfide Sulfur (calculated*)	
OA-VOL08	Basic Acid Base Accounting	
S-IR08	Total Sulphur (Leco)	LECO
OA-ELE07	Paste pH	
S-GRA06	Sulfate Sulfur-carbonate leach	WST-SEQ

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature:

Colin Ramshaw, Vancouver Laboratory Manager



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CERTIFICATE OF ANALYSIS VA18261067

Sample Description	Method Analyte Units LOD	WEI-21	OA-VOL08	OA-VOL08	OA-VOL08	OA-VOL08	OA-ELE07	OA-VOL08	S-IR08	S-GRA06	S-GRA06a	C-GAS05	C-GAS05	C-IR07	ME-MS41	ME-MS41
		Recvd Wt.	MPA	FIZZ RAT	NNP	NP	pH	Ratio (N	S	S	S	C	CO2	C	Ag	Al
		kg	tCaCO3/1Kt	Unity	tCaCO3/1Kt	tCaCO3/1Kt	Unity	Unity	%	%	%	%	%	%	ppm	%
		0.02	0.3	1	1	1	0.1	0.01	0.01	0.01	0.01	0.05	0.2	0.01	0.01	0.01
L2180845-1 170265		1.22	5.3	1	11	16	8.4	3.01	0.17	0.11	0.13	0.09	0.3	0.10	0.54	1.10
L2180845-2 SEPT TAL 2018		2.28	3.8	2	43	47	8.2	12.53	0.12	0.04	0.06	0.41	1.5	0.48	0.53	1.14



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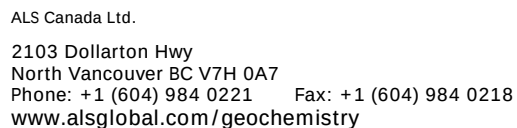
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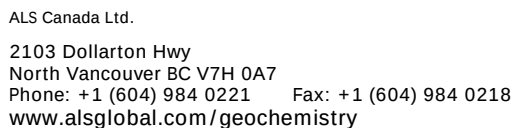
Sample Description	Method Analyte Units LOD	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
		As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga
		ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm
		0.1	0.02	10	10	0.05	0.01	0.01	0.01	0.02	0.1	1	0.05	0.2	0.01	0.05
L2180845-1 170265		0.7	0.04	60	150	0.32	0.25	1.06	0.15	20.6	6.6	6	0.28	800	2.38	5.83
L2180845-2 SEPT TAL 2018		0.8	0.13	30	200	0.29	0.17	1.19	0.37	18.40	8.1	7	0.50	1045	4.25	8.43



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CERTIFICATE OF ANALYSIS VA18261067

Sample Description	Method Analyte Units LOD	ME-MS41	ME-MS41	ME-MS41	ME-MS41	S-CAL06a
		W	Y	Zn	Zr	S
		ppm	ppm	ppm	ppm	%
		0.05	0.05	2	0.5	0.01
L2180845-1 170265		0.07	5.07	101	1.3	0.04
L2180845-2 SEPT TAL 2018		0.08	5.77	111	1.4	0.06



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Project: L2180845

CERTIFICATE OF ANALYSIS VA18261067

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

C-GAS05	C-IR07	LOG-22	ME-MS41
OA-ELE07	OA-VOL08	PUL-31	PUL-QC
S-CAL06a	S-GRA06	S-GRA06a	S-IR08
SPL-21	WEI-21		



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QC CERTIFICATE VA18261067

Project: L2180845

This report is for 2 Crushed Rock samples submitted to our lab in Vancouver, BC, Canada on 17-OCT-2018.

The following have access to data associated with this certificate:

ALSE VANCOUVER WEBTRIEVE
SHANE STACK

ALSEV DATASUBLET

SOFTWARE DEVELOPMENT GROUP

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI-21	Received Sample Weight
LOG-22	Sample login - Rcd w/o BarCode
PUL-QC	Pulverizing QC Test
PUL-31	Pulverize split to 85% <75 um
SPL-21	Split sample - riffle splitter

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	
C-GAS05	Inorganic Carbon (CO2)	
S-GRA06a	Sulfate Sulfur (HCl leachable)	WST-SEQ
C-IR07	Total Carbon (Leco)	LECO
ME-MS41	Ultra Trace Aqua Regia ICP-MS	
OA-VOL08	Basic Acid Base Accounting	
S-IR08	Total Sulphur (Leco)	LECO
OA-ELE07	Paste pH	
S-CAL06	Sulfide Sulfur (calculated)	LECO
S-GRA06	Sulfate Sulfur-carbonate leach	WST-SEQ

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature:

Colin Ramshaw, Vancouver Laboratory Manager



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QC CERTIFICATE OF ANALYSIS VA18261067

Sample Description	Method Analyte Units LOD	OA-VOL08 MPA tCaCO ₃ /1Kt 0.3	OA-VOL08 FIZZ RAT Unity 1	OA-VOL08 NNP tCaCO ₃ /1Kt 1	OA-VOL08 NP tCaCO ₃ /1Kt 1	OA-ELE07 pH Unity 0.1	OA-VOL08 Ratio (N) Unity 0.01	S-IR08 S % 0.01	S-GRA06 S % 0.01	S-GRA06a S % 0.01	C-GAS05 C % 0.05	C-GAS05 CO ₂ % 0.2	C-IR07 C % 0.01	ME-MS41 Ag ppm 0.01	ME-MS41 Al % 0.01	ME-MS41 As ppm 0.1
STANDARDS																
Buffer pH6						6.0										
Buffer pH6						6.0										
Target Range - Lower Bound						5.3										
Upper Bound						6.7										
EMOG-17														64.9	1.58	575
Target Range - Lower Bound														59.5	1.45	505
Upper Bound														72.7	1.79	617
GS310-10								0.27					1.09			
Target Range - Lower Bound								0.25					1.03			
Upper Bound								0.29					1.13			
KZK-1		25.0	2	34	59		2.36									
Target Range - Lower Bound		22.9		30	54		2.18									
Upper Bound		27.1		38	64		2.54									
MA-1b								1.14					2.43			
Target Range - Lower Bound								1.12					2.34			
Upper Bound								1.22					2.54			
MA-3a											2.39	8.8				
Target Range - Lower Bound											2.31	8.4				
Upper Bound											2.77	10.2				
NBM-1		8.8	2	41	50		5.71									
Target Range - Lower Bound		7.8		37	45		5.26									
Upper Bound		9.7		47	54		6.08									
SY-4											0.88	3.2				
SY-4											0.87	3.2				
Target Range - Lower Bound											0.84	3.0				
Upper Bound											1.08	4.0				
UTS-1								0.88								
Target Range - Lower Bound								0.83								
Upper Bound								0.93								
UTS-1										0.89						
Target Range - Lower Bound										0.81						
Upper Bound										0.95						
UTS-4								1.71								
Target Range - Lower Bound								1.64								
Upper Bound								1.84								
UTS-4										1.77						
Target Range - Lower Bound										1.61						
Upper Bound										1.87						

***** See Appendix Page for comments regarding this certificate *****



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QC CERTIFICATE OF ANALYSIS VA18261067

Sample Description	Method Analyte Units LOD	ME-MS41 Au ppm 0.02	ME-MS41 B ppm 10	ME-MS41 Ba ppm 10	ME-MS41 Be ppm 0.05	ME-MS41 Bi ppm 0.01	ME-MS41 Ca % 0.01	ME-MS41 Cd ppm 0.01	ME-MS41 Ce ppm 0.02	ME-MS41 Co ppm 0.1	ME-MS41 Cr ppm 1	ME-MS41 Cs ppm 0.05	ME-MS41 Cu ppm 0.2	ME-MS41 Fe % 0.01	ME-MS41 Ga ppm 0.05	ME-MS41 Ge ppm 0.05
STANDARDS																
Buffer pH6																
Buffer pH6																
Target Range - Lower Bound																
Upper Bound																
EMOG-17		0.90	<10	20	0.49	5.60	0.96	19.75	38.8	733	45	5.95	8330	4.66	6.02	0.17
Target Range - Lower Bound		0.77	<10	30	0.32	5.32	0.87	18.35	37.6	680	42	5.57	7780	4.18	5.56	0.08
Upper Bound		0.99	20	80	0.56	6.52	1.09	22.5	46.0	832	54	6.91	8960	5.14	6.90	0.30
GS310-10																
Target Range - Lower Bound																
Upper Bound																
KZK-1																
Target Range - Lower Bound																
Upper Bound																
MA-1b																
Target Range - Lower Bound																
Upper Bound																
MA-3a																
Target Range - Lower Bound																
Upper Bound																
NBM-1																
Target Range - Lower Bound																
Upper Bound																
SY-4																
SY-4																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18261067

Sample Description	Method Analyte Units LOD	ME-MS41 Hf ppm 0.02	ME-MS41 Hg ppm 0.01	ME-MS41 In ppm 0.005	ME-MS41 K % 0.01	ME-MS41 La ppm 0.2	ME-MS41 Li ppm 0.1	ME-MS41 Mg % 0.01	ME-MS41 Mn ppm 5	ME-MS41 Mo ppm 0.05	ME-MS41 Na % 0.01	ME-MS41 Nb ppm 0.05	ME-MS41 Ni ppm 0.2	ME-MS41 P ppm 10	ME-MS41 Pb ppm 0.2	ME-MS41 Rb ppm 0.1
STANDARDS																
Buffer pH6																
Buffer pH6																
Target Range - Lower Bound																
Upper Bound																
EMOG-17		0.48	0.57	0.870	0.68	19.1	19.4	0.76	621	1050	0.17	1.14	7750	740	7020	73.5
Target Range - Lower Bound		0.39	0.46	0.814	0.60	18.3	17.2	0.73	595	1015	0.15	1.32	6930	680	6510	66.5
Upper Bound		0.53	0.64	1.005	0.76	22.9	21.2	0.91	739	1240	0.20	1.72	8470	850	7950	81.5
GS310-10																
Target Range - Lower Bound																
Upper Bound																
KZK-1																
Target Range - Lower Bound																
Upper Bound																
MA-1b																
Target Range - Lower Bound																
Upper Bound																
MA-3a																
Target Range - Lower Bound																
Upper Bound																
NBM-1																
Target Range - Lower Bound																
Upper Bound																
SY-4																
SY-4																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18261067

Sample Description	Method Analyte Units LOD	ME-MS41 Re ppm	ME-MS41 S %	ME-MS41 Sb ppm	ME-MS41 Sc ppm	ME-MS41 Se ppm	ME-MS41 Sn ppm	ME-MS41 Sr ppm	ME-MS41 Ta ppm	ME-MS41 Te ppm	ME-MS41 Th ppm	ME-MS41 Ti %	ME-MS41 Tl ppm	ME-MS41 U ppm	ME-MS41 V ppm	ME-MS41 W ppm
		0.001	0.01	0.05	0.1	0.2	0.2	0.2	0.01	0.01	0.2	0.005	0.02	0.05	1	0.05
STANDARDS																
Buffer pH6																
Buffer pH6																
Target Range - Lower Bound																
Upper Bound																
EMOG-17		0.312	3.10	580	5.2	7.1	1.9	50.3	0.01	1.33	10.0	0.207	1.98	3.07	61	1.85
Target Range - Lower Bound		0.287	2.90	574	4.3	5.5	1.5	47.5	<0.01	1.16	9.3	0.188	1.71	2.57	58	1.65
Upper Bound		0.353	3.56	776	5.5	7.2	2.6	58.5	0.03	1.44	11.8	0.240	2.37	3.25	74	2.35
GS310-10																
Target Range - Lower Bound																
Upper Bound																
KZK-1																
Target Range - Lower Bound																
Upper Bound																
MA-1b																
Target Range - Lower Bound																
Upper Bound																
MA-3a																
Target Range - Lower Bound																
Upper Bound																
NBM-1																
Target Range - Lower Bound																
Upper Bound																
SY-4																
SY-4																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-1																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																
UTS-4																
Target Range - Lower Bound																
Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18261067

Sample Description	Method Analyte Units LOD	ME-MS41 Y ppm 0.05	ME-MS41 Zn ppm 2	ME-MS41 Zr ppm 0.5
STANDARDS				
Buffer pH6				
Buffer pH6				
Target Range - Lower Bound				
Upper Bound				
EMOG-17		10.45	7080	14.1
Target Range - Lower Bound		10.20	6780	10.6
Upper Bound		12.60	8290	15.5
GS310-10				
Target Range - Lower Bound				
Upper Bound				
KZK-1				
Target Range - Lower Bound				
Upper Bound				
MA-1b				
Target Range - Lower Bound				
Upper Bound				
MA-3a				
Target Range - Lower Bound				
Upper Bound				
NBM-1				
Target Range - Lower Bound				
Upper Bound				
SY-4				
SY-4				
Target Range - Lower Bound				
Upper Bound				
UTS-1				
Target Range - Lower Bound				
Upper Bound				
UTS-1				
Target Range - Lower Bound				
Upper Bound				
UTS-4				
Target Range - Lower Bound				
Upper Bound				
UTS-4				
Target Range - Lower Bound				
Upper Bound				



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Sample Description	Method Analyte Units LOD	OA-VOL08 MPA tCaCO3/1Kt 0.3	OA-VOL08 FIZZ RAT Unity 1	OA-VOL08 NNP tCaCO3/1Kt 1	OA-VOL08 NP tCaCO3/1Kt 1	OA-ELE07 pH Unity 0.1	OA-VOL08 Ratio (N) Unity 0.01	S-IR08 S % 0.01	S-GRA06 S % 0.01	S-GRA06a S % 0.01	C-GAS05 C % 0.05	C-GAS05 CO2 % 0.2	C-IR07 C % 0.01	ME-MS41 Ag ppm 0.01	ME-MS41 Al % 0.01	ME-MS41 As ppm 0.1
BLANKS																
BLANK											<0.05	<0.2				
BLANK											<0.05	<0.2				
Target Range - Lower Bound											<0.05	<0.2				
Upper Bound											0.10	0.4				
BLANK														<0.01	<0.01	<0.1
Target Range - Lower Bound														<0.01	<0.01	<0.1
Upper Bound														0.02	0.02	0.2
BLANK						5.9										
Target Range - Lower Bound						5.5										
Upper Bound						6.9										
BLANK									<0.01							
Target Range - Lower Bound									<0.01							
Upper Bound									0.02							
BLANK										<0.01						
Target Range - Lower Bound										<0.01						
Upper Bound										0.02						
BLANK								<0.01					<0.01			
Target Range - Lower Bound								<0.01					<0.01			
Upper Bound								0.02					0.02			
DUPLICATES																
ORIGINAL														3.45	1.33	126.5
DUP														3.47	1.41	122.0
Target Range - Lower Bound														3.28	1.29	118.0
Upper Bound														3.64	1.45	130.5
ORIGINAL		29.1	2	12	41		1.41									
DUP		29.1	2	13	42		1.45									
Target Range - Lower Bound		27.3	<1	11	38		1.35									
Upper Bound		30.9	3	14	45		1.51									
ORIGINAL						8.2					0.18	0.7				
DUP						8.2					0.17	0.6				
Target Range - Lower Bound						7.7					0.12	0.4				
Upper Bound						8.7					0.23	0.9				



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Sample Description	Method Analyte Units LOD	ME-MS41 Au ppm 0.02	ME-MS41 B ppm 10	ME-MS41 Ba ppm 10	ME-MS41 Be ppm 0.05	ME-MS41 Bi ppm 0.01	ME-MS41 Ca % 0.01	ME-MS41 Cd ppm 0.01	ME-MS41 Ce ppm 0.02	ME-MS41 Co ppm 0.1	ME-MS41 Cr ppm 1	ME-MS41 Cs ppm 0.05	ME-MS41 Cu ppm 0.2	ME-MS41 Fe % 0.01	ME-MS41 Ga ppm 0.05	ME-MS41 Ge ppm 0.05
BLANKS																
BLANK																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK		<0.02	<10	<10	<0.05	<0.01	<0.01	<0.01	<0.02	<0.1	<1	<0.05	<0.2	<0.01	<0.05	<0.05
Target Range - Lower Bound		<0.02	<10	<10	<0.05	<0.01	<0.01	<0.01	<0.02	<0.1	<1	<0.05	<0.2	<0.01	<0.05	<0.05
Upper Bound		0.04	20	20	0.10	0.02	0.02	0.02	0.04	0.2	2	0.10	0.4	0.02	0.10	0.10
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
DUPLICATES																
ORIGINAL		<0.02	<10	30	1.32	0.04	2.97	0.16	35.9	40.7	22	10.15	207	7.68	4.89	0.09
DUP		<0.02	<10	30	1.21	0.05	3.05	0.16	39.7	41.0	23	10.70	207	8.05	5.11	0.09
Target Range - Lower Bound		<0.02	<10	20	1.15	0.03	2.85	0.14	35.9	38.7	20	9.85	199.5	7.46	4.70	<0.05
Upper Bound		0.04	20	40	1.38	0.06	3.17	0.18	39.7	43.0	25	11.00	214	8.27	5.30	0.10
ORIGINAL																
DUP																
Target Range - Lower Bound																
Upper Bound																
ORIGINAL																
DUP																
Target Range - Lower Bound																
Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18261067

Sample Description	Method Analyte Units LOD	ME-MS41 Hf ppm 0.02	ME-MS41 Hg ppm 0.01	ME-MS41 In ppm 0.005	ME-MS41 K % 0.01	ME-MS41 La ppm 0.2	ME-MS41 Li ppm 0.1	ME-MS41 Mg % 0.01	ME-MS41 Mn ppm 5	ME-MS41 Mo ppm 0.05	ME-MS41 Na % 0.01	ME-MS41 Nb ppm 0.05	ME-MS41 Ni ppm 0.2	ME-MS41 P ppm 10	ME-MS41 Pb ppm 0.2	ME-MS41 Rb ppm 0.1
BLANKS																
BLANK																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK		<0.02	<0.01	<0.005	<0.01	<0.2	<0.1	<0.01	<5	<0.05	<0.01	<0.05	<0.2	<10	<0.2	<0.1
Target Range - Lower Bound		<0.02	<0.01	<0.005	<0.01	<0.2	<0.1	<0.01	<5	<0.05	<0.01	<0.05	<0.2	<10	<0.2	<0.1
Upper Bound		0.04	0.02	0.010	0.02	0.4	0.2	0.02	10	0.10	0.02	0.10	0.4	20	0.4	0.2
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
DUPLICATES																
ORIGINAL		0.03	0.52	0.064	0.20	15.6	24.9	1.53	1440	1.21	<0.01	<0.05	78.0	1620	6.0	13.1
DUP		0.03	0.54	0.070	0.20	17.2	23.6	1.60	1500	1.28	<0.01	<0.05	78.7	1700	6.4	13.1
Target Range - Lower Bound		<0.02	0.48	0.059	0.18	15.4	22.9	1.48	1390	1.13	<0.01	<0.05	74.2	1570	5.7	12.3
Upper Bound		0.04	0.58	0.075	0.22	17.4	25.6	1.65	1550	1.36	0.02	0.10	82.5	1750	6.7	13.9
ORIGINAL																
DUP																
Target Range - Lower Bound																
Upper Bound																
ORIGINAL																
DUP																
Target Range - Lower Bound																
Upper Bound																



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Sample Description	Method Analyte Units LOD	ME-MS41 Re ppm 0.001	ME-MS41 S % 0.01	ME-MS41 Sb ppm 0.05	ME-MS41 Sc ppm 0.1	ME-MS41 Se ppm 0.2	ME-MS41 Sn ppm 0.2	ME-MS41 Sr ppm 0.2	ME-MS41 Ta ppm 0.01	ME-MS41 Te ppm 0.01	ME-MS41 Th ppm 0.2	ME-MS41 Ti % 0.005	ME-MS41 Tl ppm 0.02	ME-MS41 U ppm 0.05	ME-MS41 V ppm 1	ME-MS41 W ppm 0.05
BLANKS																
BLANK																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK		<0.001	<0.01	<0.05	<0.1	<0.2	<0.2	<0.2	<0.01	<0.01	<0.2	<0.005	<0.02	<0.05	<1	<0.05
Target Range - Lower Bound		<0.001	<0.01	<0.05	<0.1	<0.2	<0.2	<0.2	<0.01	<0.01	<0.2	<0.005	<0.02	<0.05	<1	<0.05
Upper Bound		0.002	0.02	0.10	0.2	0.4	0.4	0.4	0.02	0.02	0.4	0.010	0.04	0.10	2	0.10
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
BLANK																
Target Range - Lower Bound																
Upper Bound																
DUPLICATES																
ORIGINAL		<0.001	1.91	8.98	9.0	1.0	0.6	63.1	<0.01	0.01	0.8	<0.005	0.16	0.14	76	0.36
DUP		<0.001	1.98	8.20	9.0	0.9	0.6	67.1	<0.01	0.01	0.8	<0.005	0.17	0.15	79	0.34
Target Range - Lower Bound		<0.001	1.84	7.90	8.5	0.7	0.4	61.6	<0.01	<0.01	0.6	<0.005	0.13	0.09	73	0.27
Upper Bound		0.002	2.05	9.28	9.6	1.2	0.8	68.6	0.02	0.02	1.0	0.010	0.20	0.20	82	0.43
ORIGINAL																
DUP																
Target Range - Lower Bound																
Upper Bound																
ORIGINAL																
DUP																
Target Range - Lower Bound																
Upper Bound																



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Project: L2180845

QC CERTIFICATE OF ANALYSIS VA18261067

Sample Description	Method Analyte Units LOD	ME-MS41 Y ppm 0.05	ME-MS41 Zn ppm 2	ME-MS41 Zr ppm 0.5
BLANKS				
BLANK				
BLANK				
Target Range - Lower Bound				
Upper Bound				
BLANK		<0.05	<2	<0.5
Target Range - Lower Bound		<0.05	<2	<0.5
Upper Bound		0.10	4	1.0
BLANK				
Target Range - Lower Bound				
Upper Bound				
BLANK				
Target Range - Lower Bound				
Upper Bound				
BLANK				
Target Range - Lower Bound				
Upper Bound				
BLANK				
Target Range - Lower Bound				
Upper Bound				
DUPLICATES				
ORIGINAL		18.35	107	0.8
DUP		19.50	108	0.8
Target Range - Lower Bound		17.95	100	<0.5
Upper Bound		19.90	115	1.0
ORIGINAL				
DUP				
Target Range - Lower Bound				
Upper Bound				
ORIGINAL				
DUP				
Target Range - Lower Bound				
Upper Bound				



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QC CERTIFICATE OF ANALYSIS VA18261067

Sample Description	Method Analyte Units LOD	OA-VOL08 MPA tCaCO3/1Kt 0.3	OA-VOL08 FIZZ RAT Unity 1	OA-VOL08 NNP tCaCO3/1Kt 1	OA-VOL08 NP tCaCO3/1Kt 1	OA-ELE07 pH Unity 0.1	OA-VOL08 Ratio (N) Unity 0.01	S-IR08 S % 0.01	S-GRA06 S % 0.01	S-GRA06a S % 0.01	C-GAS05 C % 0.05	C-GAS05 CO2 % 0.2	C-IR07 C % 0.01	ME-MS41 Ag ppm 0.01	ME-MS41 Al % 0.01	ME-MS41 As ppm 0.1
L2180845-1 170265 DUP Target Range - Lower Bound Upper Bound											0.09 0.09 <0.05 0.10	0.3 0.3 <0.2 0.4				
L2180845-2 SEPT TAL 2018 DUP Target Range - Lower Bound Upper Bound							0.12 0.11 0.10 0.13						0.48 0.48 0.46 0.50			
ORIGINAL DUP Target Range - Lower Bound Upper Bound								<0.01 <0.01 <0.01 0.02								



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QC CERTIFICATE OF ANALYSIS VA18261067

Sample Description	Method Analyte Units LOD	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
		Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga
		ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm
		0.02	10	10	0.05	0.01	0.01	0.01	0.02	0.1	1	0.05	0.2	0.01	0.05
L2180845-1 170265 DUP Target Range - Lower Bound Upper Bound		DUPLICATES													
L2180845-2 SEPT TAL 2018 DUP Target Range - Lower Bound Upper Bound															
ORIGINAL DUP Target Range - Lower Bound Upper Bound															



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QC CERTIFICATE OF ANALYSIS VA18261067

Sample Description	Method Analyte Units LOD	ME-MS41 Hf ppm 0.02	ME-MS41 Hg ppm 0.01	ME-MS41 In ppm 0.005	ME-MS41 K % 0.01	ME-MS41 La ppm 0.2	ME-MS41 Li ppm 0.1	ME-MS41 Mg % 0.01	ME-MS41 Mn ppm 5	ME-MS41 Mo ppm 0.05	ME-MS41 Na % 0.01	ME-MS41 Nb ppm 0.05	ME-MS41 Ni ppm 0.2	ME-MS41 P ppm 10	ME-MS41 Pb ppm 0.2	ME-MS41 Rb ppm 0.1
L2180845-1 170265 DUP Target Range - Lower Bound Upper Bound		DUPLICATES														
L2180845-2 SEPT TAL 2018 DUP Target Range - Lower Bound Upper Bound																
ORIGINAL DUP Target Range - Lower Bound Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18261067

Sample Description	Method Analyte Units LOD	ME-MS41 Re ppm 0.001	ME-MS41 S % 0.01	ME-MS41 Sb ppm 0.05	ME-MS41 Sc ppm 0.1	ME-MS41 Se ppm 0.2	ME-MS41 Sn ppm 0.2	ME-MS41 Sr ppm 0.2	ME-MS41 Ta ppm 0.01	ME-MS41 Te ppm 0.01	ME-MS41 Th ppm 0.2	ME-MS41 Ti % 0.005	ME-MS41 Tl ppm 0.02	ME-MS41 U ppm 0.05	ME-MS41 V ppm 1	ME-MS41 W ppm 0.05
L2180845-1 170265 DUP Target Range - Lower Bound Upper Bound		DUPLICATES														
L2180845-2 SEPT TAL 2018 DUP Target Range - Lower Bound Upper Bound																
ORIGINAL DUP Target Range - Lower Bound Upper Bound																



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QC CERTIFICATE OF ANALYSIS VA18261067

Sample Description	Method Analyte Units LOD	ME-MS41 Y ppm 0.05	ME-MS41 Zn ppm 2	ME-MS41 Zr ppm 0.5
L2180845-1 170265 DUP Target Range - Lower Bound Upper Bound		DUPLICATES		
L2180845-2 SEPT TAL 2018 DUP Target Range - Lower Bound Upper Bound				
ORIGINAL DUP Target Range - Lower Bound Upper Bound				



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QC CERTIFICATE OF ANALYSIS VA18261067

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

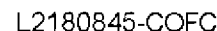
Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

C - GAS05	C - IR07	LOG - 22	ME - MS41
OA - ELE07	OA - VOL08	PUL - 31	PUL - QC
S - CAL06	S - GRA06	S - GRA06a	S - IR08
SPL - 21	WEI - 21		



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OCTOBER 2015 EPO

Appendix C: 2018 Modified NP Method (MEND 1991) ABA Results for Tailings

Appendix C. 2018 Summary Tailings Analysis Results from ALS Minerals									
Monthly Tails Sample ID	Paste pH	TIC	S(T)	S(SO ₄)	S(S ⁻²)	AP	Net NP	NP:AP Ratio (NP/AP)	NP Modified
		%	%	%	%	CaCO ₃ kg / tonne		(NP/AP)	NP
JANTAL2018	8.2	0.23	0.12	0.07	0.05	1.5625	17	13.44	21
FEBTAL2018	8.1	0.25	0.11	0.06	0.05	1.5625	19	14.08	22
MARTAL2018	8	0.48	0.12	0.05	0.07	2.1875	24	12.80	28
APRTAL2018	7.9	0.39	0.12	0.08	0.04	1.25	25	23.20	29
MAYTAL2018	7.9	0.43	0.12	0.09	0.03	0.9375	23	28.80	27
JUNTAL2018	8.1	0.50	0.10	0.02	0.08	2.50	26	11.60	29
JULTAL2018	8.5	0.48	0.06	0.01	0.05	1.5625	27	18.56	29
AUGTAL2018	8.1	0.44	0.08	0.04	0.04	1.25	29	24.80	31
SEPTAL2018	8.2	0.41	0.12	0.06	0.06	1.875	43	25.07	47

Appendix O – Wildlife and Hazing Tracking Report

Date	Time	Type of Animal	Number of Animals	Location	Description: Size/Color/Markings and Additional Notes	Reported By (Name)	Was the animal hazed?	What hazing technique was used?	What was the animals response?	Who performed the hazing?	Has this animal been hazed in 2018?	Reportable Incident (Yes/No)	Notes
4-Jan-18	12:00	Fox	1	Portal road Main ahul road intersection	Scrambled up bank and watched as the truck drove past	D. Avar	No				No		
9-Mar-18	13:30	Lynx	1	TDD	Adult, Calm	Nathan	No						
19-Mar-18	18:30	Black Bear	1	TDD	Black bear	Ryan Silverfox	No				No	No	Early sighting on a warm afternoon (above freezing), heavy snow later
5-Apr-18	5:30	Lynx	1	Haul Road-W15	Healthy	Dale/Gerard	No						
19-Apr-18	9:30	Black Bear	1	Landfill	Dark black, see photos - they're good	Danny	yes	Enviro fired 3 bangers and safety fired 2 bangers and 2 rubber bullets	Bangers had no effect on it, The first rubber bullet made contact with its back, and the second made contact with its butt. He took off, rather slowly above the berm he was headed west (towards Dyno)	Enviro and Safety	No	No	First official bear encounter at Minto!
19-Apr-18	17:30	Black Bear	1	WMA	Dark brown	Site Services	Yes	Enviro fired 3 bangers	The bear got into a tote that had been cut out and filled with garbage (including plenty of food waste) But he did mosy on when the bangers were fired	Enviro	Yes	No	Totes were sorted through the following day - 2 totes were found with garbage waste and enviro has brought up the issue to management
20-Apr-18	15:00	Black Bear	1	WMA	Dark brown	Site Services	Yes	Safety got him with bangers	Same bear came back for the totes that were gone, he went around the incinerator - and through the back toward the core shack. We intercepted him there, fired 2 bangers, he took off down the hill behind the propane tanks there.	Safety	Yes	No	
20-Apr-18	17:40	Black Bear	1	Dumas Shop	Dark Brown	Dumas Mechanic	Yes	Fired off 2 bangers	Same bear, he was close to Dumas shop in the lay down area. We pushed him off towards the Dry Stack Tailings and he was walking along toward the hill	Enviro	Yes	No	
20-Apr-18	20:30	Black Bear	1	Sewage Treatment Plant	Dark Brown	Ryan Herbert	Yes	Fired 4 bangers	Same bear, he was playing with hoses at the STP. When Ryan H. and Rob P. were walking back to camp spotted him and scared him off. He was walking up the hill towards camp when environment arrived at the scene. Fired off 2 bangers, he walked up the valley, safety showed up but no good shots could be taken. Safetv fired off 2 more bangers	Enviro and Safety	Yes	No	
22-Apr-18	20:00	Black Bear (named him Stew)	1	Camp	Dark Brown	Jeff Hewko	yes	Fired only 1 banger	Same bear, came up to the back door (North side) of the Selkirk Towers. He seemed confused , Safety Dave did some yelling. He mosied on up the hill, northly.	Enviro	Yes	No	
22-Apr-18	21:00	Black Bear (named him Stew)	1	Camp	Dark Brown	Gene	yes	Air horn, rubber bullets and bangers	Same bear, came into the Selkirk parking lot. Walked along the Arctic Corridor. And onto the ice rink, tried to come up to the door (smoke shack door) Enviro Emilie fired the air horn to get him away from the building. Safety got a bullet on him, he took off down the hill (towards the STP). Fired off bangers to scare him off further.	Enviro and Safety	Yes	No	
24-Apr-18	18:30	Black Bear	1	Camp	Dark Brown	Travis	yes	Fired 2 Bangers	Animal moved away from the banger, but couldn't escape due to steep hill, upon seeing ENV person, he retreated up a shallower slope, fire second banger as he went out of site.	Enviro	Yes	No	
24-Apr-18	20:30	Black Bear	1	Camp - Selkirk	Dark Brown	Todd	Yes	Safety fired a banger	Was seen again in the North site of the arctic cooridor, near the blue garbage seacan. Walked around towards the front parking lot, but went over the berm and down the hil upon seeing Enviro. Waited until Safety arrived in case rubber bullets would act a s better deterrent.	Safety	Yes	No	
24-Apr-18	21:30	Bear	1	Smoke shelter by capstone			Yes	Banger, Yelling	Went towards the hill and up and out of the camp area		Unknown	No	
25-Apr-18	13:30	Black Bear	1	Landfill	Dark Brown	Danny	Yes	Safety hit him with rubber bullets (x2)	Bear had found a small amount of food waste (from	Safety	Yes	No	Had Pelly push, compact, and cover the landfill on April 26 to remove
2-May-18	6:30	Fox	1	Portal entrance	grey fox, healthy looking, hanging around the waste bins and portal. No	Doug. M	No						
5-May-18	0:00	Black Bear	1	Core Shack	Dark Brown	Benoit Gervais	yes	Honking and chasing with a vehicle	Bear was just wandering around the core shack	Ben	Unknown	No	
6-May-18	10:15	Black Bear	1	Dyno Access	Black	Austin /Dyno	No	N/A			No	No	Austin Called to notify of a bear on dyno access area, not moving
7-May-18	9:45	Black bear	1	Road up to coreshack /	Brown, lean	Tim	Yes	Multiple bangers by Envrio. X1 rubber	Bear travelled >400m from point of hazing, following	Env / Safety KR	No	No	bear
7-May-18	17:00	Black bear	1	Far side of WSP	Black	Dale H.	No	N/A			No	No	Far side of the WSP not near people
7-May-18	18:45	Black bear	1	1km	Black	Tony M.	No	N/A					Same bear that was at WSP earlier.
11-May-18	11:00	Black bear	1	7 km	dark ruddy brown	Colin P, Corey R	No	N/A	Bear began running from the truck before any action was	N/A	Unknown	No	bear looked very healthy, appeared to be afraid of humans without any
13-May-18	19:00	moose and calf	2	dumas corner	no discernable identifiable markings		No	N/A		N/A	No	No	

13-May-18	13:00	Bear	1	Silos in dyno area	Large, brown coloured black bear	Gerard B							
15-May-18	15:00	Moose and calf	2	4 km	no discernable identifiable markings	Ryan Silverfox	No	N/A		N/A	No	No	
16-May-18	12:15	Bear	2	Dyno yard	Black sow and a brown cub	Lewis Mcleod							
17-May-18	16:15	black bear	1	dry stack near dumas	dark red/brown	Doug Harris	yes	yelling, bangers	ran from bangers. Appeared to be wary of humans.	SR/CP	Yes	No	appeared to be eating vegetation. Was not moving deliberately
18-May-18	11:30	Black Bear	1	Hillside near WSP	Black	Doug Harris	No	N/A		N/A	Unknown	No	Bear looked very healthy, grazing and far enough from site to not be a
18-May-18	17:15	Black Bear	1	West end of WSP	Black with grey face small but fat	Todd Swenson	Yes	Honking horn, yelling	Cocked it's head and looked curious. No fear	TS	Unknown	No	Might possibly be the bear described as "aggressive" in 2017, due to
20-May-18	16:00	Black Bear	1	13KM	Black	Doug Harris	No	N/A	N/A	N/A	Unknown	No	Bear looked healthy in the bush on the hill side.
22-May-18	8:00	moose and calf	2	air strip	no discernable identifiable markings	Jean Lagarde	No	N/A	N/A	N/A	No	No	
22-May-18	7:00	Bear	2	8 km	brown	Bob Alexander	No	N/A	N/A	N/A	Yes	No	reported as "brown bear", currently uncertain if it was grizzly or brown black bear
22-May-18	9:15	Black Bear	1	KM 1.5	Black	Shaun	No	N/A	N/A	N/A	Unknown	No	Eating vegetation up on the hill across the road from the WSP
22-May-18	8:40	moose and calf	2	Driftwood laydown	wandering towards airstrip	Curt (S.S)	No						
23-May-18	9:50	Black Bear	1	KM 1.5	Black	Shaun	No	N/A	N/A	N/A	Unknown	No	Eating vegetation up on the hill across the road from the WSP
23-May-18	10:05	Deer	3	KM 0.8		Shaun	No	N/A	N/A	N/A	No	No	Walking down access road towards WSP and ran up the hill as I drove by
26-May-18	0:00	Black Bear	1	Dumas	Black large	Shawn (mechanic)	yes	Honking horn, truck, yelling and bear banger	Ran away at sight and sound of truck.	CH	Yes	No	Bear reported going to Dumas shop, responded and bear ran up the hill towards portal. Chased bear off with truck and shot banger and yelled. The bear then ran into the bush/ Exploration roads.
27-May-18	14:00	Moose	1	Km 19	adult, healthy, bull moose	Trever Harris	No						
29-May-18	15:00	Black Bear	1	Behind Selkirk towers	large, fat, black	Colin P	yes	voice	ran away when people charged and yelled at it	CP	Yes	No	This bear has been hazed several times this year, and seems to be very responsive to hazing.
29-May-18	14:00	Black Bear	1	W2	Small, young, brown	Chris H, Shaun R	yes	Voice, bear banger	did not respond to voice, shot banger twice, ran away after second shot	SR/CH	No	No	Bear must have followed us out of W1 trail, was behind us when we got to the truck and didn't run when we yelled. Shot bear banger twice and it ran away after second shot.
29-May-18	14:45	Black Bear	1	KM7	Large, black	Chris H, Shaun R	No				No	No	Walking on road, ran into bush when truck approached.
29-May-18	19:20	Black Bear	1	Pumphouse near camp		Stanley	No						
30-May-18	13:40	Bear	1	Dyno	Medium ,brown, dark legs	Dale	Yes	Airhorn	ran away but came back to dynos laydown later	CH/CR	No	No	after we hazed the bear it came back to its spot 30 mins later but ran
31-May-18	11:15	Bear	1	Dyno yard	Large Black Bear / Bold walked up to loader an operator in it	Lewis Mcleod	Yes	Bangers	Ran off but came back later	CR/CH	Potentially	No	Once it ran off it came back later. Dyno called again but it wondered off before enviro got to the scene.
3-Jun-18	14:00	Bear	1	WMA	Medium black	Corey	yes	Bear banger, yelling	Did not come out of bush	CH	n/a	No	saw bear by where nitirc barrels are stored, when I walked over it was in the bush. I yelled and fired a bear banger and the bear did not come back while we were there.
3-Jun-18	15:50	Bear	2	Exploration roads behind	MED. One brown, one black	Chris	No				Yes	No	Went for ride on roads for bear check as one was seen earlier and saw
4-Jun-18	15:00	Hawk - Sharp-shinned	1	Warehouse	Approx. 8" long, light coloured underbelly with stipes on wings and tail, back, head and wings are dark in colour	Devon	No				No		Door was left open for the bird to leave, fans and lights were turned off. Bird remained in the Warhouse rafters (overnight). Bird left Warehouse June 5th about 1pm. See photos.
5-Jun-18	10:00	Fox	1	Portal	Black in colour / healthy	Lewis Mcleod							
9-Jun-18	7:30	Deer	1	Airport road by W35	Meduim white-tail	Emilie	Yes	yelling	Took off when I yelled at it	EB	No	No	
9-Jun-18	8:40	moose and calf	2	5.5 km	Very young calf, lean cow	Emilie / Deborah	No				No	No	
10-Jun-18	18:00	Hawk - Sharp-shinned	1	Washbay	Found deceased. Preserved in freezer for CO if needed.	Driftwood	No						
11-Jun-18	12:30	Deer	1	near propane farm	curious walked up close to pick-up	Mark (Driftwood)	No						
13-Jun-18	7:00	Deer	1	up on hill behind	Chilling on the hill behind camp	Stan G	No						
27-Jun-18	16:25	Deer	1										
27-Jun-18	15:50	Bear	1	N.Communication Tower	Big Black Bear; not aggressive, sniffing	Shawn - IT	No				Unknown	No	
27-Jun-18	16:25	Deer	1	Just above capstone	eating minding his own buisness	Stan G	No						
28-Jun-18	13:00	Deer	1	Beside ERT building	calm, walking through camp area	Roger H	No						
1-Jul-18	5:15	Deer	1	Portal	Walking up the road		No						
3-Jul-18	9:15	Deer	2	Km 15	Doe and fawn on road. Very young fawn	Shelby/Emilie	No				N/a	No	

4-Jul-18	10:00	Black Bear	1	KM 11	Large Black Bear	Robert Proc	No					No	
4-Jul-18	11:30	Black Bear	1	km 6	Small black bear, still shedding his winter coat	Emilie	Yes	Yelling, throwing rocks, and honking.	He had no reaction, moved very slowly until I got a rock on his head. He didn't like it. His ears went back and he seemed confused. He walked off slowly. - I wanted to ensure he associated humans with not a good thing.	EB	No	No	
5-Jul-18	9:30	Black Bear	2	Pelly Yard	One small black bear, and one small light brown black bear	Gene - Pelly	Yes	Honking.	They both moved on quickly.	EB	No	No	It was noticed afterwards that the bears (not sure which one) had gotten into a garbage bag full of old food in their outdoor plywood bin.
5-Jul-18	13:30	Black Bear	1	Pelly office	Small light brown black bear	Gene - Pelly	Yes	Yelling and air horn	He moved on very slowly at first and with the airhorn he	Gene	Yes	No	He was scratching and pulling on the plywood holding the office
6-Jul-18	7:00	Black Bear	1	Pelly office		Gene - Pelly							A bear (I am assuming the same light brown that has been hanging
7-Jul-18	2:15	Black Bear	1	Dumas Shop	Small light brown black bear	Dumas Mechanic	No		He wandered inside the shop and checked it out, took off	EB	Yes	No	Core shack also seems to have been entered by the bear at some point
7-Jul-18	5:40	Black Bear	1	Camp	Small light brown black bear	Nona	Yes	Bear banger, yelling	He took off in the woods behind the ERT building. First	EB	Yes	No	He'll be back for sure. Sodexo employees were warned to be on the
7-Jul-18	10:00	Grizzly bear	1	22km		Adam Vlastimil	No						
7-Jul-18	10:00	Bear	1	KM 22			No						
8-Jul-18		Black bear	1	Camp	medium (>5') chocolate brown black bear	Kevin Rookes	Yes	Rubber bullet, banger, yelling	He took off in the woods behind the ERT building.	KR	Yes	No	KR seems to think it wasn't the same bear, it seemed larger than the pictures enviro had provided.
8-Jul-18	10:00	Mule deer	1	22km		David Petkovich	No						
8-Jul-18	10:00	Mule deer	1	KM 22.5	healthy standing at side of road		No						
8-Jul-18	9:30	Deer	3	Km 10.5	Doe and two fawns		No						
9-Jul-18	7:00	Deer	1	Warehouse		Kevin Rookes	No						She moved off the the MVFE
10-Jul-18	9:30	Black Bear	1	km 10	Medium size black	EB	No						
10-Jul-18	10:00	Mule Deer	4	Dry stack tailings facility	Mule deer with doe and two fawns		No						
12-Jul-18	8:00	Black Bear	1	Pelly Yard	Light body and dark legs. Bear was spotted multiple times through out the day.	SB	Yes	bangers, yelling, honking	Went into woods by W15	DC	Yes	Yes	Bear broke into Pelly office, core shack, and Dumas. Caused property damage and attempted to re-enter when workers were cleaning up the office.
13-Jul-18	1:00	Black Bear	1	Multiple Locations	Same light body bear	SB	Yes	Bangers, honking	Went to other buildings	SB/DC	Yes	Yes	Same bear. 4 bear calls at night. Dumas, Core Shack, Mill Building, and Camp. CO called.
15-Jul-18	11:00	Lynx	1	North side of the Selkirk	Looked healthy - Adult	Curt (S.S)	Yes						
20-Jul-18	15:30	Deer	2	Mill Pond	Running around not caring about	Brandon Brown	No						
27-Jul-18	10:10	Bear	1	Driftwood laydown	Black bear - Looked healthy - Adult	S.S	No						
29-Jul-18	14:00	Deer	2	Portal road	Doe and fawn on road. Very young fawn	CH	no					No	doe and fawn running on portal road. Went up towrds tent on bank
2-Aug-18	10:00	Black Bear	1	Ridgetop Road	Black bear	Mike Ethelston	Yes	honking	took off behind the UG fuel farm	EB/SMB	Unknown	No	Small black
2-Aug-18	10:30	Deer	1	STP	Light brown deer	EB	No			EB/SMB			
2-Aug-18	12:30	Black Bear	1	Old Pelly Laydown	Light brown	SS	Yes	Bear bangers	Took off towards MN	EB/SMB	Unknown	No	Looks like our problematic bear, but I am not sure
3-Aug-18	8:00	Black bear	1	Airstrip and WMA corner	unknown	Brandon Brown	No			EB/SMB			We couldn't find it by the time we got up there.
5-Aug-18	9:40	Black Bear	1	WMA area	Small black bear.	Brandon Brown	No						
8-Aug-18	14:00	Black bear	1	WMA area / Airstrip	small black bear	Curt (S.S)	No					No	Not found once enviro got up there
8-Aug-18	13:58	Deer	1	Between mine tech and	Adult doe	Everett P	No						
8-Aug-18	10:30	Deer	3	Selkirk Towers	Doe and 2X fawn drinking water	Ryan Herbert	No						
19-Aug-18	5:45	Fox	1	Between dry and safety		Ian L	No						
26-Aug-18	17:40	Bear	1	KM 9	Black bear with blonde hair	Dave G	No						
27-Aug-18	16:00	Black bear	1	8km	Black bear with white patch on head	David Grennen	No				No	No	
29-Aug-18	13:30	Black bear	1	Dyno Road	Black bear	Brandon Brown	No				No	No	
6-Sep-18	5:30	Fox	1	By the rink	Red body black tail - large in size -	Peter M	No						
7-Sep-18	5:50	Fox	1	Behind ERT		Don Patterson	No						
11-Sep-18	14:20	Brown bear	1	km 19	Medium size dark brown bear	Shaheen Baker	No						
12-Sep-18	11:00	Eagle	1	km 23	Sitting on a tree near road	Shaheen Baker	No						
14-Sep-18	16:00	Fox	1	Main pit dump		Ian L	No						
20-Sep-18	10:15	Deer	5	Warehouse laydown	1 Adult deer and 4 samller fawns	Tim C	Yes	Honking, Truck engine	Took off toward mill valley	CR	No	No	
24-Sep-18	13:10	Fox	1	Area 2 pit bench	Red in colour - unintrested in humans	Cobalt	No						
26-Sep-18	8:20	Lynx	1	11.5km	Found dead on the road; likely hit by a	Ryan Silverfox	No					Yes	Found on the road dead by Site Services this morning. Pull at the side
3-Oct-18	10:30	Deer	3	Mine Tech	1 doe with 2 fawns	Ryan F.	No						
5-Oct-18	11:00	Deer	3	Mine Tech	1 doe with 2 fawns	Bob G.	No						
5-Oct-18	17:20	Bear	1	W62 Road	Light brown, large black bear	Bob G.	Yes	Honking	Mosied off into the wooden area (diagonally away from	Bob G.	Probably	No	
6-Oct-18	11:45	Bear	1	Burn pile	Light brown, large black bear	Ryan S.	Yes	Yelling	Mosied on	Ryan S.	Probably	No	
6-Oct-18	13:45	Fox	1	ERT Building	Healthy, red fox	Lesley S.	No				No	No	
20-Oct-18	3:35	Fox/Coyote	1	Behind kitchen	Healthy/Non Aggressive	Randy R	No						
2-Nov-18	8:15	Fox	1	Mobile Maint Shop (Mill)	Healthy red fox	Brett Austin	Yes	Yelling, Clapping	Took a lot to make it move on. Aggressively curious	Brett A. Todd S.	Unknown	No	Tried to follow Brett inside the shop. Looks very people friendly, possibly has been fed, or just more brave and curious now that activities/noise has slowed down.
2-Nov-18	15:30	Black bear	1	Km 10	Tracks in fresh snow	Doug Harris	No						Bear not seen, only tracks observed in 2 day old snow.
2-Nov-18	15:35	Wolves	2	Km 9	Tracks in fresh snow	Doug Harris	No						Wolves were tracking/following Moose. Not seen, only tracks observed in 2 day old snow.
2-Nov-18	15:35	Moose	1	Km 9	Tracks in fresh snow	Doug Harris	No						"
18-Nov-18	11:00	Lynx	1	Km 20	healthy	Greg S	No						
19-Nov-18	14:00	Wolf	1	Barge Landing	healthy	Greg S	No						
24-Nov-18	12:00	Doe and 2 fawns	3	Km 0.5	Healthy	Emilie	Yes	Honking	Mosied on up the hill	Emilie B	No	No	
Nov 16 2018	11:00	fox	1	Dumas shop	Healthy full coat	Dan Fries	Yes	threw my hard hat at it	ran away	Dan Fries	Unknown	No	Fox ran towards me when I opened vehicle door. It appears it may have
Nov 18 2018	8:15	Fox	1	outside mill/ ERT	healthy	Dan Fries	Yes	3 shots with bangers	ran away initially but returned in short order.	Dan Fries	Yes	No	Noticed same fox as Nov 16 scrounging outside mill entrance, I

Appendix P – 2018 Update Minto Mine Constructed Wetland Treatment Research Program

Minto Mine Constructed Wetland Treatment Research Program – Demonstration-Scale 2018 Update Report

Document #011_0119_13B



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Executive Summary

The Minto Mine is an open pit and underground copper mine located 240 km northwest of Whitehorse in the Yukon Territory. As a result of mining activities, cadmium, copper, molybdenum, selenium, and zinc are slightly elevated beyond background concentrations and have been identified as constituents of concern in the Reclamation and Closure Plan for the Minto Mine. As part of the Reclamation and Closure Plan, a constructed wetland treatment system (CWTS) was designed by Contango with the objective of attaining suitable passive treatment of water quality at mine closure. In October 2018, Capstone announced that due to unfavourable equity market conditions, the Minto Mine would be placed into temporary care and maintenance (Capstone, 2018), and that condition is currently in effect.

A phased approach is being followed to guide the site-specific design and implementation of a CWTS at closure. The phased approach for Minto Mine was initiated with a site assessment in 2013 followed by pilot-scale testing to confirm and provide proof-of-concept before constructing the on-site demonstration-scale wetland.

The demonstration-scale constructed wetland treatment system was constructed at Minto in 2014, commissioned from 2015 through mid-2017 and transitioned into the operational period in August 2017. In 2018 it was planned that the demonstration-scale CWTS would continue in the operational period with the primary objective being to assess performance under conditions that would be similar to the full-scale CWTS. However, this objective shifted to assessing the CWTS ability to recover and perform under the unintentionally imposed stresses of a winter/freshet drought and elevated nitrate concentrations (on average 3 times higher than 2017 concentrations in early spring) in the inflow water (feed). This double stress test provided an opportunity to evaluate mitigation strategies for returning the CWTS to an operational status. Recovery period from the double stress test in 2018 was variable for each COC. Additional recovery strategies were attempted on the systems, including stagnation (both series), and addition of iron (Series 1). These recovery strategies are applicable to full-scale operation and are detailed in this report. Recovery periods ranged from 0 days (treatment likely unaffected) to 93 days for different constituents and recovery strategies.

Additional aspects of the performance and operation of the system were measured in 2018 and are detailed in this report including: treatment performance, fate and distribution of treated metals, evapotranspiration, detritus decomposition, microbial community characterization (catalyzing treatment reactions), and pest control.

During the operational period Series 1, (which received an additional recovery intervention strategy of iron addition) achieved an average decrease of 0.0214 µg/L for cadmium, 53.3 µg/L for copper, 8.16 µg/L for molybdenum, 3.15 µg/L for selenium, and 16.1 µg/L for zinc. Series 2, an average decrease of 0.0214 µg/L for cadmium, 49.7 µg/L for copper, 7.06 µg/L for molybdenum, 3.20 µg/L for selenium, and 16.1 µg/L for zinc. Additional positive results were also documented; plant uptake of constituents remained minimal throughout operation, maintenance of high abundance of beneficial sulphide-producing bacteria for metals treatment, and nitrate- and selenium-treating bacteria associated with plant roots.

The operational period of the demonstration CWTS confirmed that the predicted water quality for the Minto Mine at closure is amenable to treatment by these methods. Results from ongoing monitoring of the system in 2019 will be used to inform the designs for the full-scale constructed wetland treatment system.

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Abbreviations and Definitions

Accretion – The process of growth or increase of sediments through deposition and accumulation of organic material deposited solids (such as minerals) within a wetland.

Acid volatile sulphide (AVS) – Sulphide complexed with Fe (FeS) where the sulphide can preferentially exchange Fe for heavy metals (Ni, Zn, Cd, Pb, Cu, Hg) which are then more stably bound.

Amendment – A chemical or organic material added to encourage specific conditions (e.g., aerobic/anaerobic, pH, ORP) or as a source of something that is needed for passive treatment (e.g., nutrients, alkalinity, binding sites, etc).

Bio-Banked – Samples received were stored frozen for potential future DNA extraction and MCP analysis.

Biofilm(s) – A visible and often slimy-looking film (community) of bacteria (may contain other microbes).

Biochemical oxygen demand (BOD) – The amount of dissolved oxygen needed by aerobic microorganisms to break down organic material in water.

Carbon source – A source of carbon (energy/electrons) for microbes (see electron donors). Examples include ethanol, methanol, acetate, sugar (glucose), molasses, wood chips, detritus (dead plant matter).

***Carex aquatilis* (*C. aquatilis*)** – A plant (emergent macrophyte) commonly known as water sedge.

Chemical oxygen demand (COD) – A measurement of all organic and inorganic material in the water than can be oxidized.

Contango – Contango Strategies Ltd.

Constituent of Concern (COC) – Specific elements that have been identified for evaluation, including cadmium, copper, molybdenum, selenium, and zinc.

Constructed wetland treatment system (CWTS) – Wetlands that are designed and constructed to remove compounds from water, using natural processes to sequester them into the soils rendering them less bioavailable. They are different from wetlands that provide habitat for wildlife.

Denitrification – Where nitrate (NO_3^-) is reduced by microorganisms to form nitrite (NO_2^-), nitric oxide (NO), or nitrous oxide (N_2O), or nitrogen gas (N_2) (see nitrate reduction).

Dissolved organic carbon (DOC) – Organic (carbon based) molecules in water, that have passed through a filter of 0.45 μm .

Dissolved oxygen (DO) – Diatomic oxygen (O_2) dissolved in water; oxygen can dissolve in water by diffusion from surrounding air, as a product of photosynthesis, or through forced aeration.

Explanatory parameters – Quantifiable parameters that describe how water treatment reactions take place.

Evapotranspiration – The process by which water is transferred to the atmosphere by evaporation from the surface of water and by transpiration from plants.

Forebay – A Forebay is an artificial pool of water in front of a larger body of water. The larger body of water may be natural or man-made. In the context of a CWTS a forebay can allow for the addition of supplementary amendments (e.g. organics, iron) as needed.

Genetic analysis/sequencing – Analysis to assess the presence, identity, and diversity of different microbes in a sample.

Hydraulic retention time (HRT) – The residence time of the inflow water to outflow.

ICP-MS – Inductively coupled plasma mass spectrometry.

Microbes – Microscopic organisms that can be uni- or multi-cellular. This includes algae, bacteria, fungi, viruses, and yeast.

Most probable number (MPN) – A statistical value representing the viable population of microbes in a sample through use of dilution and multiple inoculations.

Nitrate reduction – Where microbes reduce nitrate (NO_3^-) to form nitrite (NO_2^-); the first step in denitrification (see denitrification).

Nominal HRT – The targeted HRT calculated based on the targeted flow rate for a given size of wetland.

Oxidation – The loss of electrons, or increase in valence state, by a molecule, atom, or ion. Can be driven by microbes. Process is complementary to chemical reduction.

Oxidation-reduction potential (ORP) – A measure of the tendency of a chemical species to acquire or donate electrons, thus becoming reduced or oxidized, respectively, measured in millivolts.

Redox – Oxidation-reduction potential (in sediment), a measure of the tendency of a chemical species acquire or donate electrons, thus becoming reduced or oxidized, measured in millivolts. This measurement is relative to the water ORP.

Reduction (chemical) – The gain of electrons, or a decrease in valence state, by a molecule, atom, or ion. Can be catalyzed by microbes. Process is complementary to chemical oxidation.

Selenium reduction – Microbially mediated reduction of soluble Se(VI) and Se(IV) to insoluble elemental selenium.

Simultaneously extracted metals (SEM) – amounts of heavy metals such as Ni, Zn, Cd, Pb, Cu, Hg in sediment, assessed in the context of AVS for excess sulphide. (also see acid volatile sulphide)

Sorption – The physical and/or chemical process by which one substance becomes attached to another substance.

Specific conductivity (SPC) – A measurement of electrical conductivity in water that is typically expressed in $\mu\text{S}/\text{cm}$, which has been adjusted for temperature (25°C).

Species (sp.) – One of the basic units of biological classification and a taxonomic rank. Rank in the classification of organisms below genus and above strain. Also can be used to refer to the oxidation state of a mineral (e.g., selenate and selenite are species of selenium).

SPLP – Synthetic precipitation leachate procedure.

Sulphide – An inorganic anion of sulphur that can form stable complexes with metals and make them insoluble in water (remove them from the water).

Sulphide producing bacteria (SPB) – Microbial reduction of sulphur compounds, such as sulphate, sulphite, thiosulphate, and sulphur, which produces sulphides and alkalinity. (see also SRB).

Sulphate reducing bacteria (SRB) – a form of sulphide producing bacteria that specifically uses sulphate for reduction (see sulphide producing bacteria).

Sulphide production – Microbial reduction of sulphur compounds, such as sulphate, sulphite, thiosulphate, and sulphur, which produces sulphides and alkalinity.

Total dissolved solids (TDS) – A measure of the combined organic and inorganic salts dissolved in water.

Total kjeldahl nitrogen (TKN) – The sum of organic nitrogen, ammonia (NH_3), and ammonium (NH_4^+) in water (or soil). To calculate the total nitrogen, the concentrations of nitrate as N (NO_3^- -N) and nitrite (NO_2^- -N) are added to TKN.

Total organic carbon (TOC) – A measurement of the total organic carbons present in water.

Total suspended solids (TSS) – A measurement of all particles in water that are larger than 2 μm (anything smaller than 2 μm considered a dissolved solid).

Transfer – Processes that treat water by transferring a constituent to another location without changing its form. For example: absorption, adsorption, dilution, dispersion, filtration, precipitation (aqueous to solid), and volatilization.

Transform – Processes that change the chemical form or state of a constituent. For example: biodegradation, biotransformation, hydrolysis, ionization, oxidation, photolysis, and reduction.

1. Introduction

The Minto Mine, owned and operated by Capstone Mining Corp. (Capstone), is located 240 km northwest of Whitehorse on the west side of the Yukon River. The Minto Mine is a combination open pit/underground copper mine that has been mining since October 2007. In October 2018, Capstone announced that due to unfavourable equity market conditions, the Minto Mine would be placed into temporary care and maintenance (Capstone, 2018), and that condition is currently in effect.

The Minto Mine has been in commercial operation since October 2007 and the deposits being mined are copper sulphide mineralized zones. Surface and groundwater water quality is a key consideration in the evaluation of potential effects of mining and mineral development projects and changes to water quality parameters have the potential to affect aquatic and human use of water resources. A Reclamation and Closure Plan (RCP) is required under both the Water Use License and the Quartz Mining License. The RCP is intended to address the long-term physical and chemical stability of the site and closure of the proposed features and disturbances associated with the mine. As a part of the RCP, a Constructed Wetland Treatment System (CWTS) is being designed, evaluated, and optimized for water treatment at closure through a phased program approved during the Minto Phase V/VI Expansion Project (Yukon Online Registry Project Number 2013-0100).

The CWTS is currently undergoing a phased design approach, including design, evaluation, and optimization for post-closure water treatment. Constituents of concern that are being evaluated through the CWTS program include cadmium, copper, molybdenum, selenium, and zinc. Nitrate is also being evaluated as it impacts treatment rates by consuming electrons (Contango, 2014b).

The phased design used at the Minto Mine include:

- 1) Site assessment and information gathering (complete);
- 2) Technology selection and conceptual design (complete);
- 3) Pilot-scale testing and optimization (controlled environment, off-site; complete);
- 4) Demonstration-scale confirmation and optimization (on-site; current scope); and
- 5) Full-scale implementation (future scope).

Phases 1 to 3 have been completed, and this work is summarized in the Site Assessment, and Pilot-Scale reports (Contango, 2014a and 2014b). Phase 4 of the project is currently underway, with the on-site demonstration-scale CWTS constructed at the Minto Mine during fall 2014. Commissioning was conducted from 2015-2017 and operations beginning in late 2017 with update reports provided annually (Contango, 2015, 2016; 2017a; 2017b).

The primary objective of the demonstration-scale program in 2018 was to assess performance under conditions that would be similar to the full-scale CWTS. However, this objective shifted to assess the CWTS ability to recover and perform under the unintentionally imposed stresses of a drought and elevated nitrate concentrations in the inflow water (feed). These imposed stresses will be herein referred to as the double stress test period.

Due to delays in running water to the system, the cells had dried out significantly by May 2018 and soils were exposed to air. This was problematic as the demonstration-scale CWTS was designed to operate under reducing conditions requiring constant water cover. This spring drought scenario is highly unlikely to occur in full-scale operation as that system would have water entering from gravity flow from freshet, rather than the pumped scenario of the demonstration-scale CWTS. Even though the freshet drought scenario is unlikely to occur at full-scale, the information gathered could generally inform about recovery from drought scenarios for other times of year. Furthermore, upon analysis of data, it was determined that nitrate concentrations in the influent (feed) from May to mid-June 2018 were on average 14.5 mg/L, which is about three times higher than nitrate concentrations in the same timeframe in 2017. While elevated nitrate concentrations are a potential stress that could occur on the full-scale CWTS in early closure, it is not expected to be a concern in long term closure as the residues from blasting will deplete over time.

The recovery from the double stress test period and subsequent calculation of operational removal rate coefficients (RRC; k) were the focus of the 2018 program documented in this report. Other ongoing activities that have been reported on in previous years and continued in 2018 included:

- Evaluating CWTS performance, and determining achievable concentrations of contaminants of concern (COCs; performance limits);
- Updating site-specific RRCs with data from the operational period;
- Determining the amount of water loss due to evapotranspiration and the effect on outflow concentrations;
- Monitoring metals leaching from the mineralized soils used in construction;
- Monitoring for the presence of aphids in the CWTS, and implementing a routine insect pest control plan (for aphids);
- Determining the rate and extent of detritus decomposition (*Carex aquatilis* leaves) in the CWTS over time;
- Assessing treatment mechanisms (including microbes).

Other activities completed in 2018 included:

- Adding sandbags to the end and along the perimeter of each CWTS cell to increase the water depth (to enhance reducing conditions) and minimize short circuiting (would be achieved by rip rap armouring in full-scale system);
- Replanting areas in the CWTS that had been impacted by aphid infestation in 2017;
- Monitoring of explanatory parameters and performance to determine when the double stress test recovery was complete, and full operational capacity had returned;
- Assessing the stability of COCs in soils and production of acid volatile sulphides (AVS) with the addition of iron to Series 1; and
- Harvesting of a vegetation plot to determine amount of growth of above water biomass of *C. aquatilis* in a 1 m² plot.

Results and recommendations are presented within this main document, while background information and methods are provided in Appendix A, data in Appendix B, and summary of past and future recommended activities in Appendix C. Operations of the CWTS are detailed

in Section 2, timeline and sampling schedule in Section 3, and results in Section 4. Summary of results and next steps for 2019 are summarized in Sections 5 and 6, respectively.

2. Demonstration-Scale CWTS Operations 2018

2.1 Overview of operations

The demonstration-scale CWTS was constructed in 2014 and commissioned throughout 2015 - 2017 (Table 1). The completion of commissioning and the start of operations was marked by the achievement of the expected treatment performance objectives on August 18, 2017 (Table 1). Details on the construction and commissioning can be found in past Contango reports (Contango, 2015; 2016; 2017a; 2017b). In 2018, it was anticipated that the CWTS would continue with the operational period; however, due to the unintentionally imposed stresses of drying out of the CWTS and the elevated nitrate concentrations in the spring (May to mid-June), an opportunity arose to determine the effects these stresses on CWTS performance and assess the amount of time needed for the CWTS to recover. Beginning of the operational period (and, therefore recovery from the double stress test) was marked by meeting the same criteria used to determine the end of commissioning period in 2017 and by achieving consistent extent of removal of COCs, comparable or better removal than what was observed during the operational period in 2017 (Contango, 2017b). The following criteria were used to evaluate stress test recovery and are further discussed in the sections as listed:

- Plant establishment and maturation such that the plants have grown in to densities visually similar to natural wetlands in the area, but in monoculture (Section 2.6),
- Establishment of reducing conditions within the CWTS soils (i.e., average soil redox was below -100 mV consistently in 2018; Section 4.1),
- No increase in aqueous copper concentrations through the CWTS (due to leaching from copper containing soils used in construction; Sections 4.2.1 and 4.6),
- Achieving consistent extent of removal of COCs, comparable or better than removal observed during the operational period in 2017 (Section 4.2.3), and
- Microbial population establishment and maturation to levels similar or better to 2017 operational period (Section 0).

Once the above criteria were met, the CWTS was deemed to be returned to operational status. The same criteria, other than the copper leaching (which would be avoided by proper substrate selection), could be used for the full-scale CWTS.

2.2 Recovery period and definition of operational period

Recovery period from the double stress test in 2018 was variable for each series and COC and is further discussed in Section 4.2.2. Additional recovery strategies were attempted on the systems, including stagnation (both series), and addition of iron (Series 1). Recovery periods ranged from 0 days (treatment likely unaffected) to 54 days for Series 1 and 0 days (treatment likely unaffected) to 93 days for Series 2. For consistency of data analysis and comparison of performance between series, only data from when recovery criteria were met for all COCs in both series, and flows were at target levels was used (August 17 to September 9, 2018). This 24 day period will be referred to as the 2018 operational period (Table 1). Flow to the CWTS continued until September 28, 2018; however, intermittent flow occurred after September 9, 2018 due to pumps and waterlines freezing. Although treatment

continued to occur, it was not possible to calculate accurate retention times therefore removal rate coefficients were not calculated for this time period. Discussions in this document are focused on the defined operational period of August 17 to September 9, 2018.

Table 1 – Days of operation of demonstration-scale CWTS.

Scale	Year	Period (days)	Date	
			Start	End
Commissioning-A ²	2014 ¹	23	Aug 27	Sep 19
	2015	135	May 16	Sep 29
	2016	87	May 2	Jul 28
Commissioning-B ³	2016	63	Jul 29	Sep 30
	2017	82	May 27	Aug 17
Operational Period ³	2017	35	Aug 18	Sep 22
Double Stress Test Period - Series 1 ⁴	2018	0-54	May15	Jul 8
Double Stress Test Period - Series 2 ⁴	2018	0-93	May15	Aug 16
Operational Period ⁴	2018	24	Aug 17	Sep 9

¹ The CWTS was constructed in 2014, but no water testing occurred during this first month of commissioning-A.
² The end of the commissioning-A period and beginning of the commissioning-B period was marked by the addition of organics on July 28, 2016.
³ The end of the commissioning-B period and beginning of the operational period in 2017 was marked by stabilization of flow rates and resolution of feed water delivery complications.
⁴ The end of the double stress test period and beginning of the operational period in 2018 was marked by re-establishment of commissioning criteria. Series 1 recovered sooner than Series 2.

2.3 Start-up

The Minto Mine typically experiences fully frozen conditions from October to March, with overnight freezing temperatures beginning in September and persisting until May (Access, 2013). To start-up the demonstration-scale CWTS at the Minto Mine, temperatures must be sufficiently above freezing to operate the water supply pumps from monitoring station W62. In 2018, the criteria for the pumps was met on May 11, 2018 and water was pumped from station W62 to the header tank and subsequently into the CWTS on May 14, 2018 (Figure 2).

Once the ice and snow as melted from the CWTS, it was also observed on May 11, 2018 that the standing water in the CWTS had receded from all four cells (Figure 1), exposing the soils to oxygen for a period of time, and potentially releasing metals from the soils once the flow of water was re-introduced to the system. Ideally, a reducing CWTS such as that at Minto should operate under a constant water cover to maintain reducing conditions. This scenario of spring freshet drought is not expected to occur during full-scale operations as water will be flowing into the wetland by gravity as spring melt occurs and will not rely on pumps with seasonal constraints to supply water to the CWTS.



Figure 1 – Demonstration-Scale CWTS prior to start-up on May 11, 2018.

No standing water in cells as water dried out in early spring/freshet. Although vegetation is brown, other vegetation around the area is also brown at this time of year. Therefore, actual effects of drought on vegetation could not be evaluated at this time.

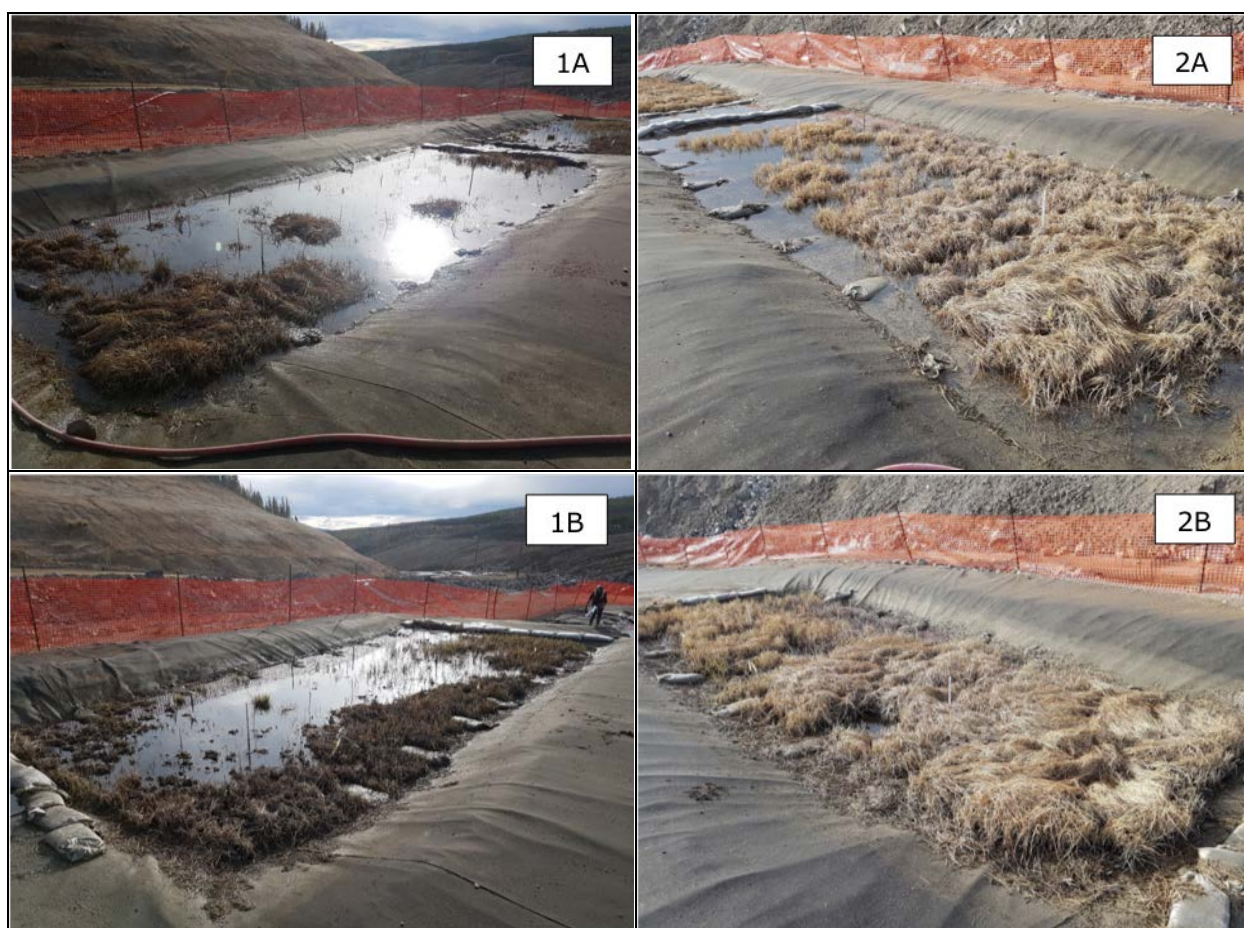


Figure 2 – Demonstration-Scale CWTS after water was pumped into the system on May 14, 2018.

2.4 Water Depth

Sandbags were added to the end and along the perimeter of each CWTS cell on May 18, 2018 to increase the water depth and minimize short circuiting, respectively. At full-scale short circuiting would be achieved by rip rap armouring around the edges of the wetland. The increase in water depth was conducted to promote reducing conditions and speed recovery of the cells from the drought. The depths were increased by 1 to 5 cm in each of the four cells (Table 2).

Table 2 – Demonstration-scale CWTS water depths.

CWTS Cell	Water Depth 2017 (cm)	Water depth 2018 (cm)
1A	15.2	20.2
1B	16.0	20.3
2A	15.9	18.6
2B	14.4	15.6

2.5 Flow Rates

To facilitate recovery of the CWTS cells from the double stress test, a long hydraulic retention time (HRT) was required to reintroduce reducing conditions. The targeted nominal HRT was calculated using the actual depth in each series (after adding sandbags on May 18, 2018; Section 2.4), plus the correction factor obtained from the 2017 tracer study. The targeted HRT was 7.25 days. Actual flow rates varied from the targeted flow rates and are presented with their corresponding HRTs in Table 3.

Once the CWTS had recovered from the double stress test, the targeted flow rates were continued into the operational period (August 17 to September 9, 2018) to continue monitoring the extent of treatment of COCs at a low flow. Due to flow meter fluctuations, the actual flow rates varied from targeted flow rates as outline in Table 3 below.

The flow rates were increased on September 10 to obtain a nominal HRT of 5 days to mimic the nominal HRT in 2017. However, due to unintentional changes in flow rates and shutdown of the demonstration-scale CWTS on September 28, 2018, there was limited data provided at the increased flow rate and the data collected from September 10 – 28, 2018 was omitted from further interpretation.

Table 3 – 2018 targeted and actual flow rates and corresponding HRTs.

Testing Period	Series 1				Series 2			
	Flow		HRT		Flow		HRT	
	GPM (m ³ /day)		days		GPM (m ³ /day)		days	
	Target	Actual	Target ³	Actual ⁴	Target	Actual	Target ¹	Actual ²
Double Stress Test Period ³	0.37 (2.02)	0.32 (1.76)	7.25	8.42	0.31 (1.69)	0.25 (1.39)	7.25	7.61
Operational Period ⁴	0.37 (2.02)	0.36 (1.95)	7.25	7.60	0.31 (1.69)	0.27 (1.49)	7.25	7.09

¹ Targeted HRTs were calculated with the targeted depth of 0.2 m corrected with the 0.01 m depth correction factor from the tracer study of 2017 (Contango, 2017b).
² Actual HRTs were calculated with the actual measured depth corrected with the 0.01 m depth correction factor from the tracer study of 2017 (Contango, 2017b).
³ Actual HRT and flow rate are an average from May 15 to August 16, 2018.
⁴ Actual HRT and flow rate are an average from August 17 to September 9, 2018.

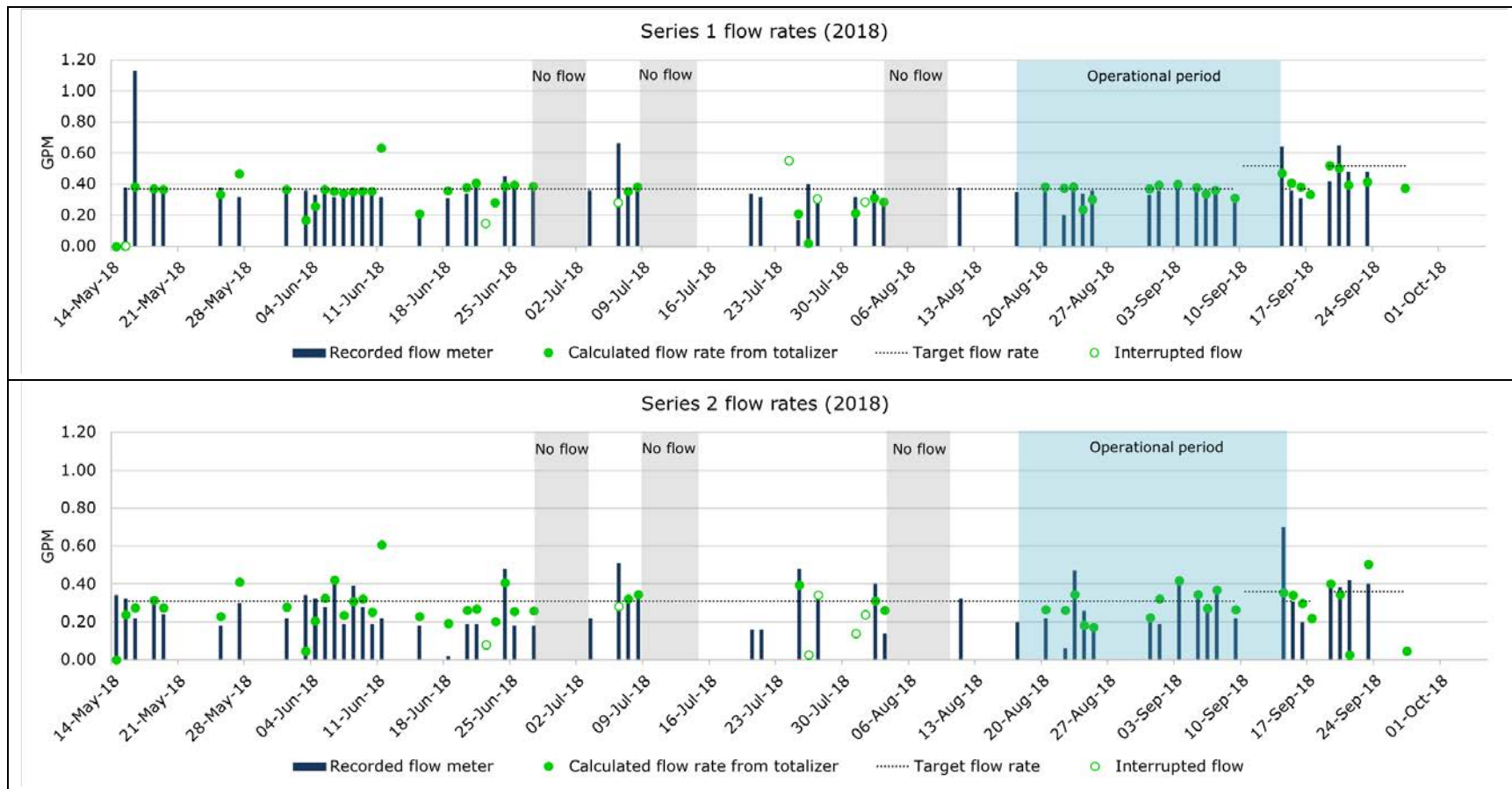


Figure 3 – Flow rates during CWTS operations in 2018.

Blue bars indicate flow rates displayed on flow meter, while green dots are flow rates calculated from the totalizer values (values from meter were recorded by Minto personnel). Specific flow rates of 0.37 and 0.31 gallons per minutes (GPM) for Series 1 and Series 2, respectively, were targeted where the lower flow rates in Series 2 are due to the smaller size of Series 2 cells. Due to flow meter fluctuations, the actual flow rates during the drought recovery period averaged 0.32 and 0.25 GPM for Series 1 and Series 2, respectively. The totalizer value is the cumulative volume of water passing through the flow meter between two measurement dates. Areas with no blue bars or green dots are time periods where flow rates and totalizer values were not recorded. Areas shaded grey indicate dates of interrupted flow due to evapotranspiration trials. Areas shaded blue indicate the 2018 operational period. Further details are outlined in Table 3.

2.6 Health and Establishment of CWTS Vegetation

2.6.1 *Carex aquatilis*

During the commissioning period, plants establish and mature, with density expected to increase over time. From planting in 2014 to the last site visit in July 2017, *Carex aquatilis* thrived in the CWTS creating a dense emergent macrophyte monoculture, supplemented with aquatic mosses (Figure 4). Due to the location of the CWTS on the waste rock dump being in a relatively isolated area, away from other vegetation and potential sources of predatory insects, in July 2017, an aphid infestation occurred in the CWTS which affected the growth of *C. aquatilis* (September 2017 and May 2018 photos in Figure 4, Contango, 2017b). The biomass above water partially died off, however, the plants continued to send out new shoots suggesting the *C. aquatilis* were resilient to the infestation. To assist with plant recovery in 2018, the CWTS was sprayed with pesticide biweekly starting on May 14, 2018 (Section 4.8), and on July 8, 2018, *C. aquatilis* was replanted where vegetation was sparse. Plant re-establishment and maturation such that the plants had grown in to densities visually similar to natural wetlands in the area, but in monoculture, was reached after replanting *C. aquatilis* (Figure 4), with the exception of cell 1A which was still recovering. Weekly pesticide application was conducted starting on August 24, 2018 to control a small aphid population in cell 2A (Section 4.8). It is recommended that pictures of the CWTS cells are taken from all four corners to better monitor plant growth and development in the cells in 2019.

Generally, the *C. aquatilis* has been successful in creating the desired conditions for water treatment, and the results of the 2018 operations confirm that *C. aquatilis* is a good candidate for use in the full-scale CWTS at Minto.

2.6.2 Moss

Aquatic mosses have also continued to mature and expand in size from 2014 through 2018 (Figure 5). The mature mosses show signs of successful transfer (sorption, filtration) and transformation (mineralization, reduction) processes such as new green biomass at the top of moss and black decomposition at the bottom of the moss.

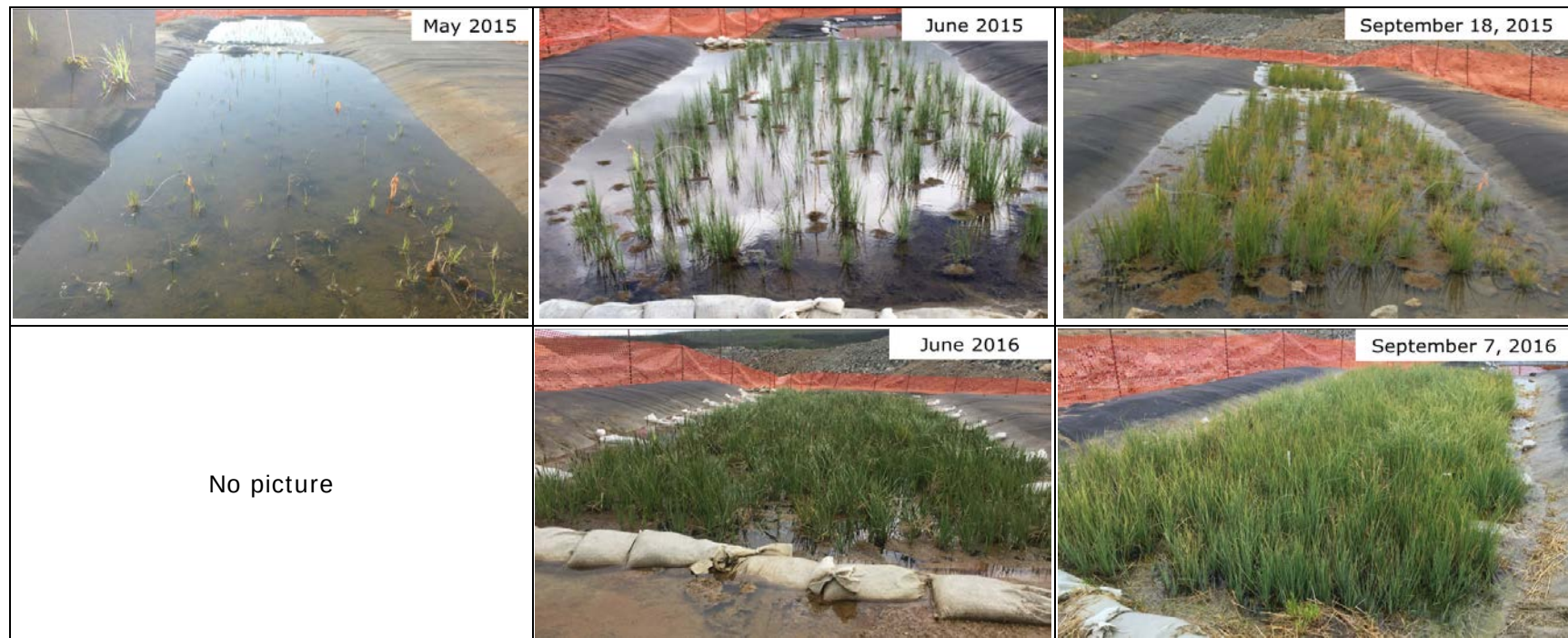


Figure 4 – Maturation of the CWTS from construction through operations.
2015 pictures show cell 2A. 2016 pictures show cell 1B.



Figure 4 continued – Maturation of the CWTS from construction through operations.
2017 and 2018 pictures show cell 1B. September 12, 2017 shows increased yellowing and die off in cell 1B due to aphid infestation.

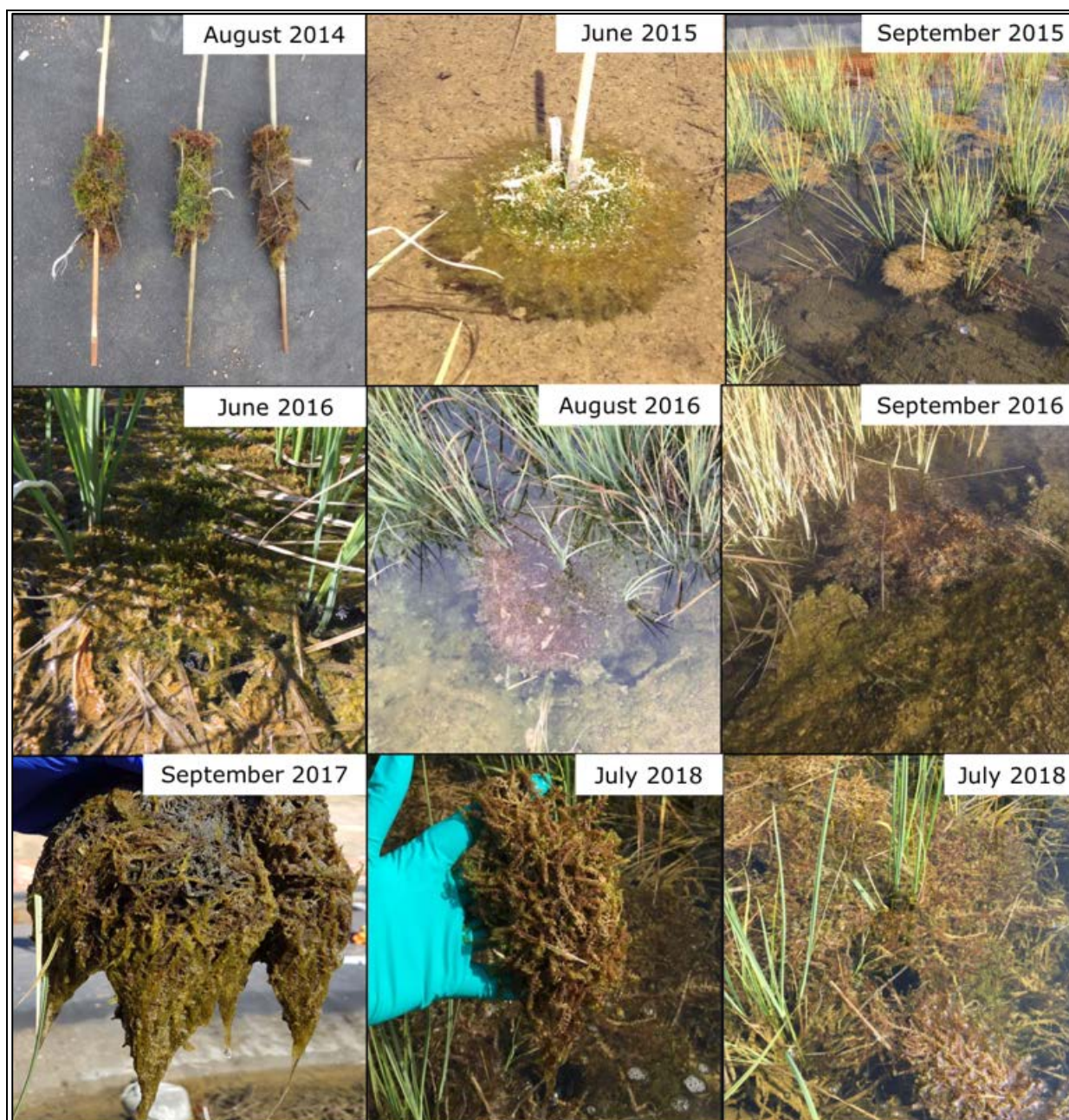


Figure 5 – Moss maturation in CWTS from construction through operations.

3. Timeline and Sampling Schedule

Major events and operational adjustments or amendments for 2018 are listed in Table 4. Details for events up to 2018 can be found in the Minto Demonstration-scale 2017 Update Report (Contango, 2018). The actual dates as well as effective days of operation are provided, which adjusts for time that the CWTS was not receiving water when it was frozen. The effective days of operation allows for comparison to expected timelines from the pilot-scale testing, and for planning and scheduling to be done for full-scale construction and commissioning. The sampling schedule for 2018 was conceptually developed prior to beginning construction of the demonstration-scale CWTS (Appendix A). Actual dates of sampling were adjusted for timing of spring thaw and winter freeze-up, and the associated ability to have the pumps operating at the W62 sump to supply water to the demonstration-scale CWTS.

Table 4 – Events and sampling activities in 2018.

Event	Key Activity	Flow Rate Recorded m ³ /day (GPM)		Dates	Effective Days of Operation (start date = August 27, 2014)
		Series 1	Series 2		
Aphid spraying started	Applied insecticide biweekly	n/a	n/a	May 14, 2018	439
CWTS refilled	Re-established water level post drought	No flow	No flow	May 14, 2018	439
Drought recovery period started	Flow started	2.07 (0.38)	1.74 (0.32)	May 15, 2018	440
Water level raised	Added sandbags	2.02 (0.37)	1.64 (0.30)	May 18, 2018	443
Spring seasonal sampling	Tested soils, water & sampled microbiology ¹	1.74 (0.32)	1.64 (0.30)	May 27, 2018	452
Spring microbiology re- sampling	Tested microbiology ¹	2.13 (0.39)	0.98 (0.18)	June 25, 2018	481
Evaporation Study #1	Flow stopped	No flow	No flow	June 27, 2018	483
	Flow re-started	1.96 (0.36)	1.20 (0.22)	July 3, 2018	489
Contango Site Visit #9 & summer seasonal sampling	Tested microbiology, soils, water, detritus bags, and vegetation plot	1.96 (0.36)	1.74 (0.32)	July 7 – 9, 2018	493 – 495
Sedge transplanted	Replenished aphid devastated areas	No flow	No flow	July 8, 2018	494
Iron addition	Flow stopped	No flow	No flow	July 8, 2018	494
	Flow re-started	*	*	July 15, 2018	501
Fertilizer additions started	Applied biweekly to <i>C. aquatilis</i>	n/a	n/a	July 14, 2018	500
Unknown flow and HRT	Missed totalizer record	*	*	July 20, 2018	506
Evaporation Study #2	Flow stopped	No flow	No flow	Aug 3, 2018	520
	Flow re-started	*	*	Aug 10, 2018	527
Operational period for all COCs began				August 17, 2018	534
Aphids observed and spraying regiment changed	Applied insecticide weekly	n/a	n/a	August 24, 2018	541
Target flow rates increased	Adjusted flow to target a 5 day HRT	2.83 (0.52)	1.96 (0.36)	September 10, 2018 – September 14, 2018	558 – 562
Flow rate unintentionally reduced ²	Adjusted flow to drought recovery targets	2.29 (0.42)	2.07 (0.38)	September 14, 2018 – September 19, 2018	562 – 567
Winter freeze up	Flow stopped & wetland closed	0.00 (0.00)	0.00 (0.00)	September 28, 2018	576
¹ Contango received microbiology samples that exceeded hold times for testing. Microbiology re-sampled on June 25, 2018 was bio-banked until analyzed. ² Due to miscommunication on site, new target flow rates were returned to original target flow rates.					

4. Results

4.1 Monitoring Explanatory Parameters

Key findings (detailed below):

- Dissolved oxygen (DO) increased during the double stress test period and operations in 2018. Elevated DO is likely the result of photosynthesis of algae, which had increased growth due to fertilizer addition. Despite the DO levels being in aerobic ranges, stable reducing conditions were achieved in CWTS soils within the targeted range.
- Other than the day that the CWTS was refilled (May 14, 2018), soil redox was unaffected by the drought. Average soil redox values were more reducing (and stable in the targeted range) in 2018 than 2017.

Average water temperature of the demonstration-scale CWTS in 2018 were similar to those in 2015 (12.9°C), 2016 (10.2°C), and 2017 (9.7°C). The average water temperature during the operational period in 2018 was 9.8°C, ranging from 6.4°C to 12.6°C. Conductivity decreased slightly since 2017, and as expected, pH remained circumneutral. Water oxidation-reduction potential (ORP) was similar to 2017 (Table 5).

During operations, DO concentrations in the CWTS cells in 2018 were on average 7.9 mg/L, which is higher than the operational period in 2017 (Table 5). DO measurements at Minto were taken mainly during the day, between 8 am and 4 pm, when DO concentrations have been shown to be higher (SRCSD, 1998). Furthermore, DO fluctuations are generally more extreme in open (such as the demonstration-scale CWTS in this phase where vegetation is still growing in) versus densely vegetated waters and may vary based on distance through the wetland (SRCSD, 1998). Algae can also cause DO levels to fluctuate through their photosynthetic cycles, which peak during the afternoon and are at a minimum in the early morning (SRCSD, 1998). Algae growth increased compared to 2017, particularly in cell 1A, due to the addition of fertilizer, and average DO was notably higher than other cells (10.0 mg/L in 1A, compared to 8.1, 5.1, and 8.5 mg/L in 1B, 2A, and 2B, respectively). The elevated DO in cell 1A is associated with decreased performance in that cell, specifically for selenium and copper (Section 4.2.3). Despite the elevated DO concentrations, treatment in Series 1 still occurred by the end of the B cells. Due to the fluctuations in DO, it is recommended that DO is measured at various locations and water depths through the CWTS in 2019 for a more thorough understanding of aerobic zones within the CWTS.

Table 5 – Average *in situ* measurements from the demonstration-scale CWTS.

Testing Period		DO (mg / L)	Conductivity (μ S / cm)	pH	ORP (mV)	Soil redox (mV)
Demonstration-scale 2015		10.0	817.9	8.11	147.9	-52
Demonstration-scale 2016	Commissioning-A ¹	15.9	890.9	7.79	143.7	-85
	Commissioning-B ²	8.4	1020	7.59	157.6	-89
Demonstration-scale 2017	Commissioning-B ³	4.3	795.9	7.43	18.7	-162
	Operational period ⁴	5.3	879.7	7.36	124.9	-152
Demonstration-scale 2018	Double stress test period ⁵	6.1	753.0	7.55	143.3	-176
	Operational period ⁶	7.9	703.4	7.45	143.1	-178
DO – dissolved oxygen; ORP – oxidation-reduction potential. ¹ Data for commissioning-A period is from May 2-July 28, 2016. ² Data for commissioning-B period is from July 29-September 30, 2016. ³ Data for commissioning-B period is from May 27-August 17, 2017. ⁴ Data for operational period is from August 18-September 22, 2017. ⁵ Data for double stress test is from May 15-August 16, 2018. ⁶ Data for operational period is from August 17-September 9, 2018.						

As expected from the pilot-scale testing, the soil redox in all the demonstration-scale CWTS cells has decreased and stabilized to within the targeted range (-100 and -250 mV; Contango, 2014b), indicating maturation of the CWTS (Figure 6). At the end of 2016, the demonstration-scale CWTS had begun achieving soil redox values that are conducive to sulphide production due to the decomposition of the organics that were added on July 28, 2016 (Contango, 2017). By the end of 2017, the CWTS had matured and became self-sufficient in producing enough organic matter to maintain reducing soil redox conditions between -100 and -250 mV. In 2018, the average soil redox in Series 1 was unaffected by the CWTS drying out in early spring/freshet, while Series 2 was above -100 mV on May 14, 2018. However, the average soil redox in Series 2 decreased to ideal reducing conditions by May 27, 2018 without additional carbon amendments. The average soil redox for Series 1 and 2 was -176 mV during the double stress test period and remained in the targeted range (-178 mV) throughout the operational period in 2018, indicating a matured CWTS. Soil redox will continue to be monitored throughout operation in 2019.

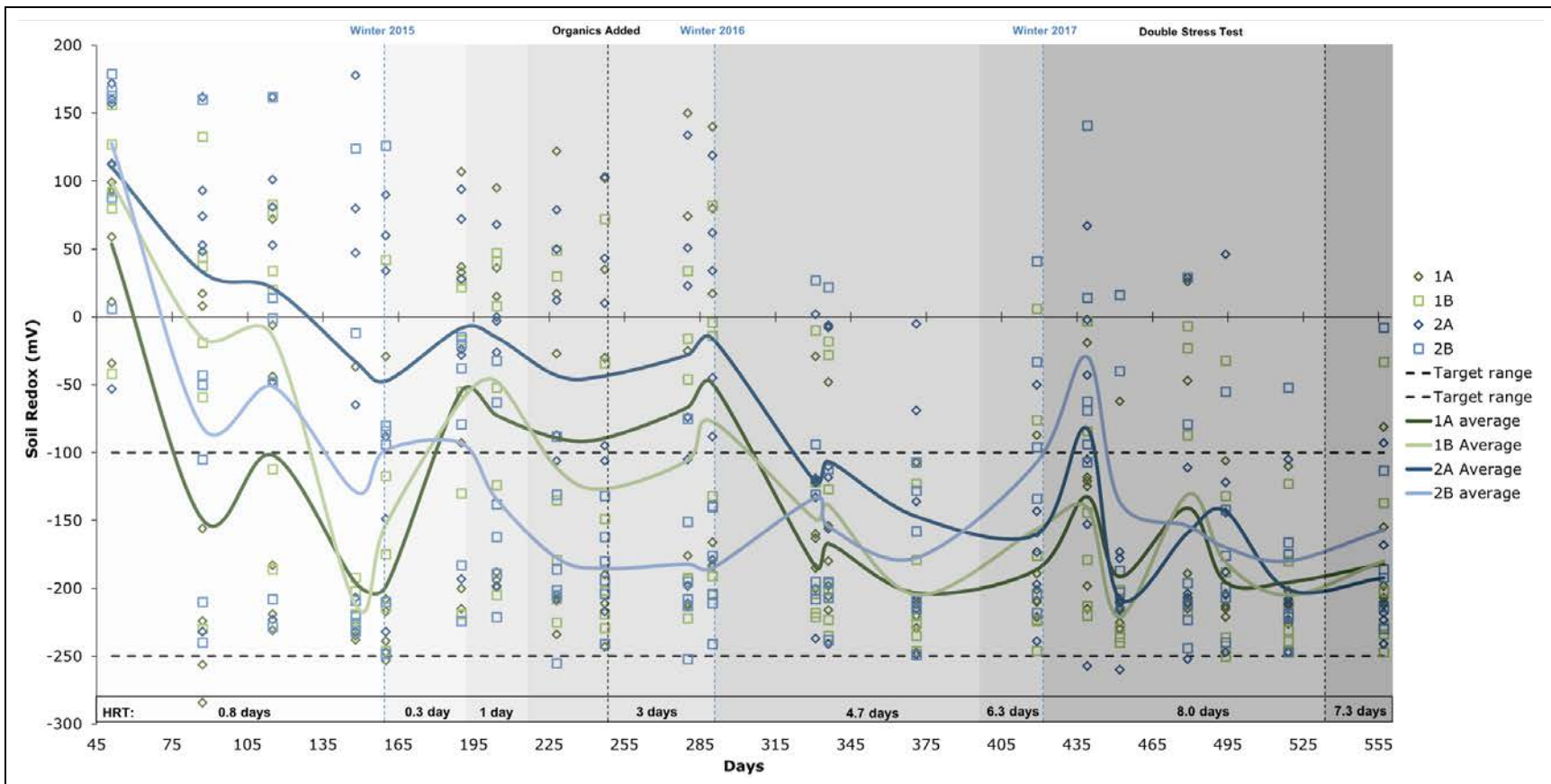


Figure 6 – Soil redox potential of each CWTS cell over time.

All demonstration-scale CWTS soil redox measurements are plotted. Targeted soil redox values based on pilot-scale testing are indicated with dotted lines. The blue dotted line indicates break in measurements for winter 2015, 2016, and 2017. Grey shading corresponds to periods of nominal HRT (days) in 2015 and 2016 indicate the nominal HRT. Grey shading corresponds to periods of nominal HRT (days) in 2017 and 2018 indicate the actual HRT (average of Series 1 and 2) using recorded water depths and flow rates during those time periods.

4.2 Water

Key findings (detailed below):

- While leaching of copper from substrates used in construction was remedied by the end of the commissioning-B period in 2017, copper leached from the soils into the water in early 2018, likely due to the drying out of the CWTS in the early spring/freshet of 2018. However, leaching had subsided by July 8, 2018 as the rate of treatment exceeded the rate of leaching. Copper is not expected to leach in 2019 operations provided that the CWTS remains flooded.
- Stagnation and iron addition can be used at full-scale to mitigate recovery length after periods of drought (or stagnation/slower HRT for high nitrate concentrations).
- During the 2018 operational period the demonstration-scale CWTS successfully treated all COCs.

4.2.1 Metal Leaching from Soils into Overlaying Water

Due to metals leaching from the soils, the treatment occurring within the CWTS was far greater than what was being observed by simply measuring the inflow and outflow points. Therefore, additional sampling locations were tested throughout the CWTS in 2017 and 2018 to identify these fluctuations. Details of the sampling methods can be found in Appendix A of the Minto Constructed Wetland Treatment Research Program – Demonstration Scale 2017 Update (Contango, 2017b). Graphs showing concentrations of copper throughout the CWTS are presented in Figure 7, while graphs for the remaining COCs can be found in Appendix B (Figures B1 to B4).

Since the beginning of operations of the demonstration-scale CWTS, significant concentrations of copper have been leaching from the CWTS soils used in construction (Contango, 2016, 2017a, and 2017b; Section 4.6). Once sufficient reducing conditions were established at the end of the 2017 commissioning-B period, copper leaching subsided as treatment occurred at a faster rate than leaching (Contango, 2017b). However, due to the drying out of the CWTS in early 2018, copper once again began leaching from the soils into the water in Series 2 (June 22, 2018 sampling date; Figure 7).

As corners in Series 1 are deeper than Series 2, it is likely that Series 2 dried out first and was therefore more affected by the drought than Series 1. However, at later sampling dates (July 8, 2018 onwards), copper was no longer leaching at a rate that the CWTS could not keep up with for treatment. Copper concentrations generally decreased by the end of the A cells and stabilized through B cells (Figure 7), indicating that treatment of copper was occurring and that copper leaching from the soils had subsided to a slower rate than treatment. Leaching of copper is not expected to be a concern in 2019 operations provided that the CWTS remains flooded throughout the 2018/2019 winter and early spring season. Therefore, it is recommended that the CWTS be periodically monitored throughout the 2018/2019 winter and early spring, with close observation in the spring to add water immediately once thawed, should the CWTS be dry. Leaching of constituents from the substrates used in construction is further described in Section 4.6.

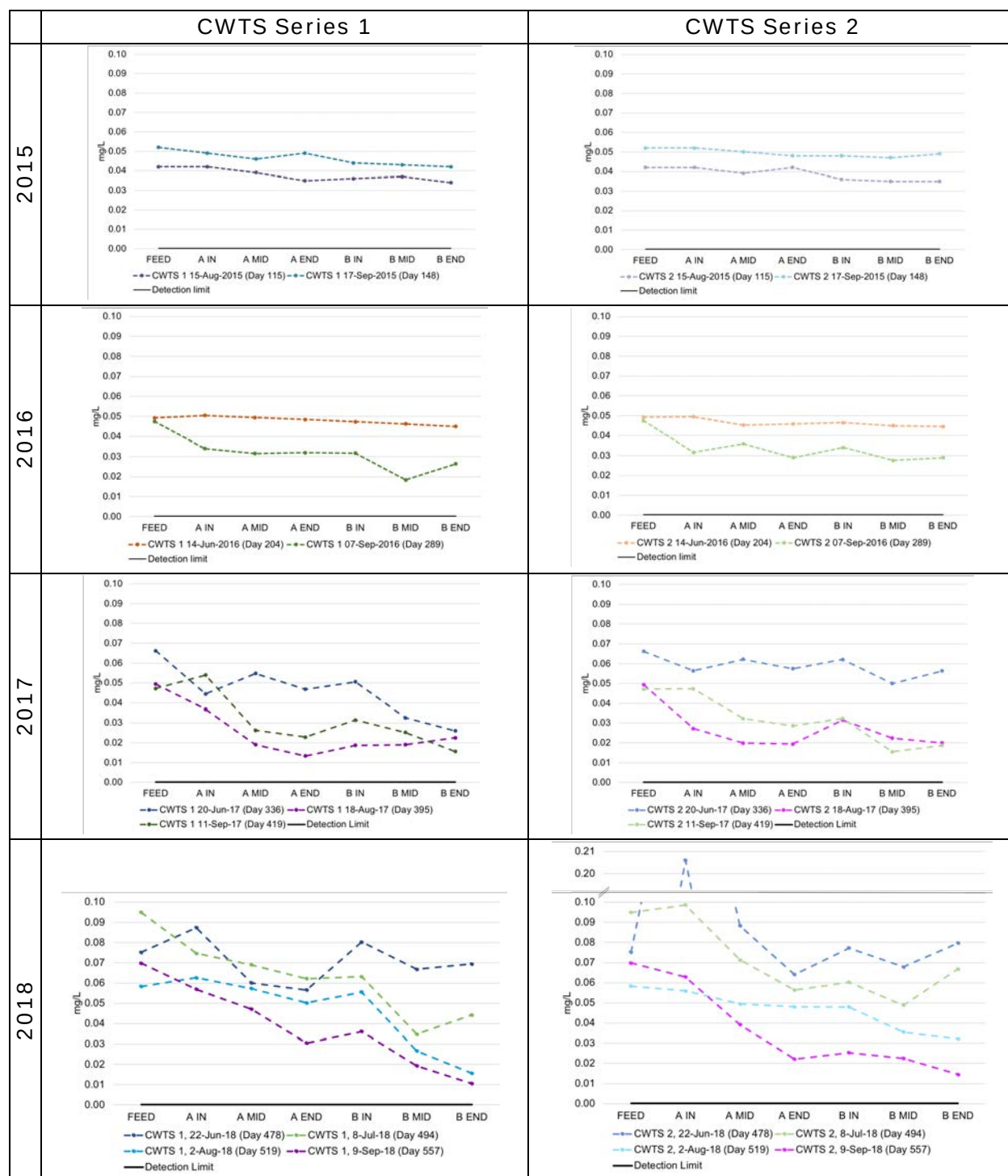


Figure 7 – Copper concentrations through the demonstration-scale CWTS.

Dissolved copper concentrations along the length of the CWTS in 2015 through 2018. Data shown for 11 timepoints, where water was sampled at seven locations through the flow path of the CWTS to assess for treatment fronts within the CWTS, or possible leaching of constituents from the soils into the CWTS. The Maxxam (2015 results) and ALS (2016 – 2018 results) detection limit (DL; black line) for copper is 0.0002 mg/L. Spikes in copper concentrations were observed in early sampling points in Series 2 of the CWTS in 2018 indicating leaching from the soils is occurring; however, later sampling points do not show any copper spikes and, therefore, leaching has subsided.

4.2.2 Performance During 2018 Double Stress Test Period

Due to the drying out of the CWTS as well as higher nitrate concentrations in early 2018, the performance of the CWTS was impacted, resulting in decreased removal of COCs. While these risks are unlikely to occur for an extended period of time during full-scale operations, there are measures that can be taken to mitigate the risks, based on data from the demonstration-scale CWTS. The issues identified, along with the risk to the CWTS, impact on performance, and mitigation actions are outlined in Table 6 and will be considered for full-scale CWTS implementation.

Table 6 – Risks, impacts, and mitigation measures based on issues identified during operations of the demonstration-scale CWTS.

Issue	Risk to CWTS	Potential Impact on Performance	Mitigation Measures for Full-Scale CWTS
High nitrate concentrations	Increase electron (carbon) demand	Dependent on time of year, may overcome vegetation's ability to use as nutrient, forming an oxidative redox buffer, which increases carbon demand needed to treat metals and metalloids.	- Run at slower flow rates (longer HRT) to decrease the load of electron demand to the CWTS - Add organics (carbon) to forebay (at full-scale) to produce excess electrons for treatment to account for unexpectedly high concentrations - Prevent effects on metal treatment by having a strong pool of AVS to continue treatment through AVS buffering while Nitrate uses electrons from carbon in system (outcompeting sulphate for sulphides).
Drought in spring thaw	Soil exposure to oxygen, potential change in redox status if prolonged	- Oxidizing conditions may establish, impacting treatment of COCs. - When water returns, no vegetation to draw water into root zone and commence treatment.	- Stagnate or increase HRT to re-establish reducing conditions - Add iron to remove metals/metalloids with iron oxyhydroxides (which will eventually form sulphide minerals) - Prevent effects by having strong AVS pool to provide redox buffering
Drought in summer		- Oxidizing conditions may establish, impacting treatment of COCs. - When water returns, vegetation can rapidly draw water through root zone to return treatment.	

The period of time required for the CWTS to recover from the double stress test was variable for each series and COC based on treatment front, and amendments added to the CWTS (Table 7). During the double stress test period, while the CWTS recovered, the percent load removal of all COCs, except cadmium, were lower than the 2017 operational period (Table 8; Figure 8 to Figure 13). Additionally, with the exception of molybdenum, percent load removal in the drought recovery period for remaining COCs was higher in Series 1 (Table 8).

In both series, nitrate treatment was likely unaffected as the amount of removal remained stable throughout 2018 and the extent of removal was better than previous years, where the CWTS was not affected by a drought in the spring (Contango, 2017b). Treatment of selenium followed the same trend as nitrate, however, it was not treated until nitrate was depleted. This is due to the reaction order in an anaerobic system where nitrate is easier to reduce than selenium.

In Series 1, treatment of cadmium and zinc resumed concurrently (July 8, 2018) while in Series 2, zinc recovered before cadmium (Table 7). While zinc is expected to be treated following copper and cadmium via metal-sulphide formation, it can also sorb to mosses, thereby decreasing its recovery time. Copper and molybdenum treatment began improving in both series following the first evapotranspiration trial when flow to the CWTS was stopped and reducing conditions further established (Figure 9). However, the addition of iron to Series 1 enhanced the recovery of copper and molybdenum by 33 and 20 days, respectively, compared to Series 2 (no added iron; Table 7). Although copper treatment is expected to occur prior to cadmium, zinc, and molybdenum, leaching of copper from the soils in early 2018 increased the load of copper needing treatment (Section 4.2.1; Table 8). However, this is not expected to occur in the full-scale system provided soils with low concentrations of leachable copper are used.

Based on the recovery of COCs from the double stress test, stagnating the CWTS (demonstration-scale or full-scale) immediately following an upset may increase time of recovery by promoting re-establishment of reducing conditions (to aid in the formation of metal-sulphides.) Furthermore, while iron isn't expected to be added in the full-scale CWTS long-term, it may also be used in conjunction with stagnation to decrease recovery time of the CWTS. Addition of iron promotes production of AVS for future use in metals treatment in an on-demand manner. To further encourage AVS production in the full-scale CWTS iron could be incorporated into the soils during construction.

Table 7 – Date of COC recovery from double stress test for Series 1 and 2.

COC	Series 1 (with iron)		Series 2 (without iron)	
	Period (days)	Date of recovery	Period (days)	Date of recovery
Cd	45	29-Jun-18	45	29-Jun-18
Cu	54	08-Jul-18	87	10-Aug-18
Mo	59	13-Jul-18	79	02-Aug-18
Se	12	27-May-18	24	08-Jun-18
Zn	45	29-Jun-18	31	15-Jun-18
Nitrate	Not applicable	Likely unaffected	Not applicable	Likely unaffected

4.2.3 Performance During 2018 Operational Period

In the 2018 operational period for the demonstration-scale CWTS (August 17 to September 9, 2018), dissolved cadmium, copper, selenium, and zinc treatment improved from the double stress test period (Table 8). Dissolved metals concentrations rather than total metals concentrations were used for the discussion in this report as total values are not representative of the metals concentrations in the CWTS water. During the operational period Series 1, which also received an additional recovery intervention strategy of iron addition achieved of the CWTS achieved an average decrease of 0.0214 µg/L for cadmium (Figure 8), 53.3 µg/L for copper (Figure 9), 8.16 µg/L for molybdenum (Figure 10), 3.15 µg/L for selenium (Figure 11), 16.1 µg/L for zinc (Figure 12) and 8.94 mg/L for nitrate. Series 2, an average decrease of 0.0214 µg/L for cadmium (Figure 8), 49.7 µg/L for copper (Figure 9), 7.06 µg/L for molybdenum (Figure 10), 3.20 µg/L for selenium (Figure 11), 16.1 µg/L for zinc (Figure 12) and 8.98 mg/L for nitrate. Percent removal of COCs are presented in Table 8 below, including percent removal of COCs adjusted for evapotranspiration. Evapotranspiration is further discussed in Section 4.5. Furthermore, nitrate outflow concentrations also decreased from feed water concentrations throughout the demonstration-scale CWTS. As nitrate concentrations were low during the operational period, nitrate was likely taken up by plants as a nutrient source (Figure 13). These results indicate that the CWTS can recover quickly from an upset event (double stress test). Beneficial conditions for the removal of constituents in the CWTS were re-established following the double stress test, and treatment of these constituents should continue through 2019.

Table 8 – Percent removal of dissolved constituents in the demonstration-scale CWTS.

COC (µg/L)		Operational period ¹	Double Stress Test Period ²		Post-Double Stress Test Period ³		Operational Period ⁴	
		2017 ⁵	2018					
			Series 1	Series 2	Series 1	Series 2	Series 1	Series 2
Cd	In	0.0261	0.0266	0.0266	0.0254	0.0254	0.0264	0.0264
	Out	0.0092	0.0080	0.0107	0.0051	0.0053	0.0050	0.0050
	% removal ⁶	66	70	60	80	79	81	81
	% ET ⁶	71	-	-	-	-	85	85
Cu	In	49.1	58.9	63.1	66.5	63.2	65.8	65.8
	Out	17.3	43.2	53.8	17.2	16.9	12.5	16.1
	% removal ⁷	65	27	15	74	73	81	76
	% ET ⁷	72	-	-	-	-	85	81
Mo	In	6.3	10.6	10.3	10.1	10.5	10.5	10.5
	Out	2.7	10.9	8.98	2.17	3.01	2.38	3.48
	% removal	57	0	13	79	71	77	67
	% ET	65	-	-	-	-	82	74
Se	In	4.0	9.02	7.99	3.81	3.25	3.68	3.68
	Out	0.5	6.21	3.96	0.96	0.80	0.53	0.47
	% removal	87	31	50	75	75	86	87
	% ET	89	-	-	-	-	88	90
Zn	In	49.2	24.7 ⁸	25.3	18.8	19.1 ⁶	17.3	17.3
	Out	1.9	3.90 ⁸	6.48	1.38	1.75 ⁶	1.23	1.15
	% removal ⁶	96	84 ⁸	74	93	91 ⁶	93	93
	% ET ⁶	97	-	-	-	-	94	95
Nitrate								
NO ₃ (mg/L)	In	6.98	14.5	14.5	7.51	7.51	8.99	8.99
	Out	0.17	1.98	5.05	0.02	0.01	0.05	0.01
	% removal	98	86	65	100	100	99	100
	% ET	100	-	-	-	-	100	100

% removal – percent load removal, not adjusted for evapotranspiration; % ET – percent load removal adjusted for evapotranspiration, calculated by methods described in Contango, 2017b; '-' – indicates that percent load removal adjusted for evapotranspiration was not calculated as it is not applicable to full-scale.

¹ Data for operational period was from August 18 to September 22, 2017.

² Data for double stress test period varied by COC and series, as shown in Table 7, with nitrate reported in this table as May 18-June 15, 2018 where nitrate concentrations were elevated causing stress on the system.

³ Period after the double stress test and includes data to the end of the operational period (referred to here as post-double stress test period; varied by COC and series; Table 7).

⁴ Operational period occurred from August 17, 2018 to September 9, 2018.

⁵ Data from 2017 averaged for series 1 and 2 as both series were operated the same in 2017.

⁶ Percent load removal for Cd and Zn are artificially low in 2018 due to outflow concentrations below the detection limit.

⁷ Extent of copper removal was influenced by higher copper concentrations in the soils (Figure 14, Table 7).

⁸ Data from June 22, 2018 was erroneous and therefore removed from calculations (dissolved concentration exceeded total concentration).

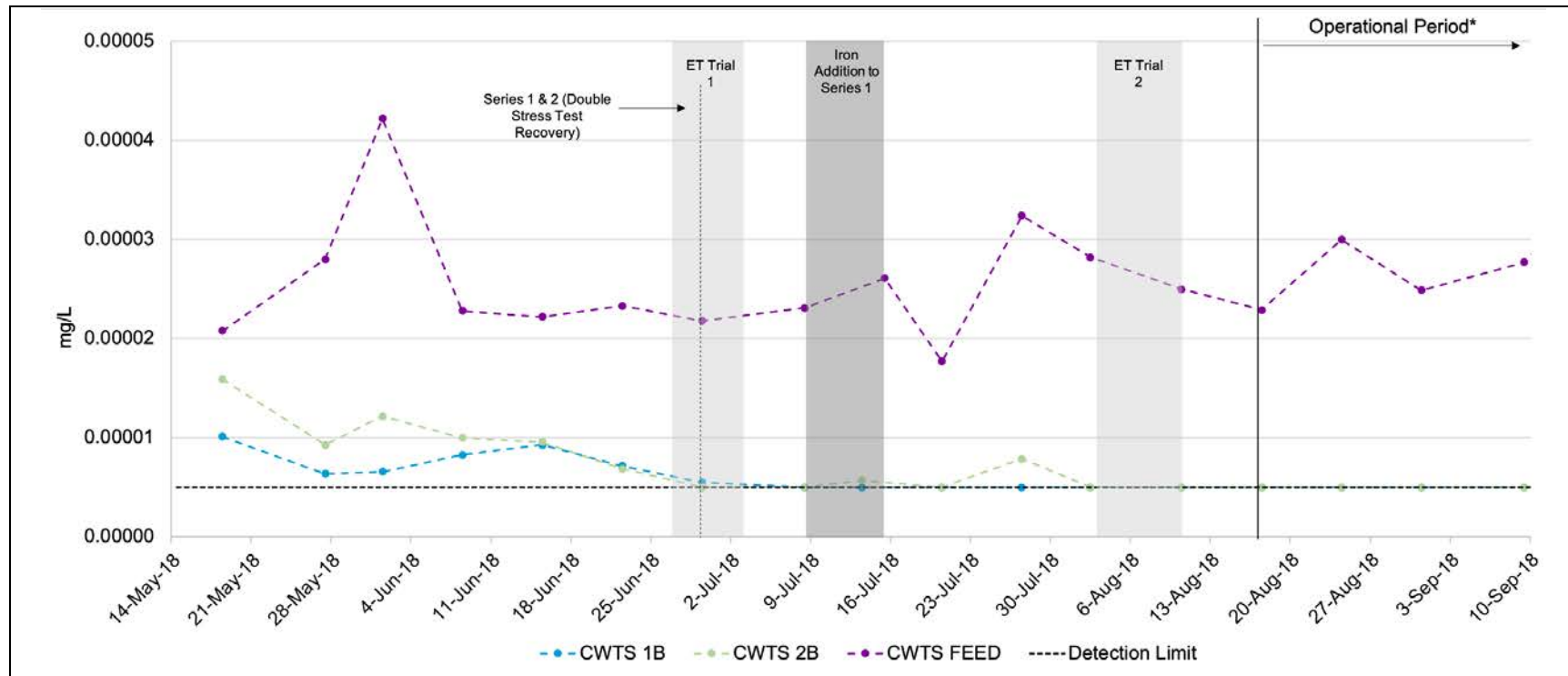


Figure 8 – Dissolved cadmium concentrations in the demonstration-scale CWTS in 2018.

‘*’ – The operational period refers to the time period when all COCs in Series 2 (no iron added) were being treated. However, cadmium recovered before this date (Table 7). The ALS detection limit for cadmium is 0.000005 mg/L. ET – evapotranspiration. Flow to the CWTS was shut off for the addition of iron to cells 1A and 1B on July 8, 2018. Flow was restarted on July 15, 2018.

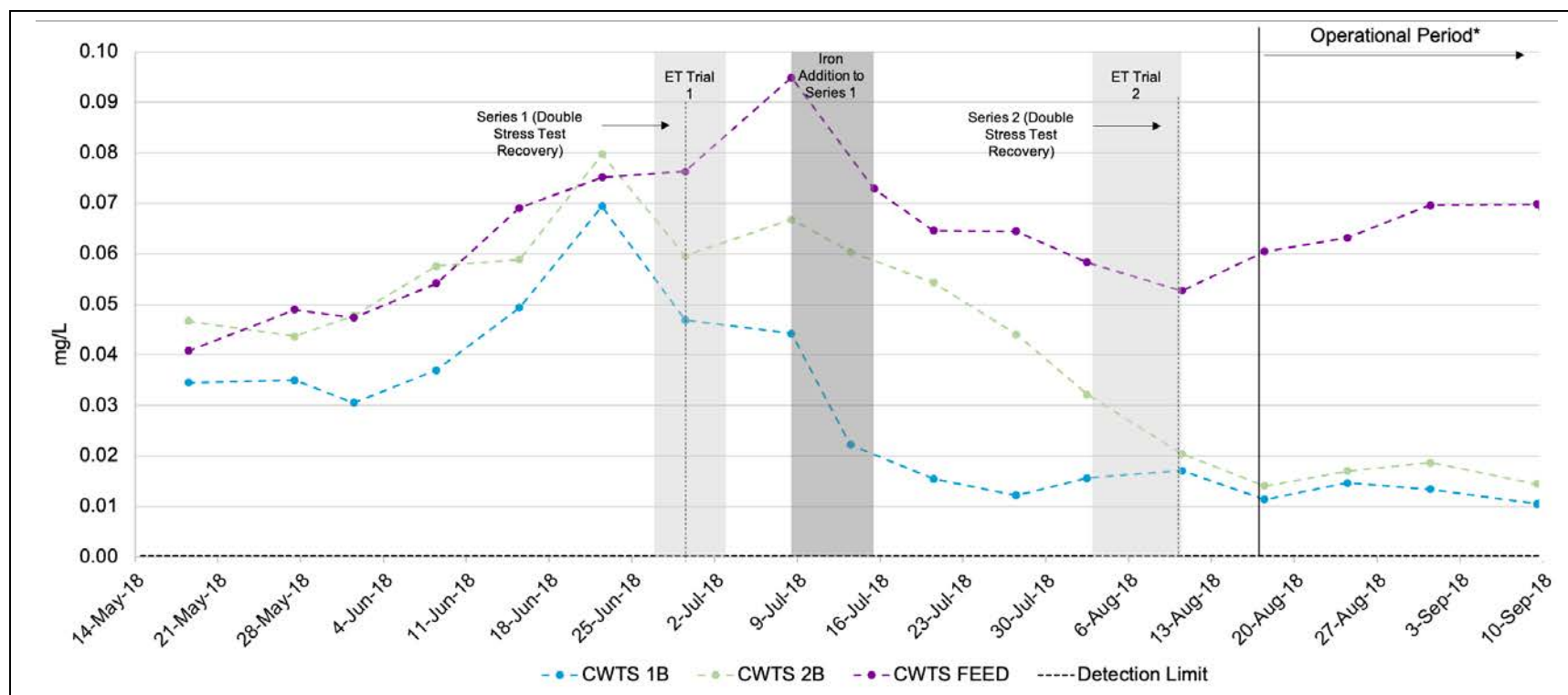


Figure 9 – Dissolved copper concentrations in the demonstration-scale CWTS in 2018.

‘*’ – The operational period refers to the time period when all COCs in Series 2 (no iron added) were being treated. However, copper in Series 1 recovered before this date (Table 7). The ALS detection limit for copper is 0.0002 mg/L. ET – evapotranspiration. Flow to the CWTS was shut off for the addition of iron to cells 1A and 1B on July 8, 2018. Flow was restarted on July 15, 2018.

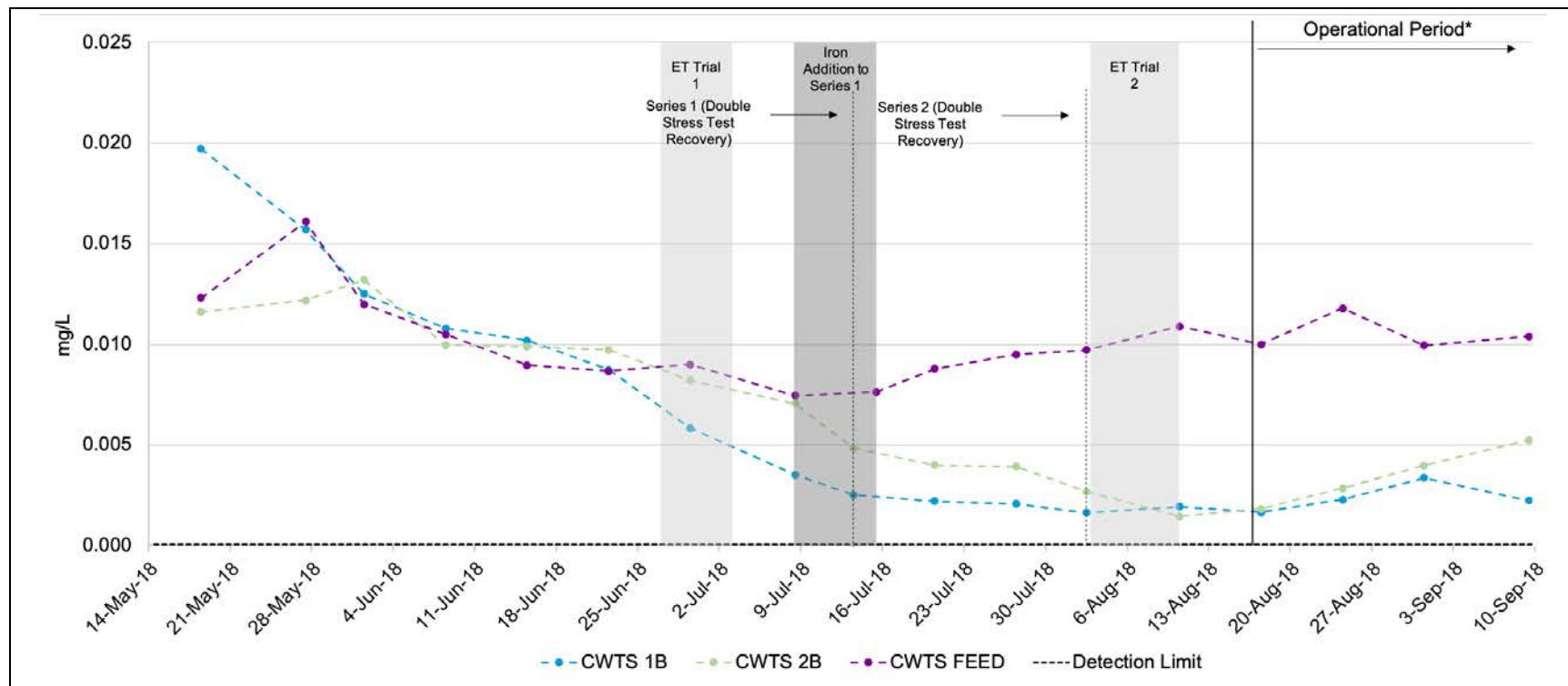


Figure 10 – Dissolved molybdenum concentrations in the demonstration-scale CWTS in 2018.

‘*’ – The operational period refers to the time period when all COCs in Series 2 (no iron added) were being treated. However, molybdenum recovered before this date (Table 7). The ALS detection limit for molybdenum is 0.000050 mg/L. ET – evapotranspiration. Flow to the CWTS was shut off for the addition of iron to cells 1A and 1B on July 8, 2018. Flow was restarted on July 15, 2018.

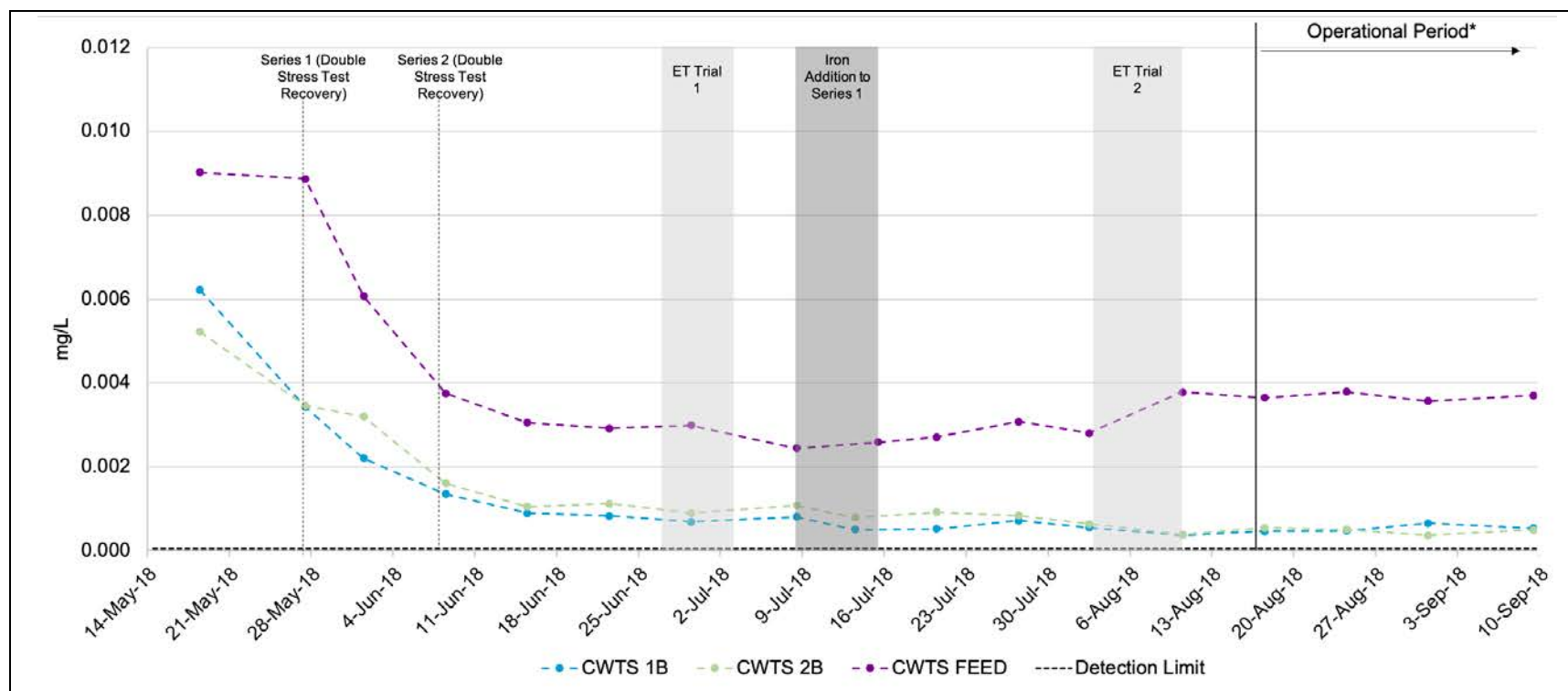


Figure 11 – Dissolved selenium concentrations in the demonstration-scale CWTS in 2018.

‘*’ – The operational period refers to the time period when all COCs in Series 2 (no iron added) were being treated. However, selenium recovered before this date (Table 7). The ALS detection limit for selenium is 0.000050 mg/L. ET – evapotranspiration. Flow to the CWTS was shut off for the addition of iron to cells 1A and 1B on July 8, 2018. Flow was restarted on July 15, 2018.

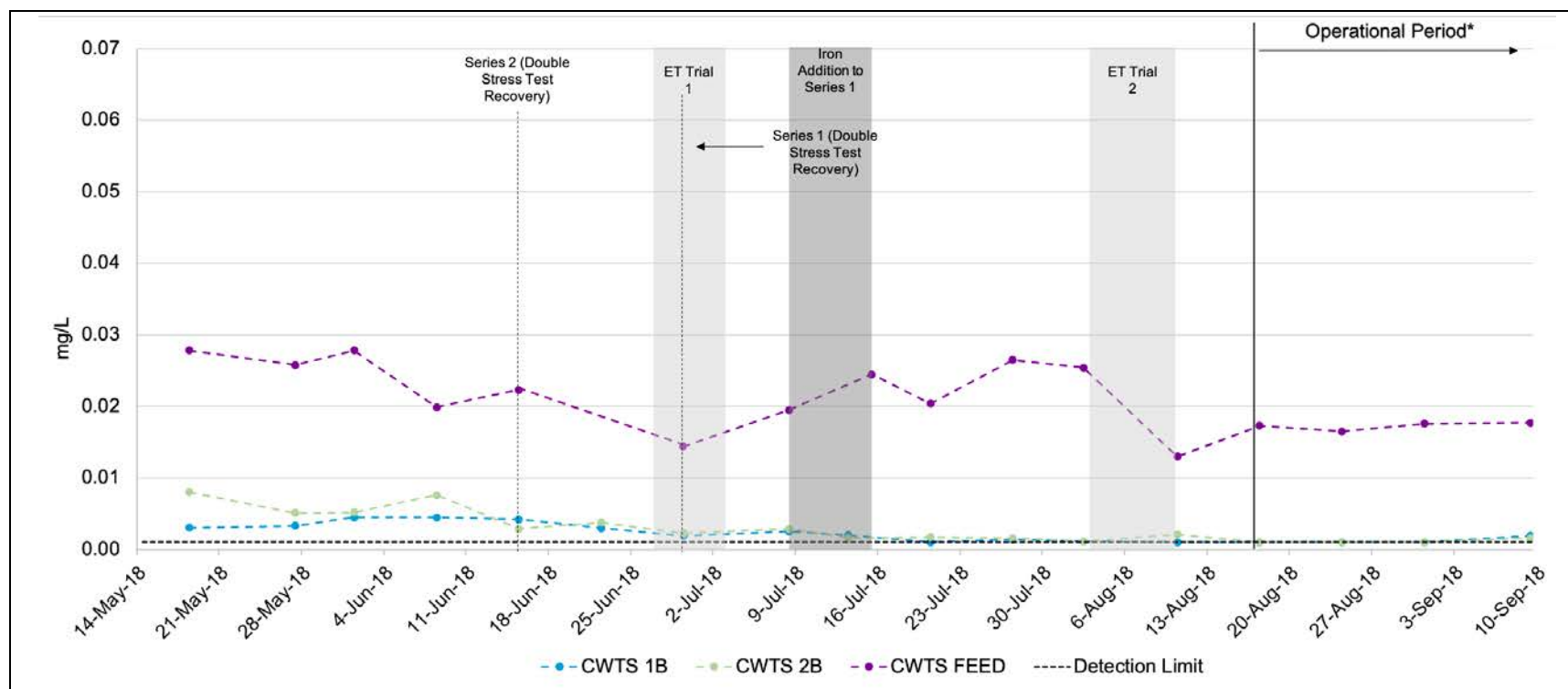


Figure 12 – Dissolved zinc concentrations in the demonstration-scale CWTS in 2018.

‘*’ – The operational period refers to the time period when all COCs in Series 2 (no iron added) were being treated. However, zinc recovered before this date (Table 7). The ALS detection limit for zinc is 0.001 mg/L. ET – evapotranspiration. Flow to the CWTS was shut off for the addition of iron to cells 1A and 1B on July 8, 2018. Flow was restarted on July 15, 2018. Data from June 22, 2018 was removed as the total zinc was higher than dissolved.

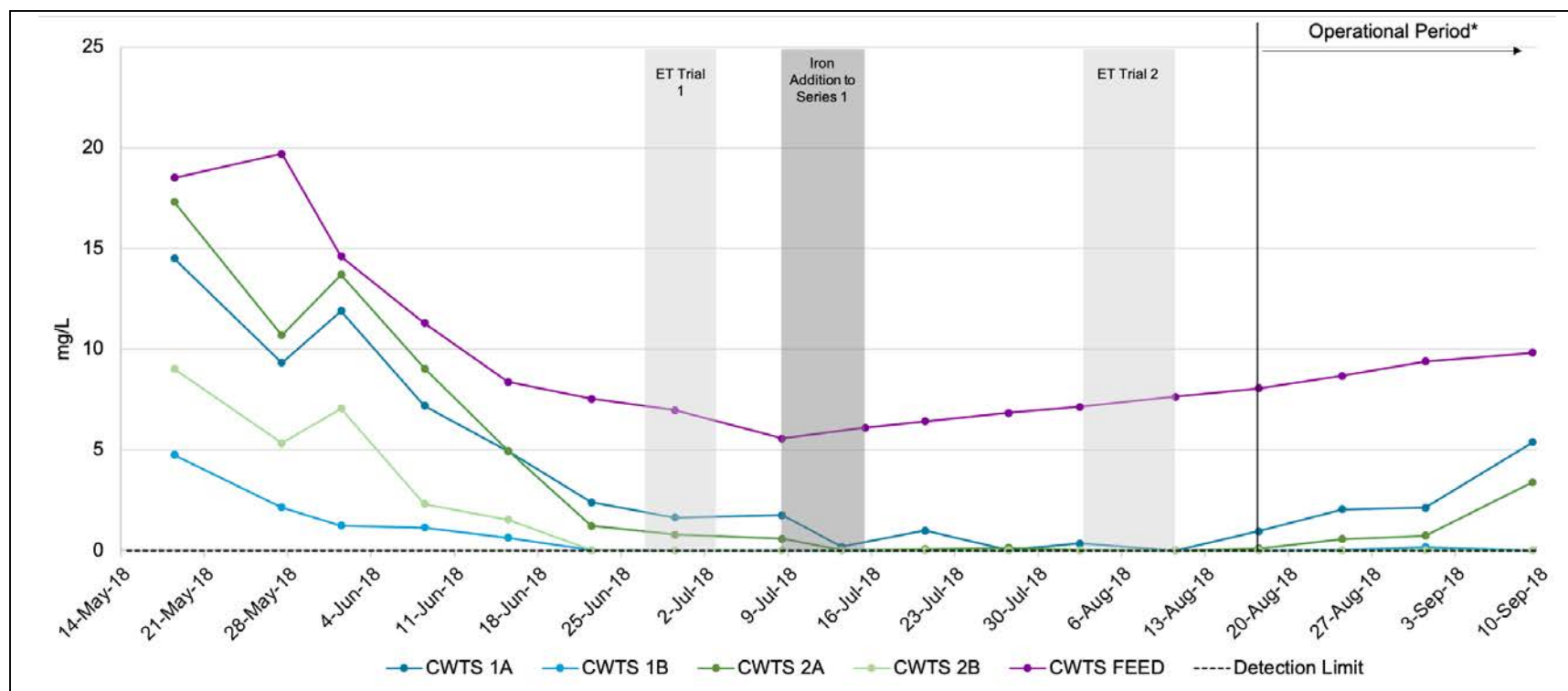


Figure 13 – Nitrate as N concentrations in the demonstration-scale CWTS in 2018.

The ALS detection limit for nitrate is 0.025 mg/L. ET – evapotranspiration. Flow to the CWTS was shut off for the addition of iron to cells 1A and 1B on July 8, 2018. Flow was restarted on July 15, 2018.

4.3 Hydraulic Retention Time

The operational hydraulic retention time (HRT) of the demonstration-scale CWTS for 2018 was calculated for each series using Equation 1. Equation 1 uses the flow rate (Q) from the operational period and the actual depth of each CWTS cell. The actual depth is calculated using the measured depths (an average of two depth sticks in each cell and, therefore, depths may vary) and a water depth correction factor of 0.01 meters determined from the tracer study conducted in 2017 (Contango, 2017b). Therefore, the average HRT for the operational period calculated separately for each series was 7.60 days and 7.09 days, for Series 1 and 2, respectively. The operational HRTs were then used in the calculation of removal rate coefficients in Section 4.4.2.

$\text{Operational HRT} = \frac{A \times \text{actual depth}}{Q}$
Equation 1 – Equation for calculation of hydraulic retention time. Operational HRT is the confirmed hydraulic retention time; A is the area of the CWTS; actual depth was calculated from the measured depth + 0.01 m correction factor; Q is the flow rate.

4.4 Treatment Effectiveness

Key findings (detailed below):

- The lowest concentrations consistently achievable for the treatment design (performance limits confirmed by t-test) were reached for cadmium after 3.80 days for Series 1 and 3.54 days for Series 2 and for copper after 3.54 days (Series 2 only).
- Removal rate coefficients (RRCs, *k*) have been developed that can be used for full-scale sizing.
- Copper leaching from soils decreased from the drought recovery period but is still likely making the RRC artificially low in this CWTS; however, the RRC is expected to improve in 2019 as leaching continues to decrease.

4.4.1 Performance Limit

The performance limit (referred to as thermodynamic minimum in previous reports) is the lowest concentration consistently achievable for a given treatment design and water chemistry. Once the performance limit is reached, making the CWTS bigger will not result in further decrease of outflow concentration (although outflow load may continue to decrease as water volume decreases through evapotranspiration). The performance limit was determined for each COC using the operational period, and were then also visually compared to the average concentrations of COCs at seven sampling locations throughout the CWTS from one time point during the operational period, to further evaluate and confirm whether concentrations appeared to have leveled off (Appendix B, Figures B5 to B9 for remaining COCs). Unfortunately, due to the double stress test, there were not enough time points in the operational period in 2018 for this data to be used in the statistical analyses to further refine the expected HRT for the performance limits. This can be refined in 2019, by varying flow rates.

Based on the results of the t-test for A cell and B cell concentrations, it was determined that the performance limit was achieved for dissolved cadmium (both series) and copper (Series 2 only), by the end of the A cells in the demonstration-scale CWTS. The detection limit was

reached for all except one timepoint during the operational period for cadmium by the outflow of cell A, suggesting that faster flows would be needed to accurately determine the HRT at which the performance limit was met. The performance limits for copper (Series 1 only), molybdenum, nitrate, selenium, and zinc were not yet statistically achieved, suggesting that a larger CWTS would achieve lower concentrations of these constituents (Appendix B, Figures B5 to B9). Results for copper should also be taken with consideration if leaching of residual copper from the soil continues, as there is more copper treatment ongoing than can be noted by just the water concentrations. However, by July 8, 2018, copper soil leaching had decreased (Section 4.2.1).

Interestingly, once nitrate, cadmium, and copper were treated, zinc, selenium and molybdenum begin to have an increase in treatment. This phenomenon is referred to as a treatment front, which generally abides by reaction orders (i.e., nitrate treatment before sulphate, sulphide exchange reaction kinetics, etc.; Morse and Luther III, 1999). Additionally, as selenium is easier to reduce than sulphate, it is often thought that selenium would be reduced before the remaining chalcophiles. However, due high concentrations of sulphate, sulphate and selenium reduction occurred concurrently (which is expected). Furthermore, due to copper leaching from soils, copper was not treated exclusively before other chalcophile metals, which would generally be expected in a full-scale CWTS with stable soils.

4.4.2 Removal Rate Coefficients

An important factor for CWTS design is the rate of treatment, also known as the removal rate coefficient (RRC; k). The RRC is based on the treatability of a specific compound and the HRT of the CWTS, both of which are site-specific based on water chemistry, CWTS designs, and characteristics of the CWTS. Information regarding calculation of RRCs can be found in previous reports (Contango, 2017b).

In pilot-scale testing specific for the Minto CWTS, the RRC for selenium was a zero-order reaction kinetic; however, optimizations of the operation of the system through the demonstration-scale commissioning enabled a first-order RRC to be maintained in 2017 (both series) and in Series 2 in 2018. The reaction kinetic of selenium in Series 1 was not reported as iron dosing in Series 1 temporarily changed the treatment mechanism and reaction order. Additionally, higher DO in cell 1A could affect microbial reduction of selenium, thereby changing the reaction kinetic (Section 0). Therefore, cadmium, copper, nitrate, selenium (Series 2), and zinc, are calculated as first-order kinetics, while molybdenum followed a zero-order kinetic. In other words, the reaction rate for molybdenum is a linear rate and does not depend on concentration, whereas the reaction rates for cadmium, copper, selenium (Series 2), zinc, and nitrate are proportional to concentration (a half-life type of reaction).

In 2017 and 2018, RRCs for cadmium and copper (Series 2 only in 2018) were calculated using outflow concentrations and HRT from the A cells as they had reached their performance limit at the end of A cells (Section 4.4.1; Table 9; Contango, 2017b). RRCs for the remaining COCs in 2017 were therefore calculated using outflow concentrations and HRTs from the B cells (Contango, 2017b; Table 9). Although the performance limit was not reached in the B cells for zinc (both series) and nitrate (Series 2), RRCs were calculated using outflow concentrations and HRTs from the A cells as outflow concentrations from the B cells were

consistently at the detection limit. The remaining constituents did not reach their performance limit and were not consistently at the detection limit in the A or B cell. Therefore, outflow concentrations and HRTs from the B cells were used. RRCs for selenium and nitrate for Series 1 were not calculated in 2018 as nitrate treatment in Series 1 was impacted by decreased plant growth and the addition of iron to Series 1 temporarily changed the treatment mechanism and reaction order for selenium. The RRCs were therefore not representative of what would be expected in a fully functioning system.

Table 9 – Cells used for removal rate coefficient calculations.

COC	2017		2018	
	Series 1	Series 2	Series 1	Series 2
Cadmium	A	A	A	A
Copper	A	A	B	A
Molybdenum	B	B	B	B
Selenium	B	B	-	B
Zinc	B	B	A	A
Nitrate	B	B	-	A
A cells were used if COCs reached their performance limit by the end of the A cell or were consistently achieving detection limit concentrations in the B cell. '-' indicates that an RRC was not calculated.				

An RRC was calculated for all COCs during the operational period (August 17 to September 9, 2018) which can be used to refine future sizing and performance estimations of a full-scale CWTS (Table 10). RRCs were then compared to the average RRCs calculated from another pilot-scale copper study completed in the Yukon and the demonstration-scale CWTS operational period of 2017 (Table 10). RRCs for cadmium in the 2018 demonstration-scale CWTS were depressed because flow rates did not provide the resolution needed to determine an accurate RRC. Additionally, RRCs for copper in the demonstration-scale CWTS are also depressed due to copper leaching from soils used in construction of the system. While the treatment rate for copper exceeded the leaching rate by August 17, 2018 (i.e., leaching was said to have subsided), it is likely that some copper continued to leach from the soils but was masked by increased performance of the CWTS. Therefore, the RRCs for copper are expected to continue to improve in 2019. In general, RRCs are generally similar to those in 2017 (Table 10; Contango, 2017b). Treatment of molybdenum is notable as the RRC nearly doubled in 2018 compared to 2017. The RRCs applied here are intended to be conservative estimates for conceptual sizing purposes and will need to be refined through further demonstration-scale (on site) testing.

Table 10 – Removal rate coefficients (k) for constituents of concern.

COC	Pilot ¹ $k \cdot \text{day}^{-1}$	Other Yukon Cu Pilot $k \cdot \text{day}^{-1}$	2017 Demonstration ² (Operational) $k \cdot \text{day}^{-1}$		2018 Demonstration ³ (Operational) $k \cdot \text{day}^{-1}$		Recommended ⁴ $k \cdot \text{day}^{-1}$
	Total	Dissolved	Dissolved	Total	Dissolved Series 1	Dissolved Series 2	Dissolved
First order removal rate coefficients							
Cd	1.14	0.50	>0.52 ⁵	>0.23 ⁵	>0.42 ⁵	>0.41 ⁵	0.47
Cu	1.17	0.50	>0.31 ⁶	>0.14 ⁶	>0.22 ⁶	>0.35 ⁶	0.29
Mo	0.101	N/A	N/A	N/A	N/A	N/A	N/A
Se	N/A	0.46	0.32	0.31	N/A	0.29	0.30
Zn	1.14	0.48	0.51 ⁶	0.39 ⁶	0.57	0.45	0.51
Nitrate	0.56	N/A	0.59	N/A	- ⁷	0.57	0.58
Zero order removal rate coefficients							
Mo	N/A	N/A	0.0006	0.0006	0.0011	0.0010	0.0010
Se	0.0018	N/A	N/A	N/A	- ⁸	N/A	N/A
N/A – an RRC is not available. All RRCs are for first-order reaction kinetics except for molybdenum in the 2017 & 2018 demonstration-scale CWTS, which has a zero-order reaction rate kinetic. The A cells were used for RRC calculations for cadmium and copper for Series 1 and 2 in 2017 and cadmium and zinc in 2018. Additionally, the A cells were used for RRC calculations for Series 2 in 2018 only, as well as for copper and nitrate. The B cells were used for all other RRC calculations. ¹ Values calculated from data in Contango, 2014b (pilot-scale report) for <i>C. aquatilis</i> + moss with low nitrogen scenario. ² Analytical results from August 18 – September 22, 2017 were used. ³ Analytical results from August 18 – September 14, 2018 were used. ⁴ Recommended RRCs are developed from averaged dissolved concentrations of 2017 & 2018 demonstration-scale CWTS operational periods. This is a modification and correction to the erroneous dissolved recommended RRCs as reported in Table 5 of the 2017 Demonstration-Scale Report (Contango, 2017b). ⁵ RRCs for cadmium in 2017 and 2018 were artificially low because low flow rates did not provide the resolution needed to determine a RRC, so the lowest potential k value based on available data is reported here. The available data had 100% and 75% of sample points at the detection limit in 2017 and 2018 respectively. ⁶ RRC's for copper in demonstration-scale CWTS are artificially low due to copper leaching from soils used in construction of the system. Therefore, RRCs are expected to improve once leaching has subsided. ⁷ An RRC was not calculated for NO_3 in Series 1 due to extensive plant damage and less NO_3 being used as a nutrient. ⁸ An RRC was not calculated for selenium in Series 1 due iron addition temporarily changing the treatment mechanism and reaction order.							

4.5 Evapotranspiration in the Demonstration-Scale CWTS

Key findings (detailed below):

- The 2018 evapotranspiration trials were unsuccessful due to precipitation throughout each trial; however, the 2017 trials revealed a significant loss of water, which will impact calculations of loads to the receiving environment (making them lower than previously estimated).
- Unlike 2017 trials, leaching of copper was not observed during periods of no flow in 2018, indicating copper leaching has improved.

Total evapotranspiration from the system is the combined effects of open water evaporation and plant transpiration and is further described in previous reports (Beebe et al., 2014; Contango, 2017b). The purpose of calculating the evapotranspiration of a system is to understand the amount of water lost, which in turn concentrates elements measured at the outflow. Thus, the actual outflow load reduction performed by the wetland should consider the difference in concentration at outflow, corrected for evapotranspiration. Due to significant precipitation during each evapotranspiration trial conducted in 2018 (two trials total), we were unable to calculate an evapotranspiration rate. Therefore, the rate of water lost by evapotranspiration determined in 2017 (5.4 L/m²/day) was used to adjust load removal calculations as previously described (Contango, 2017b). The average ambient temperature on-site for this time period was 9.2°C, and so the evapotranspiration rates from the 2017 trials (average ambient temperature of 9.6°C during the first evapotranspiration trial in 2017) are expected to be relevant to the operational period in 2018.

Evapotranspiration has shown to have a significant effect on the calculation of constituent load to the receiving environment (Table 8). Therefore, future models for assimilative capacity in the downstream receiving environment should take into account not only the predicted outflow concentrations from the CWTS using removal rate coefficients (Section 4.4.2), but also adjust the load accounting for evapotranspiration.

4.6 Soils

Key findings (detailed below):

- In 2018, leachable copper concentrations in soils decreased in the top 0-10 cm while total copper concentrations were within ranges previously measured.
- Most constituents, including copper, have shifted primarily into stable reduced and residual minerals fractions in the soil.
- Acid volatile sulphides (AVS) provide buffering capacity to the soils and continued treatment through cold temperatures. AVS concentrations have been non-detectable in the CWTS due to low iron concentrations in substrates and water. While a small amount was detected in 2017 and 2018, Series 1 was amended with iron in attempt to improve AVS concentrations.
- While Series 1 was amended with iron, it is unclear if the addition of iron was sufficient to increase AVS concentrations, but it is planned to add more in 2019.

Although unintentional, the high initial leachable copper concentrations in the CWTS soils allowed for additional testing to be carried out on the CWTS (Appendix B, Table B1, and B2). Results of these test methods during the operational period are discussed in the following sections, while definitions of extractable fractions from the sequential extraction procedure for the speciation of metals can be found in Appendix B, Table B3 (Tessier et al., 1979).

When compared to early 2016 and 2017 results, leachable copper concentrations in soils decreased in the CWTS through 2018 (Figure 14), while total copper concentrations remained within ranges previously measured. In general, soils in the demonstration-scale CWTS continued to reduce leachable copper throughout 2018. Additional soil sampling locations and more frequent sampling is recommended in 2019 to confirm that copper leaching from the soils has stopped.

Sequential extraction analysis shows that despite elevated initial leachable copper concentrations, the soils have become more stable (less leachable) over time in the CWTS setting as the soils have aged, shifting from oxidized to reduced, mineral forms (Figure 15; Appendix B, Figures B10 and B11). This beneficial aging of soils to a less soluble mineralized form of sulphide is expected for this type of treatment CWTS design (Contango, 2017b). It should also be noted that copper leached from the original substrate into the water and therefore put additional treatment demands on the CWTS.

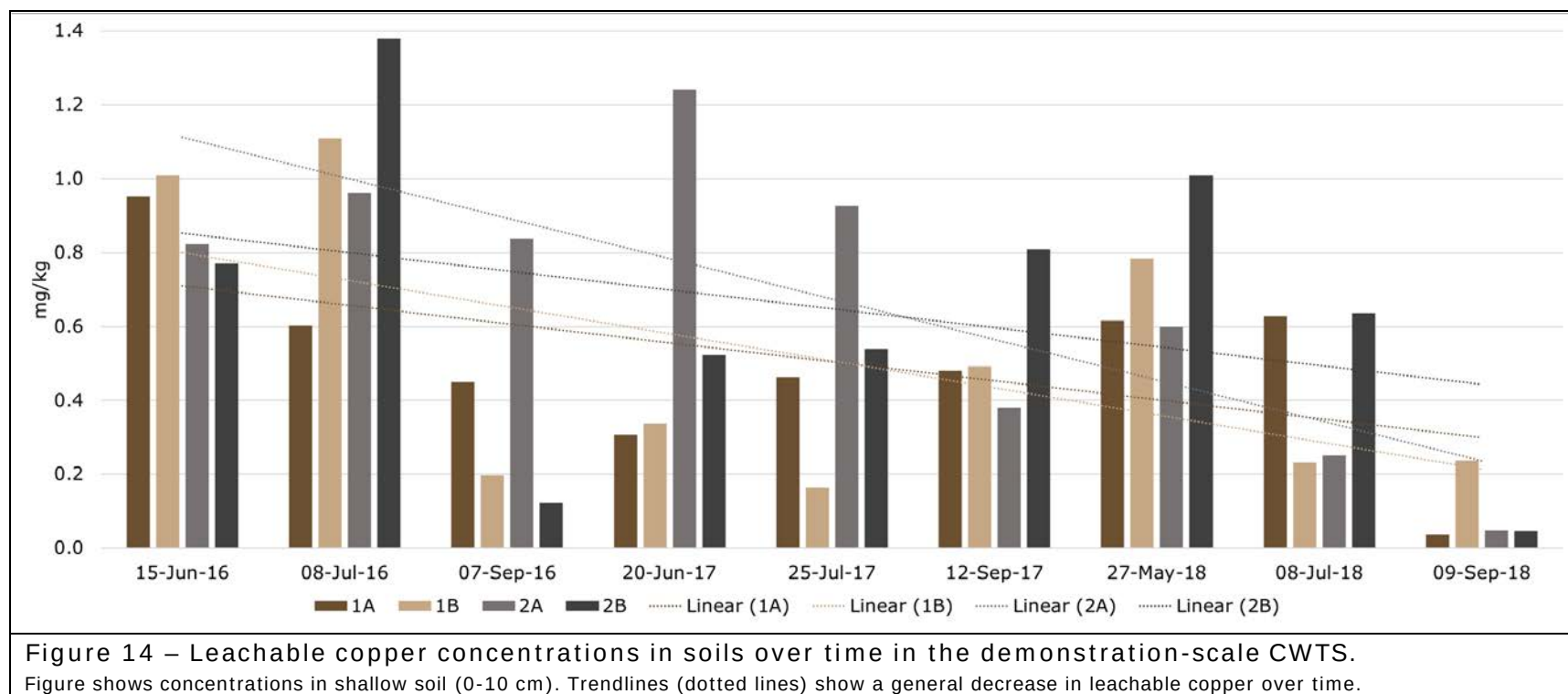
Additional reserve treatment capacity can be stored in a CWTS through creation of a reserve of AVS (newly formed amorphous iron sulphides; Contango, 2017b). An excess of AVS suggests the metals would be non-bioavailable and not likely to leach. In the case of Minto, where the soils used in construction had excess copper, the appearance of measurable AVS would also indicate that the copper in the soils is nearing an endpoint of transformation to sulphide forms.

AVS has not been measured in desired concentrations in the demonstration-scale CWTS (small amounts measured in 2017 for the first time; Contango, 2017b) as much of it was used to sequester total copper in the copper-rich soils. AVS can also serve as a buffer to

oxidation should the soils of a reducing (sulphide producing) CWTS be exposed to oxygen (e.g., briefly drying out), thereby making sequestered metals less likely to re-solubilize. Therefore, iron was added to Series 1 in 2018 to create excess AVS to combat impacts of the drought in early 2018. However, only small amounts of AVS were measured in cell A in both series (September), indicating that the added iron was not sufficient to treat constituents in the water, as well as produce AVS. As ratios of simultaneously extractable metals to AVS (Σ SEM:AVS) were similar in both series, it is unclear if the addition of iron increased AVS in cell 1A. However, as there was an observed difference in treated copper between Series 1 and 2 after the addition of iron (i.e., treatment was better in Series 1), it is recommended that iron be stoichiometrically added in 2019 (Section 4.2.2).

In October 2018, Σ SEM:AVS ratios for cells 1A and 2A increased to greater than one, indicating AVS depletion in the colder temperatures due to decreased microbial activity. As leachable copper in the soils is still consuming the sulphides, treatment performance is expected to improve as copper is transformed into more stable fractions. Once the Σ SEM:AVS ratio of all cells is consistently less than one, we do not expect any further copper leaching to occur, and overall treatment within the CWTS should improve until this benchmark is reached.

Zinc mineral forms have become stable over time, with most of these constituents found in the reduced or mineral form (fraction 4 and 5) by the end of 2018 (Appendix B, Figures B12 and B13). Cadmium concentrations are at or near detection limits for all fractions (Appendix B, Figures B14 and B15). Molybdenum was mostly found in the most stable residual mineral fraction 5, which contained around 40% of the total molybdenum in the samples (Appendix B, Figures B16 and B17). Selenium was at or near the detection limit for all fractions at the end of 2018 (Appendix B, Figures B18 and B19).



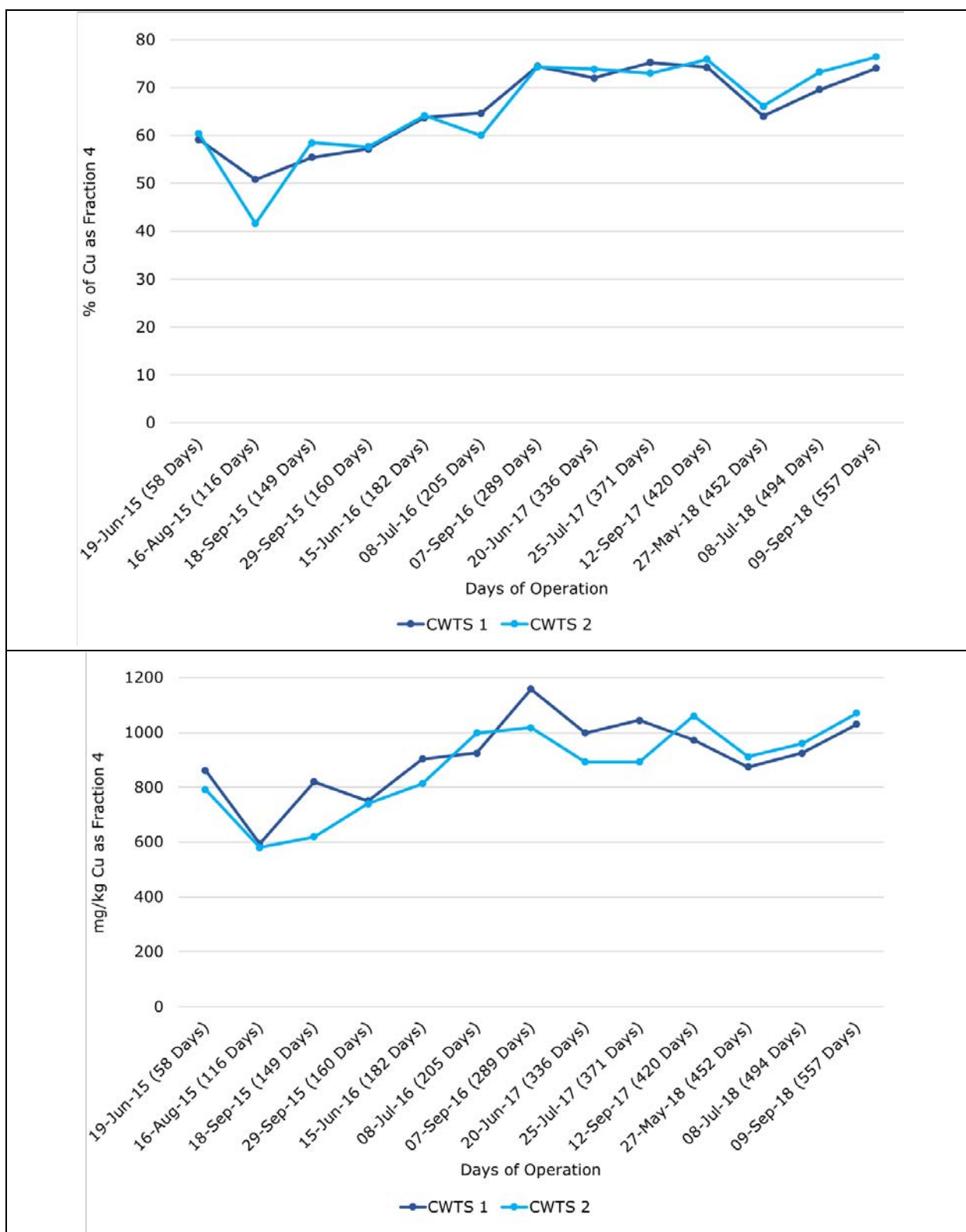


Figure 15 – Copper as sequential leach fraction 4 over time.

Copper in the form of the targeted Fraction 4 (sulphide mineral form and bound to organics), increased in the CWTS over time as the soils matured. Additional information can be found in Appendix B.

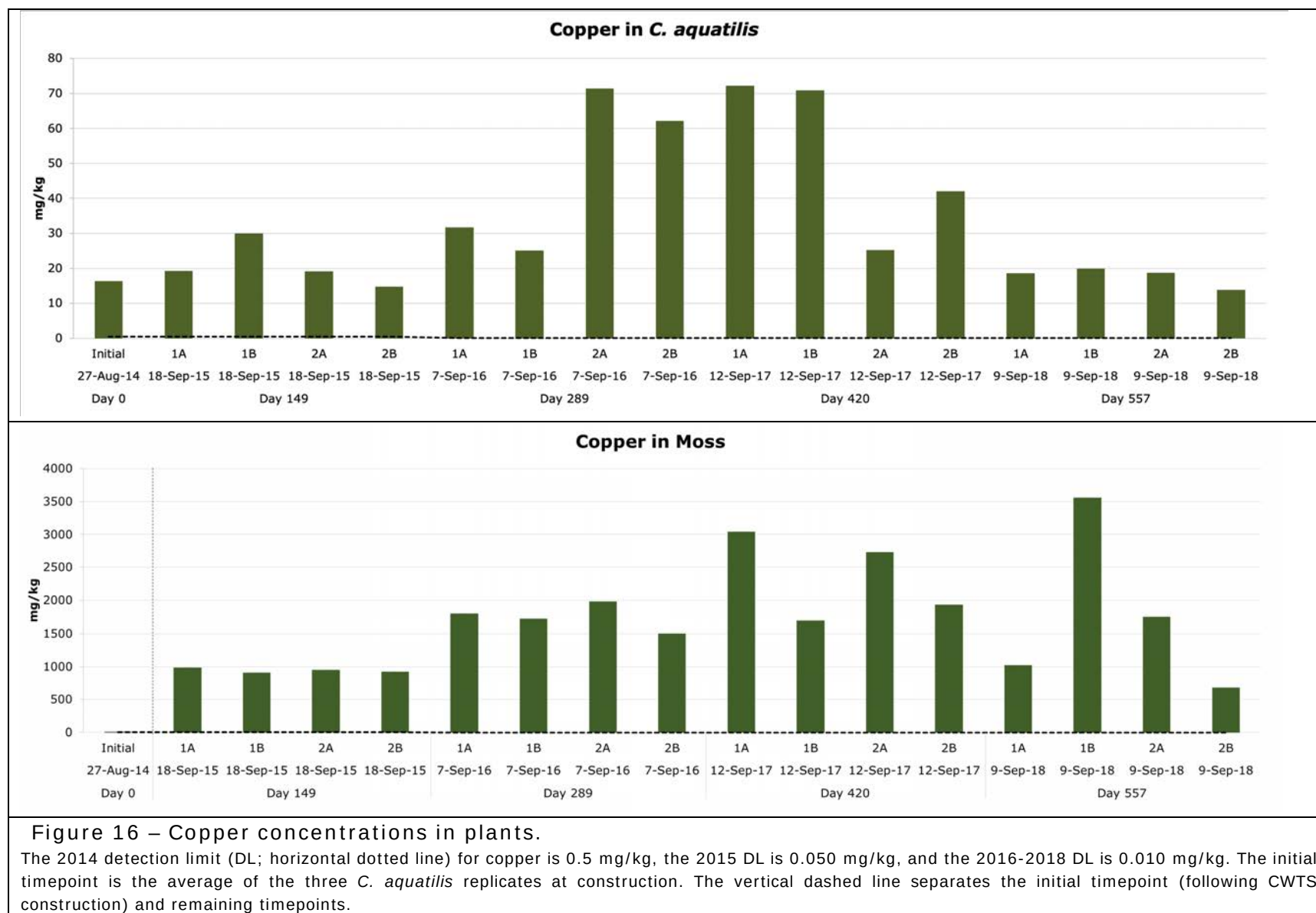
4.7 Metals Uptake

Key findings (detailed below):

- Overall, uptake of metals in *C. aquatilis* was low and generally lower in 2018 than in 2017 demonstration-scale CWTS, with the exception of selenium in cell 1A which was slightly higher in 2018.
- Targeted treatment mechanisms are becoming more robust, rendering elements non-bioavailable.

Concentrations of the COCs in *C. aquatilis* and moss from the demonstration-scale CWTS in 2018 were compared to previous years. *C. aquatilis* and moss in the demonstration-scale CWTS, from 2015 to 2018, had greater copper concentrations than the pilot CWTS, likely reflecting the bioavailable copper that was in the soils used for construction (Contango, 2014b). Concentrations of copper in *C. aquatilis* at the end of 2018 were similar or lower than 2016 and 2017 concentrations (Figure 16), indicating reduced copper bioavailability. In 2017, the moss had higher copper concentrations in the A cells than in the B cells, indicating more treatment earlier in the CWTS as it matures (Figure 16). In 2018, however, the copper sorbed to moss was lower than in 2017 with the exception of cell 1B. Over time, constituents sorbed to mosses will form reduced minerals, rendering them less bioavailable.

Cadmium concentrations in *C. aquatilis* and moss were similar or lower in 2018 compared to 2017, except for higher concentrations in moss in cell 1B (Appendix B, Figure B20). Similar or higher selenium concentrations were observed in *C. aquatilis* in 2018 as in 2017, however, similar or lower selenium concentrations were sorbed to moss (Appendix B, Figure B21). Concentrations of molybdenum in moss generally increased from 2017 to 2018 with the exception of cell 1A, indicating more molybdenum was treated through sorption in 2018. Concentrations of molybdenum in *C. aquatilis* were similar or decreased (Appendix B, B22). In 2018, concentrations of zinc were generally similar in *C. aquatilis* from 2017 (Appendix B, Figure B23); however, uptake in *C. aquatilis* was higher in cell 1A. As moss in cell 1A was sparse compared to other cells, it is likely that more zinc was taken up by plants to accommodate the lower sorption area available in 2018. Concentrations of zinc were similar or lower in moss from 2017, except for cells 1B in where concentrations of zinc increased. It is recommended that more moss be added to cell 1A in 2019 to provide area for sorption of COCs.



4.8 Pesticide Application (and Monitoring of Aphids)

Key findings (detailed below):

- An aphid infestation occurred in 2016 and 2017. While some efforts were made in 2017 to control the aphid population, the spraying regimen was not maintained and, therefore, aphids remained. However, no long-term detrimental effect on *C. aquatilis* viability was observed, despite the persistence of aphids.
- In 2018, early and consistent application of insecticidal soap greatly reduced the abundance and length of an aphid infestation as well as improved containment of the aphids.
- Pesticide application is not expected to be needed in the full-scale CWTS as it will not be in an isolated location (Contango, 2017b).

Since the demonstration-scale CWTS is constructed of an emergent macrophyte monoculture of *C. aquatilis* in a relatively isolated area (i.e., away from other vegetation and potential sources of insects), it is more susceptible to infestation by pests such as aphids (Dixon, 1971; Riley et al., 1995; Footitt and Maw, 1997; Contango, 2017b). Furthermore, due to its isolated location, the CWTS it is unlikely to attract predatory insects such as ladybugs, lacewings, and parasitic wasps to control aphid populations (Flint, 2001; Russel and Diaz, 2015; Finnamore, 1997; Contango, 2017b).

An aphid infestation of the CWTS occurred in 2016 and 2017 and, while efforts were made in 2017 to control population (through application of insecticide), the ongoing spraying regimen was not maintained and aphids remained. However, no short-term detrimental effect on *C. aquatilis* viability was observed. Therefore, due to the aphid infestation in 2017, vegetation was replanted in areas with sparse *C. aquatilis* on July 8, 2018. The stronger insecticidal soap (Trounce's Yard and Garden Insecticide) was applied biweekly starting May 14, 2018 and switched to Safer's End-All insecticidal soap on July 16, 2018 (when Trounce ran out at site). This treatment was effective until early August 2018 (exact date unknown) when aphids appeared in cell 2A only. To control the aphid population in cell 2A and to protect the other cells, insecticidal soap was then applied to all cells on a weekly schedule (starting August 24, 2018). The applied insecticide was switched to Scott's EcoSense Bug B Gone on September 21, 2018 when End-all ran out at site. By September 24, 2018, live aphids were no longer observed in cell 2A. Therefore, early application of insecticidal soap greatly reduced the abundance and length of an aphid infestation as well as improved containment of the aphids. In 2019, it is recommended to continue applying Trounce's Yard and Garden Insecticide early in the season on a biweekly schedule, as well as to ensure enough Trounce is supplied on site for the year (approximately 100 L).

While the demonstration-scale CWTS has experienced aphid infestations, this is not expected to occur in the full-scale CWTS and minimal insect control is expected (Rodgers et al., 2002). The full-scale CWTS will be built in an area with surrounding vegetation, thereby providing habitat for natural predators of aphids. With the demonstration CWTS currently located 50 m away from trees or other vegetation, there is little to no opportunity for natural predators to inhabit the area or incentive to travel the distance to the CWTS. The large buffer area

(MVFE) around the demonstration-scale CWTS allows the aphids to colonize more robustly than anticipated in the full-scale CWTS onsite, which would not have the same buffer zone.



Figure 17 – Aphids observed on *C. aquatilis* of cell 2A.
Presence of aphids on *C. aquatilis* leaves observed in August 2018.

4.9 Detritus Study

Key findings (detailed below):

- Decomposition of *C. aquatilis* is occurring in the CWTS and contributing to reducing conditions.
- Only partial decomposition of total *C. aquatilis* biomass from the previous year is occurring in an operational season, resulting in an accumulation of organic matter over time (accretion) which is an important process in the CWTS as it buries treated minerals making them more stable.
- Decomposition of *C. aquatilis* occurs quickly when initially submerged in the CWTS with 56% decomposition occurring after 34 days. Decomposition slows overtime with an average of 85% decomposition occurring after 446 days (including one winter season/freezing period).

The detritus study initiated in 2017 was continued through 2018 to assess decomposition rates of *C. aquatilis* in the CWTS over time as well as to determine the steady state of carbon contribution from algae growth on CWTS materials (Chimney and Pietro, 2006; Hammerly et al., 1989). Additional details describing the methods can be found in Appendix A. The study began on June 21, 2017 when six bags of oven dried *C. aquatilis* and six of polyester filter fiber material were submerged into each cell of the CWTS to determine the algae growth rate (Figure 18).

On July 25, 2017, September 11, 2017, July 9, 2018, and September 10, 2018 (after 34, 82, 383, and 446 days of submersion in the CWTS, respectively) one bag filled with *C. aquatilis* and one bag with the polyester fiber were sacrificed from each CWTS cell and the dried weights compared to initial sample weights. This resulted in four replicates for each treatment and sampling date.

The results show that decomposition occurs quickly immediately after *C. aquatilis* is submerged into the CWTS, with 56% decomposition occurring after 34 days. This detritus decomposition rate (and all other decomposition rates discussed herein) has been adjusted for by subtracting the weights of algal growth from the corresponding polyester fiber filled bag (Table 11). After 82 days (on September 11, 2017), 64% of *C. aquatilis* had decomposed and is representative of the decomposition that would be expected after one operational season of the CWTS (i.e., from start up in the spring to shut down in the fall). This suggests that the plant material is successfully being broken down in the CWTS promoting reducing conditions. Additionally, as plant material did not completely decompose after 446 days, this suggests that accretion in the wetland is also occurring as it indicates more organics are produced in a year than decomposes. This accretion, which is the gradual accumulation of additional layers of organic matter, aids in building new soils in the CWTS. Accretion is an important process in the CWTS as it buries treated minerals making them more stable and maintains low overall concentrations of metals.

Three bags of each material remain in each cell for future sampling. The detritus study will continue in 2019 to continue monitoring decomposition and accretion rates over time.



Figure 18 – Detritus study bags.

Left are mesh bags filled with sedges and polyester fiber fill stuffing in 2017, prior to submersion in the CWTS (June 21, 2017). Right is a mesh bag with decomposed sedges and polyester fiber fill stuffing on July 8, 2018.

Table 11 – Results of the 2018 *C. aquatilis* detritus study.

Days since beginning of study	Decrease in weight of <i>C. aquatilis</i> through decomposition ¹								Average Decomposition					
	1A		1B		2A		2B		A Cells		B Cells		All Cells	
	g	%	g	%	g	%	g	%	g	%	g	%	g	%
2017														
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	2.9	57	2.7	54	2.9	59	2.6	52	2.9	58	2.7	53	2.8	56
82	3.3	65	3.0	61	3.3	67	3.1	63	3.3	66	3.1	62	3.2	64
2018														
383	3.8	76	1.7	34 ²	4.8	96	3.2	64	4.3	86	2.5	49	3.4	68
446	5.5	Full decomposition	3.9	78	4.9	97	3.3	66	5.2	99%	3.6	72	4.4	85
Initial weight of bags prior to being placed in CWTS was 5 g.														
¹ Weight decrease of <i>C. aquatilis</i> corrected by subtracting the increase in weight from the polyester fiber fil to account for algae growth.														
² May have been affected by more algae growth than on control bags.														

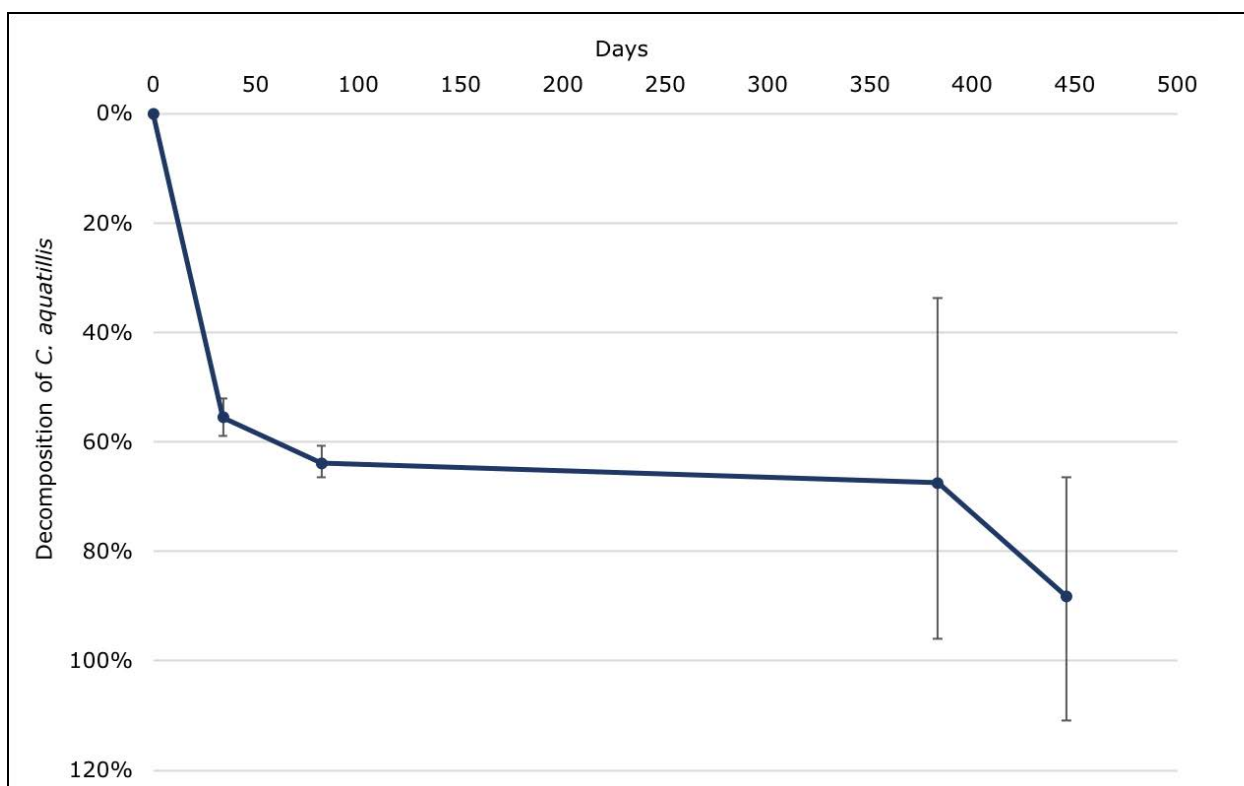


Figure 19 – *C. aquatilis* decomposition over time.

Decomposition was measured by the decrease in weight over time of the *C. aquatilis* samples compared to the initial weight. The decomposition rate was corrected for algae growth by subtracting the increase in weight of the polyester filter foam from the dry weight of the *C. aquatilis* samples over time. Error bars indicate the variation in results for each time point.

4.10 Vegetation Productivity Study

Key findings (detailed below):

- The *C. aquatilis* in the CWTS produced 0.802 kg/m² (dry weight) of above water biomass per year.
- This same amount of dry biomass should be supplemented to the full-scale CWTS (e.g., as straw) while going through maturation and filling in with vegetation for first 1-3 years after initial planting to expedite commissioning.

A 1 m² plot of above water *C. aquatilis* was harvested in 2018 (Appendix A, Section A6.7) to determine the amount of organic matter that is input into the wetland each year. The tests indicated that approximately 0.802 kg/m² (dry weight) of above water biomass is produced by the *C. aquatilis* per year. This same amount of dry biomass should be supplemented to the full-scale CWTS (e.g., as straw) while going through maturation and filling in with vegetation for first 1-3 years after initial planting to expedite commissioning.

4.11 Beneficial Microbes

Key findings (detailed below):

- Similar to 2017, root samples harboured the highest abundances of sulphide-producing bacteria (SPB), selenium-reducing bacteria (SeRB), and denitrifying bacteria in 2018.
- Microbial communities were not affected by the double stress test period, with the exception of SPB in roots, where proportions were lower following the drought. However, by the end of 2018, proportions of SPB in roots increased to levels measured in the 2017 operational period.

4.11.1 Sulphide-producing Bacteria

Sulphide production is a key biogeochemical mechanism for water treatment in the CWTS at Minto Mine and is carried out by sulphide-producing bacteria (SPB) through the reduction of sulphur-containing compounds. These SPB thrive in anaerobic conditions with soil redox ranges between -100 and -250 mV (Contango, 2015b; Mitsch and Gosselink 2007). In these redox ranges, bacterial sulphide-production through reduction of sulphur compounds is expected, alongside increases in the proportion (percentage) and abundance of these microbes. Further information regarding these mechanisms can be found in the Minto Demonstration-scale 2017 Update Report (Contango, 2018).

Diversity of SPB in all sample types (soil, roots, moss, and detritus) was generally similar to the 2017 operational period, where soil harboured the highest number of SPB, followed by root and detritus, then moss (Table 12).

Table 12 – Average number of different types of sulphide-producing bacteria in 2014/2015, 2016, 2017, and 2018.

Sample Type	2014 & 2015	2016	2017	2018
Detritus	NT	11	16	15
Moss	11	9	15	14
Root	11	13	14	15
Soil	13	17	18	17

NT – not tested. The number of different types is based on counting the number of operational taxonomic units (clustered at 97% identity) that are classified as known sulphide-producing bacteria. Organism classifications and data analysis methods have been updated from previous memo (Contango, 2017b). Therefore, additional bacteria were identified as sulphide-producing bacteria in historical samples at Minto and numbers presented herein are higher than those reported in the Minto Demonstration-scale 2017 Update Report (Contango, 2018).

Proportions of SPB in root, detritus, and moss, were generally similar to 2017, while SPB in soils were similar to or higher than 2017 (Figure 20). Proportions in *C. aquatilis* roots were initially lower than 2017 but increased to within 2017 ranges (Figure 21), while inferred abundances remained stable (Appendix B, Figure B24). Lower initial proportions of SPB indicates that roots were likely more impacted by the initial drying out of the CWTS in the early spring/freshet but began to recover by September. However, on average, roots harboured the highest inferred abundances of SPB (followed by detritus, moss, and soils; Appendix B, Figure B24). Proportions and inferred abundances of SPB in detritus were more variable within the different cells but generally remained within ranges observed in 2017 (Figure 22; Appendix B, Figure B24).

Proportions of SPB in moss in July were similar to 2017, while proportions in September were substantially lower (Figure 23). Inferred abundances of SPB in moss in September were also lower than July, however, they were within ranges observed in 2017. While sampling methods for moss requires a composite of the top (oxidizing zones) and bottom (sulphide reducing zones; Section 2.6.2) of moss, it is possible that samples collected in September contained more of the top of the moss than the bottom where SPB would be expected to thrive.

The microbial analysis of various sample types in the CWTS therefore indicates that despite the drought, SPB proportions and inferred abundances were able to recover in most sample types and diversity of SPB was unaffected by the double stress test. Soil redox and microbial populations will continue to be monitored for stability or further improvement in 2019. Additionally, a sampling procedure will be provided to Minto staff in 2019 to ensure consistency of sampling methods, particularly for moss.

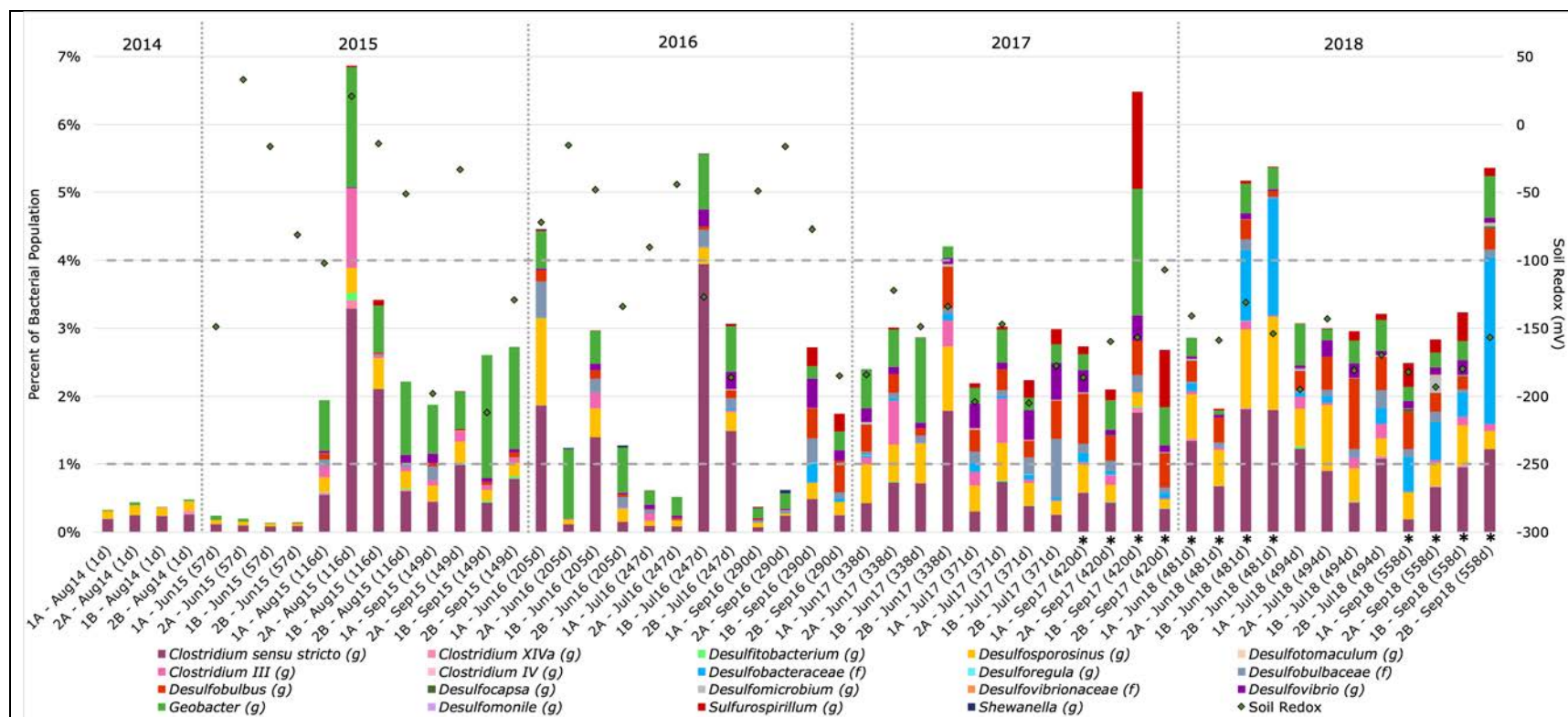
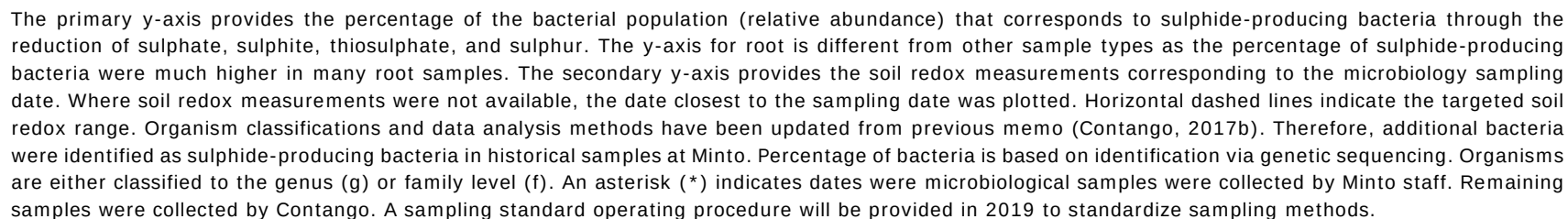


Figure 20 – Percentage and identity of sulphide-producing bacteria in soil and corresponding soil redox measurements.

The primary y-axis provides the percentage of the bacterial population (relative abundance) that corresponds to sulphide-producing bacteria through the reduction of sulphate, sulphite, thiosulphate, and sulphur. The secondary y-axis provides the soil redox measurements corresponding to the microbiology sampling date. Where soil redox measurements were not available, the date closest to the sampling date was plotted. Horizontal dashed lines indicate the targeted soil redox range. Organism classifications and data analysis methods have been updated from previous memo (Contango, 2017b). Therefore, additional bacteria were identified as sulphide-producing bacteria in historical samples at Minto. Percentage of bacteria is based on identification via genetic sequencing. Organisms are either classified to the genus (g) or family level (f). An asterisk (*) indicates dates where microbiological samples were collected by Minto staff. Remaining samples were collected by Contango. A sampling standard operating procedure will be provided in 2019 to standardize sampling methods.



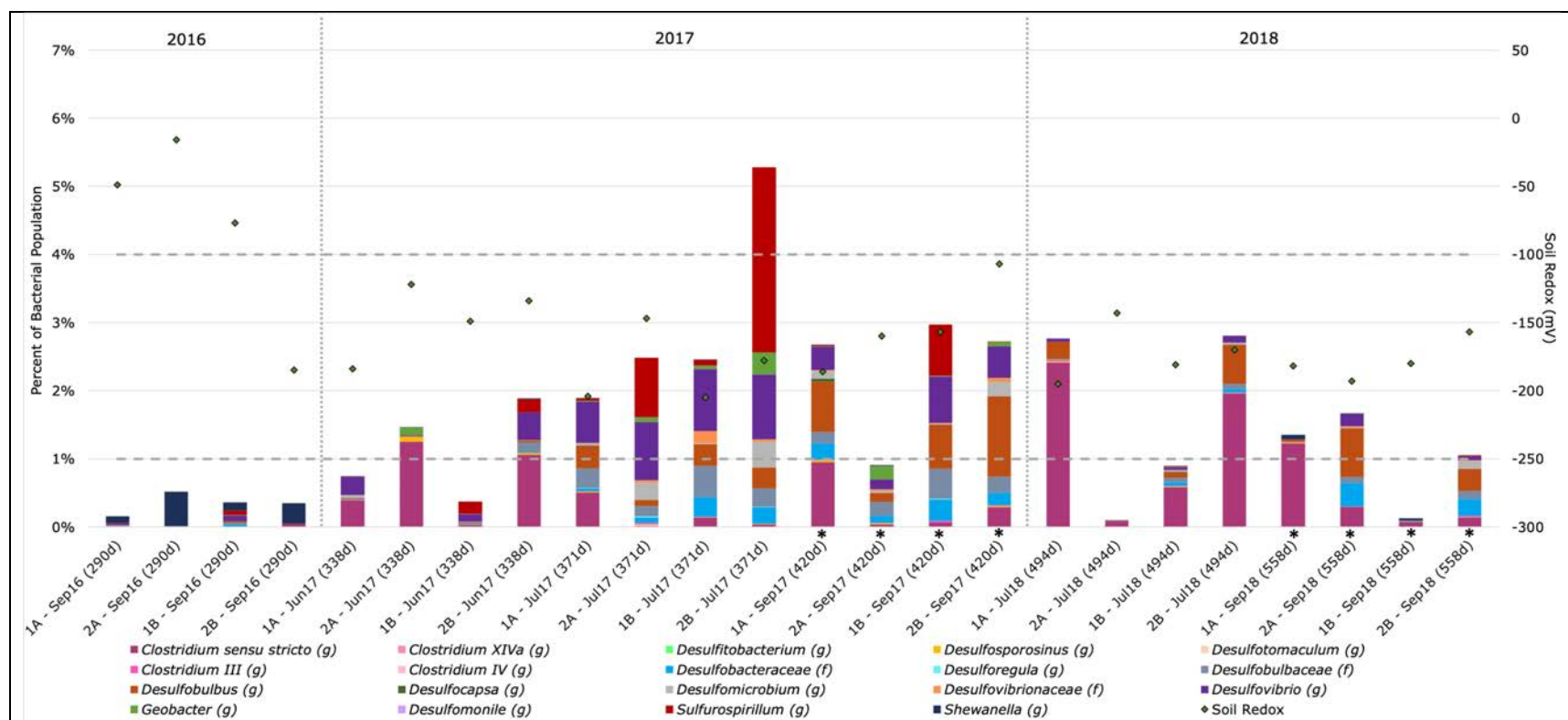


Figure 22 – Percentage and identity of sulphide-producing bacteria in detritus and corresponding soil redox measurements.

The primary y-axis provides the percentage of the bacterial population (relative abundance) that corresponds to sulphide-producing bacteria through the reduction of sulphate, sulphite, thiosulphate, and sulphur. The secondary y-axis provides the soil redox measurements corresponding to the microbiology sampling date. Where soil redox measurements were not available, the date closest to the sampling date was plotted. Horizontal dashed lines indicate the targeted soil redox range. Organism classifications and data analysis methods have been updated from previous memo (Contango, 2017b). Therefore, additional bacteria were identified as sulphide-producing bacteria in historical samples at Minto. Percentage of bacteria is based on identification via genetic sequencing. Organisms are either classified to the genus (g) or family level (f). An asterisk (*) indicates dates were microbiological samples were collected by Minto staff. Remaining samples were collected by Contango. A sampling standard operating procedure will be provided in 2019 to standardize sampling methods.

4.11.2 Selenium-reducing Bacteria

The targeted selenium treatment pathways in the Minto CWTS include direct reduction in the water column of selenate (Se(VI)) to selenite (Se(IV)) and sorption to moss, detritus, and soils, and subsequent microbial reduction of soluble (sorbed) selenite (Se(IV)) to insoluble elemental selenium (Se (0)). This reductive process can also be achieved directly in the water column, but is more effective when associated with mosses and biofilms due to their sorptive properties that bring the selenium in contact with beneficial selenium-reducing bacteria (SeRB). Selenium reduction biogeochemical processes are achieved within the range of soil redox conditions targeted for sulphate-reduction as suggested by pilot-scale testing and literature (Contango, 2014b).

SeRB were detected in all sample types, with *C. aquatilis* roots harbouring the highest inferred abundances of SeRB on average in 2018, followed by moss, detritus, and soil (Appendix B, Figure B25). While analytical methods for quantification in 2018 and previous years are not directly comparable, inferred abundances of SeRB are generally similar or higher to abundances the operational period in 2017 (Contango, 2017b). The high inferred abundances of SeRB in the CWTS indicates that environmental conditions conducive to SeRB proliferation have been created within the CWTS. Moreover, the abundances of SeRB were unaffected by the CWTS drying out and remained stable over time in through 2018. SeRB will continue to be monitored through 2019 operation of the demonstration-scale CWTS.

4.11.3 Denitrifying Bacteria

Nitrate is not a COC however it is being evaluated as it has the potential to be elevated during operations and early closure owing to residuals from blasting activities. Even if not in exceedance of water quality guidelines in terms of receiving environment objectives, nitrate often requires treatment to subsequently achieve treatment of other constituents such as selenium and metals through sulphide production. Nitrate can be removed from water through denitrification by different types of microbes, including nitrate reducing bacteria which can reduce nitrate (NO₃) to nitrite (NO₂), and also denitrifying organisms that are capable of fully reducing nitrate to nitric oxide (NO), nitrous oxide (N₂O), and dinitrogen gas (N₂, which is the most abundant gas in air).

As observed in 2016 and 2017, denitrifying organisms were found associated with all sample types in the demonstration-scale CWTS (Appendix B, Figure B26). *C. aquatilis* roots harboured the highest inferred abundance of denitrifiers, followed by moss, detritus, and soil. These results indicate denitrifying bacteria were not affected by the drought and have continued to establish in the CWTS as expected. Denitrifying bacteria will continue to be monitored in 2019, alongside performance testing.

5. Summary of Results

When designed and implemented in a strategic and scientifically guided manner, a CWTS can treat many constituents in a predictable manner. The design incorporates processes to precipitate insoluble species of these constituents for sequestration into the soils of the wetland. This treatment mechanism captures the constituents and stores them in stable form in the soil. This study addressed several important operating considerations and provided new management tactics to recover from drought and high nitrate scenarios. A summary of key findings from the 2018 studies and recommendations to meet the objectives are listed in Table 13.

Table 13 – Key findings and corresponding section for 2018 demonstration-scale CWTS testing.

Key Finding	Section
▪ Dissolved oxygen (DO) increased during the double stress test period and operations in 2018. Elevated DO is likely the result of photosynthesis of algae, which had increased growth due to fertilizer addition. Despite the DO levels being in aerobic ranges, stable reducing conditions were achieved in CWTS soils within the targeted range. ▪ Other than the day that the CWTS was refilled (May 14, 2018), soil redox was unaffected by the drought. Average soil redox values were more reducing (and stable in the targeted range) in 2018 than 2017.	4.1
▪ While leaching of copper from substrates used in construction was remedied by the end of the commissioning-B period in 2017, copper leached from the soils into the water in early 2018, likely due to the drying out of the CWTS in the early spring/freshet of 2018. However, leaching had subsided by July 8, 2018 as the rate of treatment exceeded the rate of leaching. Copper is not expected to leach in 2019 operations provided that the CWTS remains flooded. ▪ Stagnation and iron addition can be used at full-scale to mitigate recovery length after periods of drought (or stagnation/slower HRT for high nitrate concentrations). ▪ During the 2018 operational period the demonstration-scale CWTS successfully treated all COCs.	4.2
▪ The lowest concentrations consistently achievable for the treatment design (performance limits confirmed by t-test) were reached for cadmium after 3.80 days for Series 1 and 3.54 days for Series 2 and for copper after 3.54 days (Series 2 only). ▪ Removal rate coefficients (RRCs, k) have been developed that can be used for full-scale sizing. ▪ Copper leaching from soils decreased from the drought recovery period but is still likely making the RRC artificially low in this CWTS; however, the RRC is expected to improve in 2019 as leaching continues to decrease.	4.4
▪ The 2018 evapotranspiration trials were unsuccessful due to precipitation throughout each trial; however, the 2017 trials revealed a significant loss of water, which will impact calculations of loads to the receiving environment (making them lower than previously estimated). ▪ Unlike 2017 trials, leaching of copper was not observed during periods of no flow in 2018, indicating copper leaching has improved.	4.5
▪ In 2018, leachable copper concentrations in soils decreased in the top 0-10 cm while total copper concentrations were within ranges previously measured. ▪ Most constituents, including copper, have shifted primarily into stable reduced and residual minerals fractions in the soil.	4.6

Key Finding	Section
- Acid volatile sulphides (AVS) provide buffering capacity to the soils and continued treatment through cold temperatures. AVS concentrations have been non-detectable in the CWTS due to low iron concentrations in substrates and water. While a small amount was detected in 2017 and 2018, Series 1 was amended with iron in attempt to improve AVS concentrations. - While Series 1 was amended with iron, it is unclear if the addition of iron was sufficient to increase AVS concentrations, but it is planned to add more in 2019.	
- Overall, uptake of metals in <i>C. aquatilis</i> was low and generally lower in 2018 than in 2017 demonstration-scale CWTS, with the exception of selenium in cell 1A which was slightly higher in 2018. - Targeted treatment mechanisms are becoming more robust, rendering elements non-bioavailable.	4.7
- An aphid infestation occurred in 2016 and 2017. While some efforts were made in 2017 to control the aphid population, the spraying regimen was not maintained and, therefore, aphids remained. However, no long-term detrimental effect on <i>C. aquatilis</i> viability was observed, despite the persistence of aphids. - In 2018, early and consistent application of insecticidal soap greatly reduced the abundance and length of an aphid infestation as well as improved containment of the aphids. - Pesticide application is not expected to be needed in the full-scale CWTS as it will not be in an isolated location (Contango, 2017b).	4.8
- Decomposition of <i>C. aquatilis</i> is occurring in the CWTS and contributing to reducing conditions. - Only partial decomposition of total <i>C. aquatilis</i> biomass from the previous year is occurring in an operational season, resulting in an accumulation of organic matter over time (accretion) which is an important process in the CWTS as it buries treated minerals making them more stable. - Decomposition of <i>C. aquatilis</i> occurs quickly when initially submerged in the CWTS with 56% decomposition occurring after 34 days. Decomposition slows overtime with an average of 85% decomposition occurring after 446 days (including one winter season/freezing period).	4.9
- The <i>C. aquatilis</i> in the CWTS produced 0.802 kg/m² (dry weight) of above water biomass per year. - This same amount of dry biomass should be supplemented to the full-scale CWTS (e.g., as straw) while going through maturation and filling in with vegetation for first 1-3 years after initial planting to expedite commissioning.	4.10
- Similar to 2017, root samples harboured the highest abundances of sulphide-producing bacteria (SPB), selenium-reducing bacteria (SeRB), and denitrifying bacteria in 2018. - Microbial communities were not affected by the double stress test period, with the exception of SPB in roots, where proportions were lower following the drought. However, by the end of 2018, proportions of SPB in roots increased to levels measured in the 2017 operational period.	0

6. Next Steps for 2019

A conceptual testing plan was developed at the beginning of the demonstration-scale CWTS program and has been refined and adapted based on performance and scientific findings during the commissioning and operational periods of the demonstration-scale CWTS. The demonstration-scale CWTS is expected to run until at least the end of 2019 to assess performance under a wider range of conditions. In 2019, a flow rate schedule will be developed targeting different HRTs based on predicted HRTs for full-scale performance. The overriding objective of the demonstration-scale program in 2019 is to assess performance under conditions that would be similar to the full-scale CWTS. Table 11 outlines the action plan for CWTS optimization and testing for 2019 based on the performance results through 2018.

A multi-year plan is provided in Appendix C, and includes work performed to date, as well as a schedule of activities for 2019.

Table 14 – Minto 2019 demonstration-scale CWTS action items.

Timing	Task	Purpose
Jan – Apr 2019	Visually inspect CWTS monthly	The CWTS is recommended to be monitored monthly to ensure there is consistent ice cover.
Apr 2019	Develop a flow rate schedule for 2019	The flow rates will fluctuate based on expected amounts of water for full-scale CWTS (scaled to size) to evaluate the performance of the CWTS at different key periods.
	Develop sampling plan for 2019	- The sampling plan will include sampling types, parameters, frequency, and locations. These results will inform the performance of the CWTS. - Sampling of the in, mid, and out locations for water and two locations through each cell (near depth sticks) for soil to better assess removal of constituents through the CWTS cells. - Dissolved oxygen measurements will be taken at various locations and depths through the CWTS cells to obtain a more thorough understanding of aerobic zones within the CWTS. - Pictures of the CWTS will be taken from all four corners of each cell to better monitor plant growth and development, as well as monitor algae growth and aphid presence.
	Provide Minto with updated standard operating procedures (SOPs) for monitoring and sampling the CWTS and training for microbial sampling	- SOPs will include how to take progress pictures of each CWTS cell, take YSI and depth stick measurements, re-install depth stick that had fallen over in 2018 (cell 1A), record data and label samples, collect water, soil, moss, and plants for ALS and Contango microbial samples, sample bags for detritus study, and spray for aphids. - Training will be provided for microbial sampling to ensure consistent methods are used (either during first Contango site visit, or by video conference).
May 2019	Add sandbags to the end of the CWTS cells to increase the water depth to 20-30cm.	Raising the water levels will maintain desired reducing conditions in the CWTS and make for better consistency of depths in all cells.

Timing	Task	Purpose
	Monitor water levels in CWTS, add water with water truck if needed	The CWTS is recommended to be monitored weekly to add water to each cell immediately upon spring thaw to prevent the CWTS from drying out.
	Start water flow to the CWTS	Begin 2019 demonstration-scale CWTS program.
	Contango site visit (provide training, add iron to Series 1, conduct spring microbial sampling event)	- Provide training for new Minto staff for monitoring and sampling of CWTS to ensure consistency of methods. - Collect seasonal microbial samples. - Add iron as instructed by Contango to Series 1 to aid in creation of excess acid volatile sulphides.
	Implement aphid control using insecticide on a routine schedule	Begin applications in early May when vegetation begins to turn green to control the aphid population before an infestation occurs.
Ongoing through 2019 sampling season	Routine sampling program	Follow sampling plan from May to September 2019 for routine collection of water, soil, microbial, plant, and detritus samples.
	Monitor for the presence of aphids in the CWTS	Determine if the aphid presence is isolated to the CWTS (if present at all), and if more aggressive control measures are needed.
	Fertilize plants (if necessary) and add moss to cell 1A	To help plant growth and development if needed. To revegetate areas where moss is sparse.
Jul 2019	Conduct evapotranspiration trial	Although 2017 data suggests minimal release of metals from soils, another evapotranspiration trial during the operational period needs to be conducted to confirm metals leaching has subsided. Completing the evapotranspiration study in July will provide information on evapotranspiration rates in warmer months and the effects of seasonality.
	Contango site visit (conduct summer microbial sampling event)	Collect seasonal microbial samples.
Aug 2019	Develop plan for final sampling event	Additional samples will be collected upon termination of the demonstration-scale CWTS to evaluate parameters such as mass balance of constituents.

Timing	Task	Purpose
Sep 2019	Contango site visit (harvest soil and moss for additional tests off-site, conduct fall microbial sampling event)	- Collect soil sample (volume not yet determined) and bring back to Contango's temperature-controlled facilities. Soil will be subjected to several stress tests (stagnation, drought, flood, freezing, and leach tests) to assess stability of metals in the event of an upset event. - Collect all above water biomass of <i>C. aquatilis</i> and all moss in a 1 m² plot to determine quantity of biomass per m² for each <i>C. aquatilis</i> and moss. - Collect seasonal microbial samples.
	Final sampling event	Additional samples will be collected prior to decommissioning of the CWTS.
February 2020	Report	Final Demonstration-scale CWTS Report.

7. Closure

We trust the information herein satisfies your present requirements. Should you have any questions, please contact the persons listed below. We appreciate the opportunity to provide the services detailed in this report, and look forward to discussing any comments you may have.

Regards,

Contango, an AEG company



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Appendix A – Methods

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Appendix A**A1. System Layout and Dimensions**

The demonstration-scale CWTS includes two systems in parallel with two cells in each series and a final catchment basin that both systems flow into. Dimensions and construction details are available in the Minto Mine Constructed Wetland Treatment Research Program – Demonstration Scale (Contango, 2015). The two parallel systems serve as a replicate for data analysis, and as testing has progressed, the two systems have also allowed for comparison of different management techniques, such as the effect of iron addition on drought recovery in series 1.

A2. Soils Used in Construction

Soils used to construct the CWTS are described in the initial report that outlines construction (Contango, 2015). A brief summary is described in Appendix A of the Minto Constructed Wetland Treatment Research Program – Demonstration Scale 2017 Update (Contango, 2017b).

A3. Vegetation Used in Planting

The demonstration-scale CWTS was planted with *Carex aquatilis* (aquatic sedge) and aquatic mosses from the W10 area of the Minto Site. The plant selection and borrow source was previously determined through the site assessment (Contango, 2014). Five *C. aquatilis* plants were planted per square meter, with moss tied to stakes that outlined the 1 m x 1 m grid for planting (details provided in Contango, 2015).

A4. Water Source

The same water source was used for the demonstration-scale CWTS in 2018 as was used in 2017. A brief summary of the water source is described in Appendix A of the Minto Constructed Wetland Treatment Research Program – Demonstration Scale 2017 Update (Contango, 2017b).

A5. Flow Rates

Flow rates were consistent over the majority of the 2018 test period to evaluate the following conditions:

- A drought recovery period (May 15 – August 16, 2018); and
- An operational period (August 17-September 9, 2018).

Flow rates were increased near the end of the 2018 test period from September 10 – September 28, 2018, to evaluate the following operational period under faster flowing conditions, using a 5 day HRT.

The drought recovery period was stimulated by restricting flows to 0.37 gallons per minute (GPM) for series 1 and 0.31 GPM for series 2. Targeted flow rates were chosen based on the minimum range of the flow meter to simulate a drought recovery period and encourage reducing conditions. Flow rates, as well as the totalizer values, were periodically recorded throughout 2018 from the flow meters installed on the feed into the demonstration-scale CWTS, consistent with the 2017 flow rate measurement methodology (Contango, 2017b). The flow rates recorded by Minto Mine personnel represent the instantaneous flow rate at the flow meter while actual averaged flow rates were calculated based on the continuous totalizer

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values. The actual average flow rates calculated from continuous totalizer values from May 15, 2018 to September 10, 2018 were 0.34 GPM for series 1 and 0.29 GPM for series 2.

Once the drought recovery period was completed and the operations period was initiated on September 10, 2018, the targeted flow rates were increased to 0.52 GPM for series 1 and 0.36 GPM for series 2. Since the water levels were raised in each cell in spring 2018, the targeted flow rates were increased to achieve the same hydraulic retention time (HRT) as the 2017 target (5 days). However, the flow rates were unintentionally decreased back to 0.37 GPM for series 1 and 0.31 GPM for series 2 from September 14 to September 19, 2018. On September 19, 2018 the flow rate was returned to 0.52 GPM for series 1 and 0.36 GPM for series 2 and operated at that flow rate until the demonstration-scale CWTS was shut down for the year (September 28, 2018). Figure 1 in the main document of the Minto Constructed Wetland Treatment Research Program – Demonstration Scale 2018 Update illustrates the actual and targeted flow rates throughout 2018.

A6. Sampling and Analyses Methods**A6.1 Routine Monitoring of Explanatory Parameters**

Explanatory parameters are quantifiable aspects of a CWTS environment that can be used to assess feasibility of treatment for a range of constituents, and therefore ‘explain’ the performance of a CWTS. These parameters and methods are described in Appendix A of the Minto Constructed Wetland Treatment Research Program – Demonstration Scale 2017 Update (Contango, 2017b).

A6.2 Water Sampling and Analyses

Water sampling occurred on a weekly basis from spring thaw in May 2018 to freeze up in September 2018, with additional parameters tested monthly. Frequencies and sampling parameters are outlined in Table A1. Grab samples were collected as described in Appendix A of the Minto Constructed Wetland Treatment Research Program – Demonstration Scale 2017 Update (Contango, 2017b).

Due to copper leaching from the CWTS substrates into the water in 2015, an additional sampling structure was designed to sample at the inflow, mid-point, and outflow of each cell. Details of this sampling method are described in Appendix A of the Minto Constructed Wetland Treatment Research Program – Demonstration Scale 2017 Update (Contango, 2017b). Water was sampled from the inflow, mid-point, and outflow of each cell at four timepoints in 2018 (June 22, July 8, August 2, and September 9, 2018).

Appendix A

Table A1 – Summary of 2018 water sampling analytical parameters, frequencies and locations.

Analytical Parameters	Frequency of Sampling	Sample Locations
Dissolved and total metals	Weekly	Outflow of each cell and feed
Ammonia		
Nitrate		
Nitrite		
Hardness (CaCO ₃)		
Sulphate (SO ₄)		
Flow rate	Weekly	Feed
pH, DO, ORP, Conductivity (in situ)	Weekly	All cells and feed
Anion Sum ¹	Monthly	Outflow of each cell and feed
Cation Sum ¹		
Ion Balance ¹		
Total Dissolved Solids (TDS) ¹		
Chloride (Cl)		
Nitrogen (Total)		
Alkalinity ^{1,2}		
pH ^{1,2}		
Conductivity ^{1,2}		
Chemical Oxygen Demand (COD)		
Total Organic Carbon (TOC)		
Total Kjeldahl Nitrogen (TKN)		
Total Suspended Solids (TSS)		
Dissolved Organic Carbon (DOC)		
Bicarbonate (HCO ₃) ^{1,2}		
Carbonate (CO ₃) ^{1,2}		
Hydroxide (OH) ^{1,2}		

¹ For samples collected on July 8, 2018, a log in error occurred by ALS; these parameters were initially not tested.

² For samples collected on July 8, 2018, a log in error occurred by ALS, these parameters were subsequently tested past the holding time.

A6.3 Soil Sampling and Analyses

Soil sampling was conducted four times in 2018 (May 27, July 8, September 9, and October 17 for acid volatile sulphides (AVS) and simultaneously extracted metals (SEM) only), while *in situ* relative soil redox was measured monthly. A sample of the top 0-10 cm of CWTS soil was collected into a 1 L glass jar for analyses. Analyses are outlined in Table A2. Each CWTS cell was sampled during each sampling event.

Appendix A

Table A2 – Summary of 2018 soil sampling analytical parameters, frequencies and locations.

Parameters	Frequency of Sampling	Sample Locations
Relative soil redox (in situ)	Monthly	All probes (6 per cell)
Analyses completed on soil sample		
SAR ¹ , pH, EC, %sat, Ca ¹ , Mg ¹ , Na ¹ , K ¹ , Cl, SO4	Seasonally (3x per year)	From a depth of 0-10 cm.
Available NPK and sulphur		
Bicarbonate (HCO ₃) ¹		
Carbonate (CO ₃) ¹		
Total Organic Carbon (TOC)		
Metals Analysis (Total)		
Sulfur by LECO		
Metals Leach		
Acid Volatile Sulphides (AVS) and Simultaneously Extracted Metals (SEM)		
Sequential Leaching (5 Acid Test)		
Analyses completed on special leach		
Bromide (Br)	Seasonally (3x per year)	From a depth of 0-10 cm.
Chloride (Cl)		
Sulphate (SO ₄)		
Fluoride (F)		
Alkalinity		
Bicarbonate (HCO ₃)		
Carbonate (CO ₃)		
Hydroxide (OH)		
Dissolved Organic Carbon (DOC)		
Ammonia		
Nitrate		
Nitrite		
Total Dissolved Solids (TDS)		
¹ Parameters were not tested for the July 8, 2018 sample as the sample jar broke during shipment, resulting in low sampling volume for cell 1B.		

The high initial leachable copper concentrations in the CWTS soils allowed for additional types of testing to be carried out on these systems. To assess the effect of the elevated metals (copper) in the soils used in construction on CWTS functionality, four soil analytical test methods were used as described in Appendix A of the Minto Constructed Wetland Treatment Research Program – Demonstration Scale 2017 Update (Contango, 2017b). Three of these analytical test methods were used in 2018:

1. Total concentration of elements in the soils by CRC ICPMS (EPA 200.2/6020A).
2. The concentration of metals that are being released from the soil into the overlying water column by leach method (EPA 6020A and EPA 300.1).

Appendix A

3. Stability and form of elements in soils by a sequential extraction procedure for the speciation of particulate trace metals (Tessier et al., 1979; EPA 6020A).

A6.4 Plant Sampling and Analyses

Both *C. aquatilis* and moss samples were collected for metals analysis at the final sampling period of the demonstration-scale CWTS. Above water vegetation for *C. aquatilis* samples were collected from each cell in the CWTS. Analyses are outlined in Table A3. Analyses of the tissue samples followed EPA 200.3/6020A and were reported in mg/kg dry weight. The tissue samples were homogenized and sub-sampled prior to digestion.

Table A3 - Summary of 2018 plant sampling analytical parameters, frequencies and locations.

Analytical Parameters	Plants Sampled	Location	Frequency of Sampling
Total Metals by ICPMS	<i>Carex aquatilis</i> and aquatic moss	Each cell	Year end

A6.5 Microbial Sampling and Analysis

Microbial sample collection was completed for four sample types: soil, roots, detritus, and moss. Soil, roots, detritus, and moss were collected from each cell in the CWTS for microbial analysis three times in 2018: June, July, and September. However, as moss, root, and detritus samples collected in June were received frozen, no further analyses were conducted. Quantification and DNA based analyses (genetic sequencing) were therefore conducted for all sample types collected in July and September, as well as for soil samples collected in June. Methods for sample collection for each sample type is described in Appendix A of the Minto Constructed Wetland Treatment Research Program – Demonstration Scale 2017 Update (Contango, 2017).

A6.5.1 Quantification Analyses

In 2018, Contango's microbial quantification analyses had evolved away from growth-based analyses (MPN) to a more efficient quantification analyses (quantitative polymerase chain reaction; qPCR). Consequently, the soil samples collected in June 2018, and all samples collected in July 2018 were analyzed for both growth-based microbial analysis, as well as qPCR to compare the two analyses. While not directly comparable, the results of the comparison indicated that quantification analyses were an appropriate technique to move forward with. Therefore, only results from 2018 qPCR analyses are shown in graphs and overall trends for all years are described.

Growth-based Analyses (MPN)

The most-probable number (MPN) of bacteria was determined for selected microbial samples as described in Appendix A of the Minto Constructed Wetland Treatment Research Program – Demonstration Scale 2017 Update (Contango, 2017b).

Quantification Polymerase Chain Reaction (qPCR) Analyses

Appendix A

Organisms of interest were quantified using quantitative polymerase-chain reaction (qPCR). All bacteria in a sample were quantified through qPCR for the 16S ribosomal RNA (rRNA) gene (normalized for gene copy number).

A6.5.2 Genetic Sequencing Analyses

DNA was extracted and sequenced as described in Appendix A of the Minto Constructed Wetland Treatment Research Program – Demonstration Scale 2017 Update (Contango, 2017b).

A6.6 Detritus Decomposition Trials

A detritus decomposition trial was developed and established in 2017 and will continue through 2019 to assess decomposition rates of *C. aquatilis* in the demonstration-scale CWTS over time, as well as evaluate the algae growth on CWTS organic materials within the water column (Chimney and Pietro, 2006; Hammerly et al., 1989). Methods are described in Appendix A of the Minto Constructed Wetland Treatment Research Program – Demonstration Scale 2017 Update (Contango, 2017b).

On July 9 and September 10, 2018 (after 383 and 446 days of submersion in the CWTS, respectively), one bag filled with polyester filter fiber and one bag filled with *C. aquatilis* was removed from each cell, dried, and weighed as described in Appendix A of the Minto Constructed Wetland Treatment Research Program – Demonstration Scale 2017 Update (Contango, 2017b).

A6.7 Vegetation Study

A vegetation plot harvest was completed in 2018 to assess the amount of above water biomass (*C. aquatilis*) that grows per year per m² in a mature CWTS. The results from the vegetation plot harvest were applied to the area of each cell in the CWTS to estimate the amount of *C. aquatilis* that would contribute organic matter into the CWTS each year. A 1 m² quadrant was delineated in cell 2B of the demonstration-scale CWTS and all the above water *C. aquatilis* was harvested within the quadrant (Figure A1). The *C. aquatilis* was weighed and placed in a drying oven (at 50°C) until a constant mass was observed. The dry-weight of the *C. aquatilis* was then adjusted for the estimated size of the CWTS (estimated area of CWTS multiplied by 1 m² of *C. aquatilis*) to calculate the total biomass of *C. aquatilis* added to the CWTS in a year. Finally, the total biomass addition was compared to the decomposition rate and algal addition rates (Section A6.6) to establish a more accurate rate of organic matter addition to a CWTS of a given size.



Figure A1 – Vegetation plot harvest 2018.

Photo on the left shows vegetation plot harvest area delineated with wooden stakes. Photo on the right shows the area that was harvested. Photos were taken July 8, 2018.

A6.8 Water depth measurements

Depth sticks installed in the CWTS in June 2016 were used to measure the water depth over time (Contango, 2017a). One of the depth sticks in cell 1A had fallen over on June 15, 2018 and was subsequently re-installed by Minto staff. However, measurements after June 15, 2018 were higher than previously recorded. Therefore, the recorded depths for this depth stick have been corrected by subtracting 5 cm from the measured value. The corrected depths were used for further calculations regarding cell volume and HRT (Section A9). It is recommended that the depth sticks in cell 1A are corrected to the proper depth in 2019.

A6.9 Evapotranspiration Trials

In 2018, the evapotranspiration studies were performed on-site from June 27 to July 3 (trial 1) and August 3 to August 10 (trial 2). However, approximately 9.6 mm of rain occurred during trial 1 (although weather station data was unavailable on the first day of the trial) and 33 mm of rain occurred during trial 2. As it rained for the majority of trial 1 and trial 2, data obtained from this year's evapotranspiration trials were unreliable and, therefore, load removal calculations were adjusted using the 2017 evapotranspiration rate (5.4 L/m²/day water loss).

A7. Performance Limit Calculations

The performance limit (previously referred to as thermodynamic minimum) is the lowest concentration consistently achievable for a given treatment design and water chemistry. These calculations were conducted as described in Appendix A of the Minto Constructed Wetland Treatment Research Program – Demonstration Scale 2017 Update (Contango, 2017b).

A8. Load Removal Calculations

Load removals are calculated both without adjustment for evapotranspiration and adjusting for evapotranspiration. The evapotranspiration adjustment converts the calculation of load removed during each flow period to the actual amount of load removed, taking into consideration the amount of water lost from the demonstrations-scale CWTS through

Appendix A

evapotranspiration. Load removal was determined using equations to calculate the initial load removed without adjustment for evapotranspiration and with adjustment for evapotranspiration as described in Appendix A of the Minto Constructed Wetland Treatment Research Program – Demonstration Scale 2017 Update (Contango, 2017b).

A9. Removal rate coefficients and HRT calculations

An important factor for CWTS design is the rate of treatment, also known as the removal rate coefficient (k). The removal rate coefficient is based on the treatability of a specific compound and the HRT of the CWTS, both of which are site-specific based on water chemistry, CWTS designs, and characteristics of the CWTS. These calculations were conducted using removal rate coefficients (k) equations as described in Appendix A of the Minto Constructed Wetland Treatment Research Program – Demonstration Scale 2017 Update (Contango, 2017b).

A10. Iron Addition

Iron, in the form of ferrous sulphate, was added to the CWTS to promote AVS production, which in turn would serve as a redox buffer should the soils be exposed to oxygen (e.g., briefly drying out) and would also continue to treat metals and metalloids during periods of low microbial activity (e.g., cooler temperatures). Prior to adding iron to the CWTS a bench top test was conducted, and the methods for conducting the bench top test and the direct addition to the CWTS are detailed below.

A10.1 Bench Trial for Iron Addition

A bench trial was completed prior to adding the ferrous sulphate solution into cell 1A and 1B of the demonstration-scale CWTS to determine if there would be an associated drop in pH. The bench top test consisted of adding 0.050 g of ferrous sulphate heptahydrate to 1 L of water from cell 1A, for a final iron concentration of 10 mg/L. The pH of the water from cell 1A was measured using a YSI hand held meter prior to adding the ferrous sulphate and the pH was recorded at 7.59. The ferrous sulphate was then added to the 1 L container of water from cell 1A and the container was inverted three times. pH readings were recorded at 1 min, 3 min, 5 min, 10 min, 15 min, 20 min, 30 min, and 1 hour 30 mins to determine if there would be an effect on the pH. The pH remained circumneutral at 7.23 after 1 hour 30 minutes. Therefore, it was determined that a 10 mg/L concentration of iron was appropriate to add to the cells 1A and 1B.

A10.2 Iron Addition to the Demonstration-scale CWTS

On July 8, 2018, flow to series 1 was stopped and 303 g and 304 g of ferrous sulphate was added to cell 1A and 1B, respectively, to achieve a final iron concentration of 10 mg/L. Flow remained off until July 15, 2018 to promote reducing conditions and generation of AVS in the soil, which was monitored during the seasonal soil analyses on September 9, 2018 and on October 17, 2018 (Section A6.3).

A11. Aphid Monitoring and Pesticide Application

Application of pesticide (Trounce, End-All, and Bug-B-Gone) on *C. aquatilis* in each cell occurred bi-weekly, starting on May 14, 2018 as a preventative measure due to an aphid infestation identified during the 2017 test period (Contango, 2017b). Aphids were not observed in the CWTS until early August 2018 (exact date unknown), when small amounts of

aphids were observed in cell 2A. Application of pesticide on *C. aquatilis* was subsequently conducted weekly starting August 24, 2018.

A12. Fertilizer addition calculations

Due to the impacts of the aphid infestation in 2017, fertilizer, in the form of monopotassium phosphate (MKP), was added bi-weekly to each cell in the CWTS to help with *C. aquatilis* growth, starting July 14, 2018. The quantity of MKP added to each cell is shown in Table A4 and was based on the volume of water in each cell to achieve a final concentration of 1 mg/L phosphorus. MKP application occurred bi-weekly by dissolving dry MKP into 1 L of water. The MKP solution was emptied along the inflow of each cell where the flow of water then spread the fertilizer throughout the cell.

Table A4 – Quantity of MKP added bi-weekly to each CWTS cell.

CWTS Cell	Dry MKP Quantity (g)
1A	26.74
1B	26.96
2A	20.44
2B	18.56

A13. Aphid Monitoring and Sedge Transplantation

Due to the impacts of the aphid infestation in 2017, areas of the demonstration-scale CWTS were devoid of dense *C. aquatilis* plants. Therefore, on July 8, 2018, Minto and Contango personnel transplanted approximately 25 *C. aquatilis* plants from water quality monitoring station W10 into cells 1A, 1B and at the outflow of 2A.

A14. References

All references provided in main report.

Appendix B – Additional Tables and Figures

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B1. Water Results

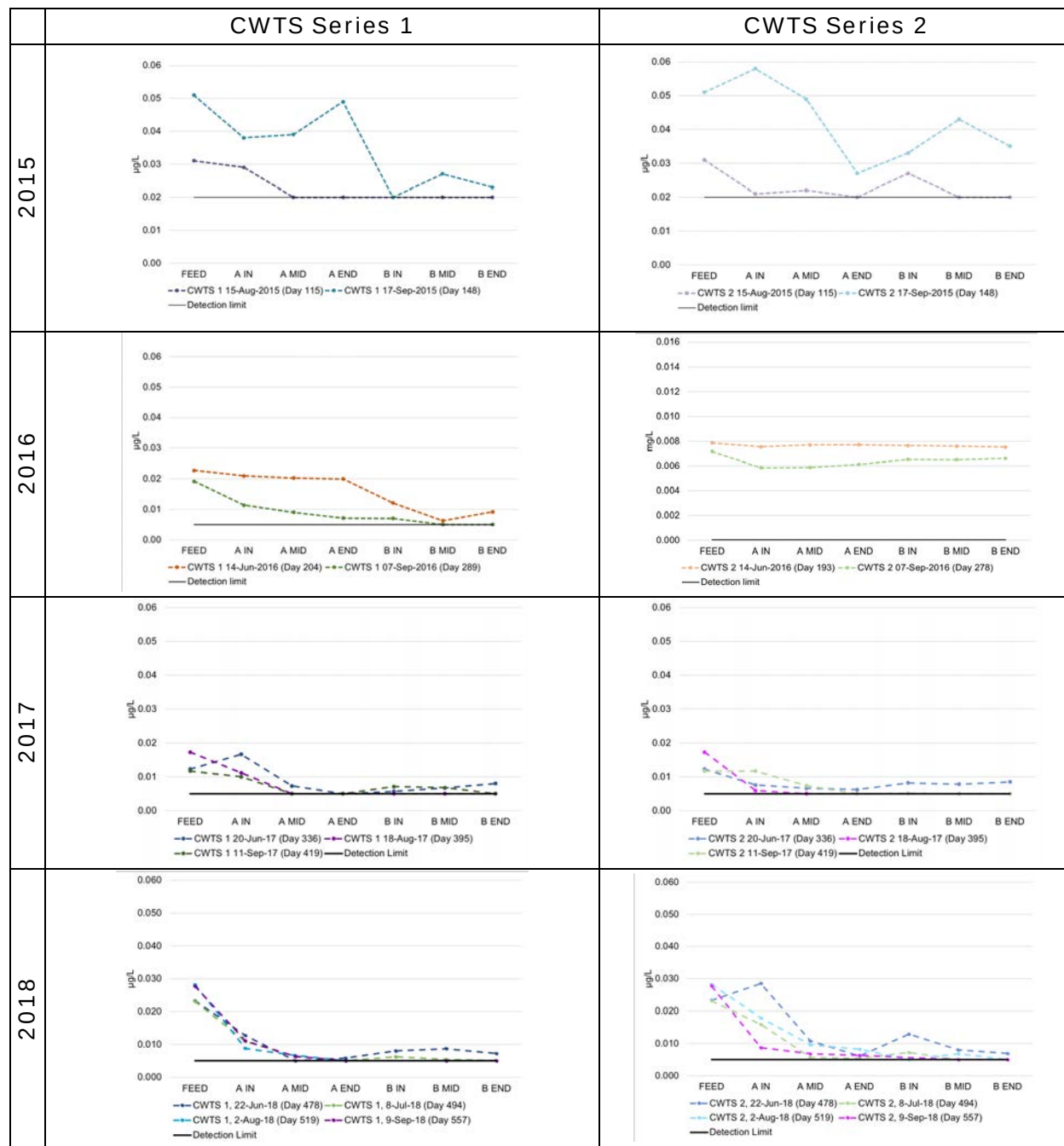


Figure B1 – Cadmium concentrations through the demonstration-scale CWTS. 2015 (top), 2016 (second down), 2017 (third down), and 2018 (bottom) dissolved cadmium concentrations. Data shown for 11 timepoints, where water was sampled at seven locations through the flow path of the CWTS to assess for treatment fronts within the CWTS, or possible leaching of constituents from the soils into the CWTS. The Maxxam (2015 results) detection limit (DL; black line) for cadmium is 0.020 µg/L. The ALS (2016 – 2018 results) DL for cadmium is 0.005 µg/L. The graphs indicate that leaching is not occurring as there are no spikes in cadmium concentrations throughout the CWTS. Data from August 2, 2018 for 1B IN and from September 9, 2018 for 1B IN and 2B IN were erroneous and therefore removed from the plot (dissolved concentration exceeded total concentration).

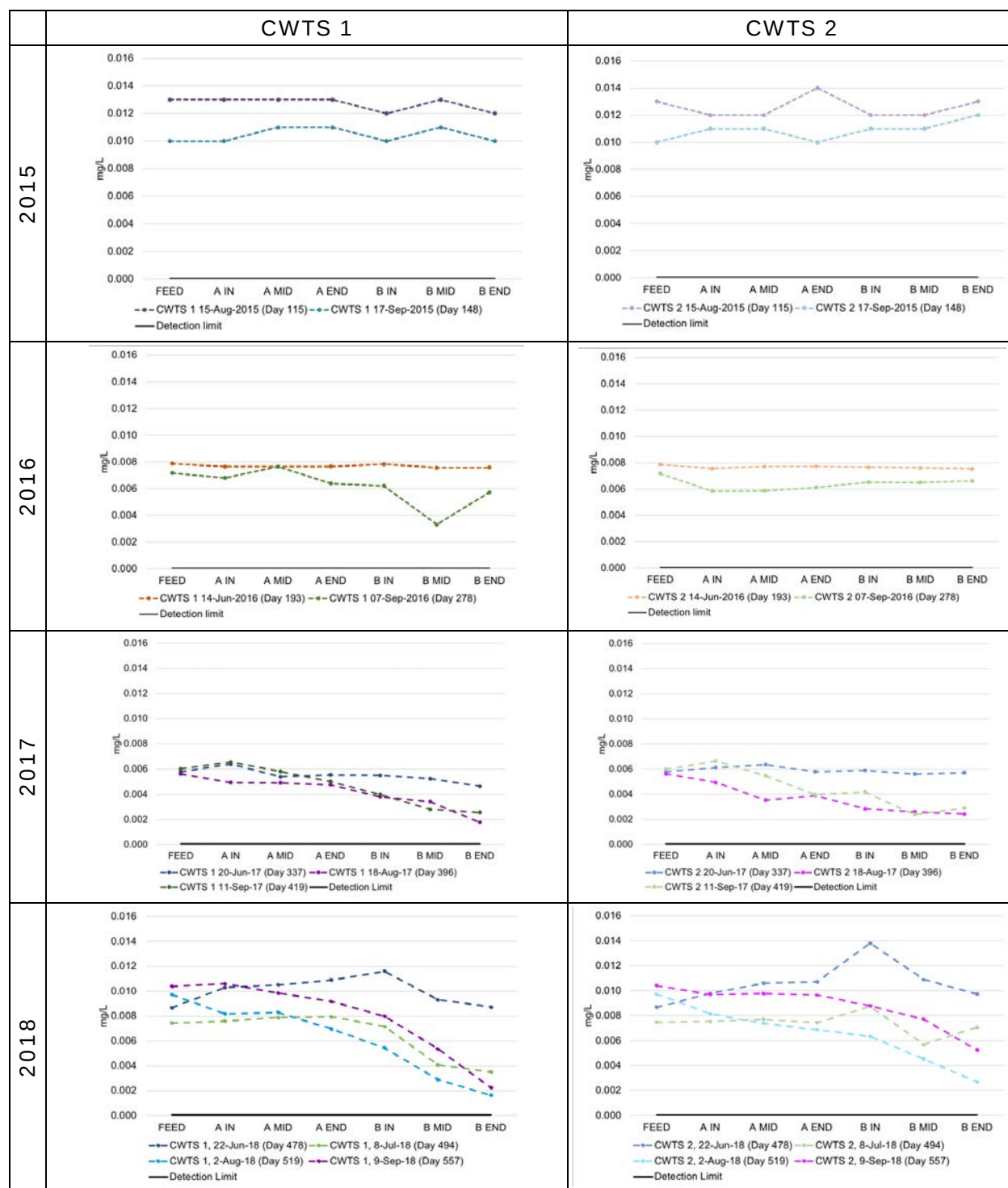


Figure B2 – Molybdenum concentrations through the demonstration-scale CWTS. 2015 (top), 2016 (second down), 2017 (third down), and 2018 (bottom) dissolved molybdenum concentrations. Data shown for 11 timepoints, where water was sampled at seven locations through the flow path of the CWTS to assess for treatment fronts within the CWTS, or possible leaching of constituents from the soils into the CWTS. The Maxxam (2015 results) detection limit (DL; black line) for molybdenum is 0.00020 mg/L. The ALS (2016 – 2018 results) DL for molybdenum is 0.000050 mg/L.

Appendix B

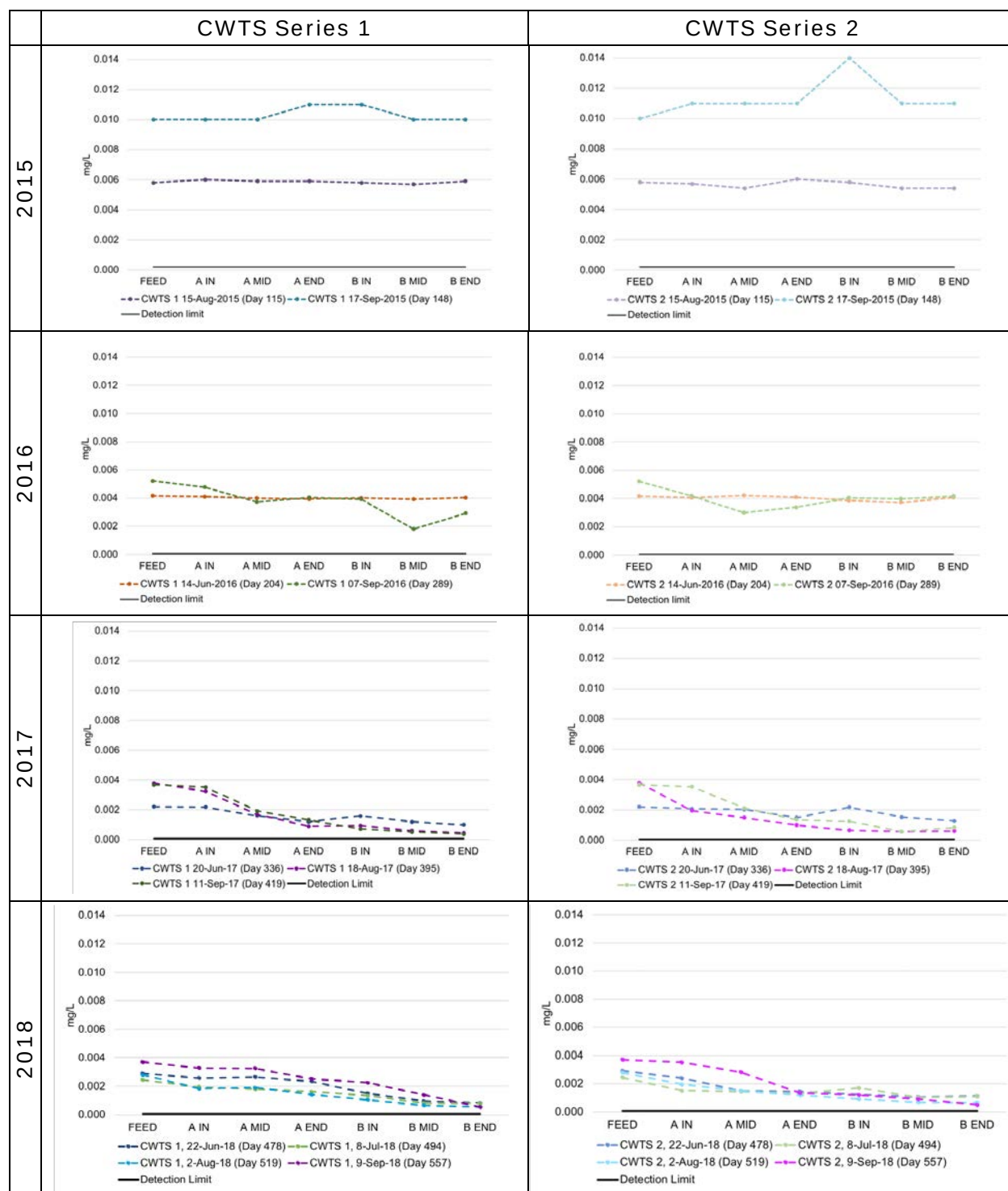


Figure B3 – Selenium concentrations through the demonstration-scale CWTS. 2015 (top), 2016 (second down), 2017 (third down), and 2018 (bottom) dissolved selenium concentrations. Data shown for 11 timepoints, where water was sampled at seven locations through the flow path of the CWTS to assess for treatment fronts within the CWTS, or possible leaching of constituents from the soils into the CWTS. The Maxxam (2015 results) detection limit (DL; black line) for selenium is 0.00020 mg/L. The ALS (2016 – 2018 results) DL for copper is 0.000050 mg/L. The graphs indicate that leaching is not occurring as there are no spikes in selenium concentrations throughout the CWTS. Data from June 22, 2018 for 2B IN was erroneous and therefore removed from the plot (dissolved concentration exceeded total concentration).

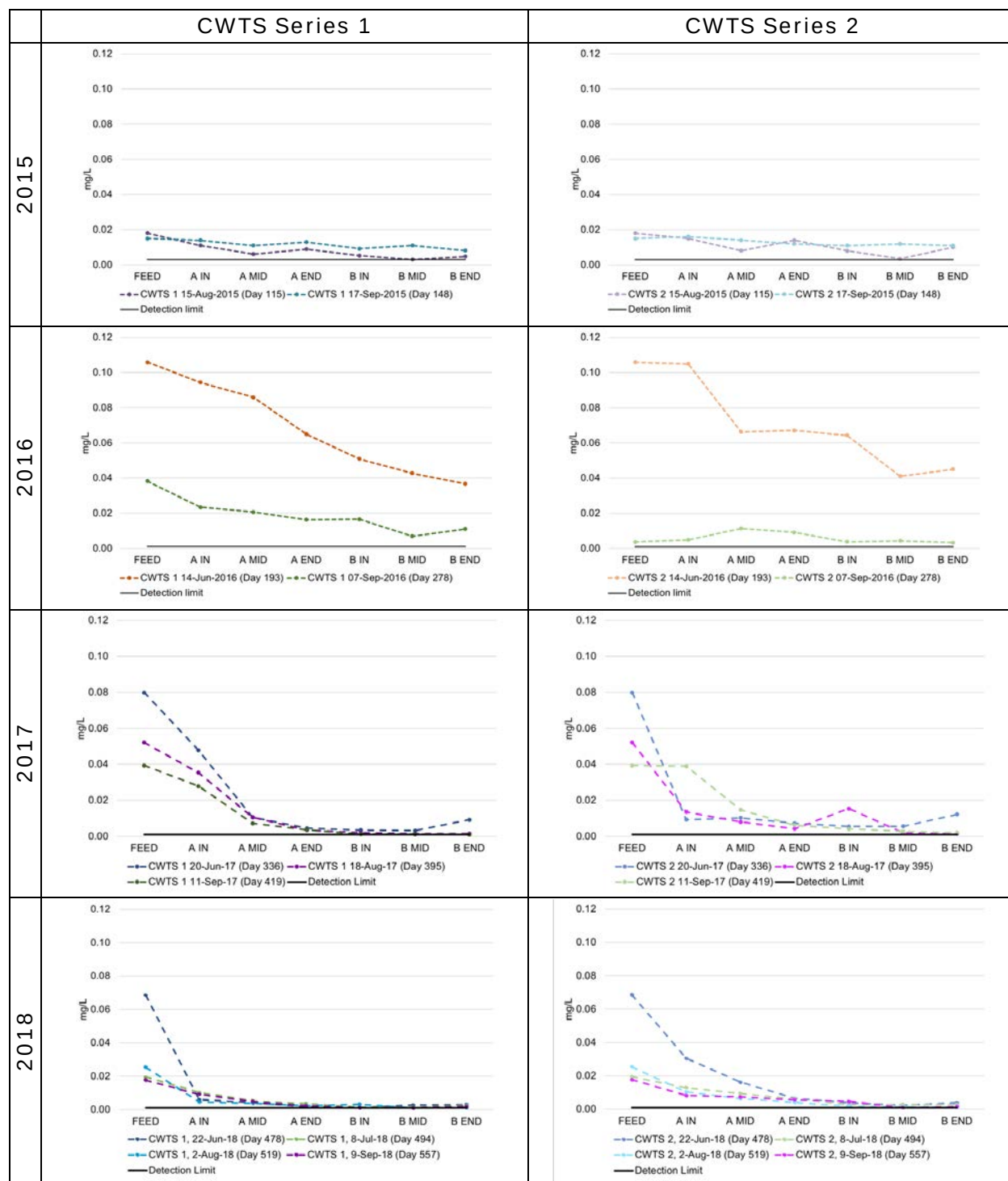
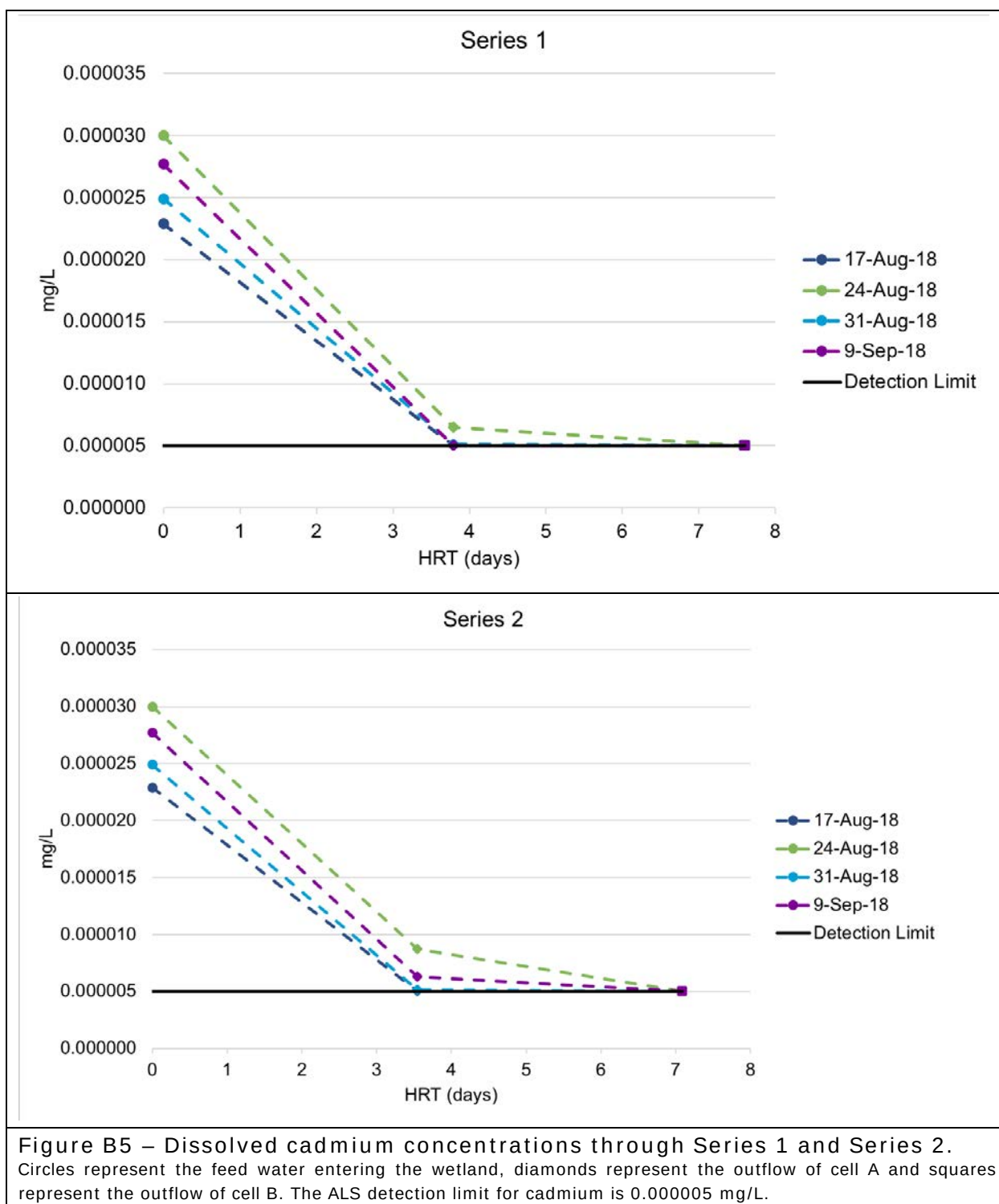
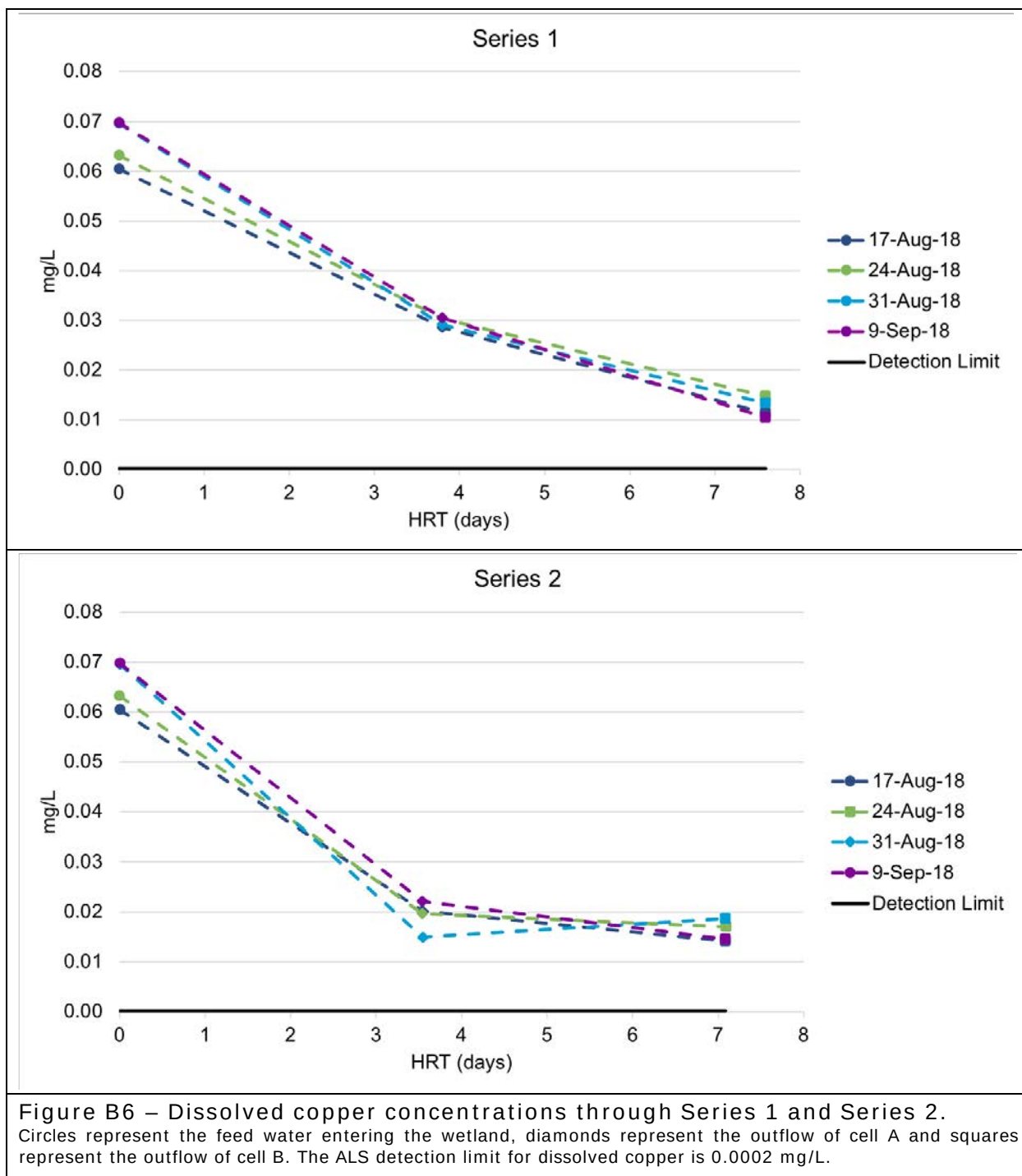


Figure B4 – Zinc concentrations through the demonstration-scale CWTS. 2015 (top), 2016 (second down), 2017 (third down), and 2018 (bottom) dissolved zinc concentrations. Data shown for 11 timepoints, where water was sampled at seven locations through the flow path of the CWTS to assess for treatment fronts within the CWTS, or possible leaching of constituents from the soils into the CWTS. The Maxxam (2015 results) detection limit (DL; black line) for zinc is 0.0030 mg/L. The ALS (2016 – 2018 results) DL for zinc is 0.0010 mg/L. The graphs indicate that leaching is not occurring as there are no spikes in zinc concentrations throughout the CWTS.



Appendix B



Appendix B

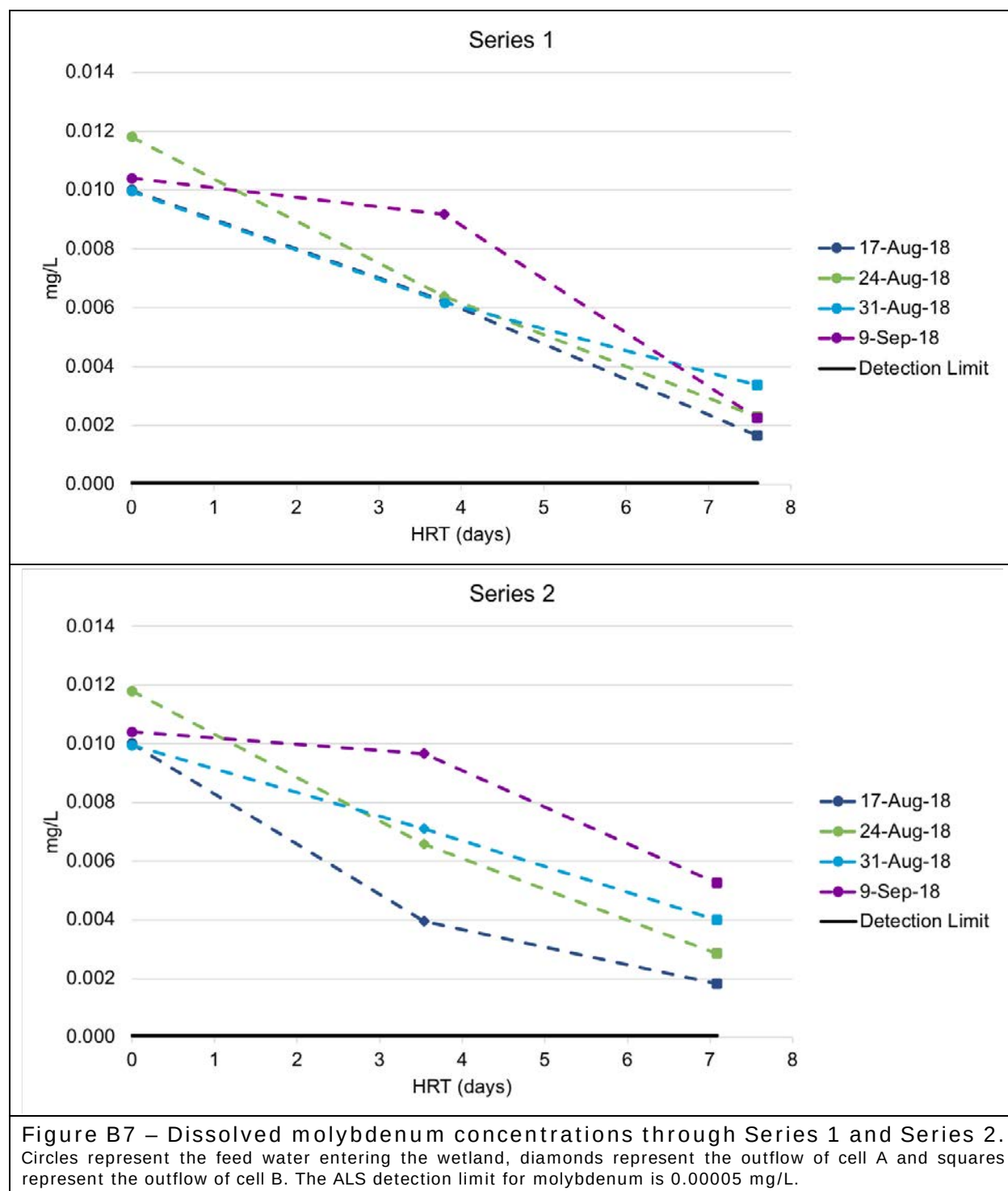


Figure B7 – Dissolved molybdenum concentrations through Series 1 and Series 2. Circles represent the feed water entering the wetland, diamonds represent the outflow of cell A and squares represent the outflow of cell B. The ALS detection limit for molybdenum is 0.00005 mg/L.

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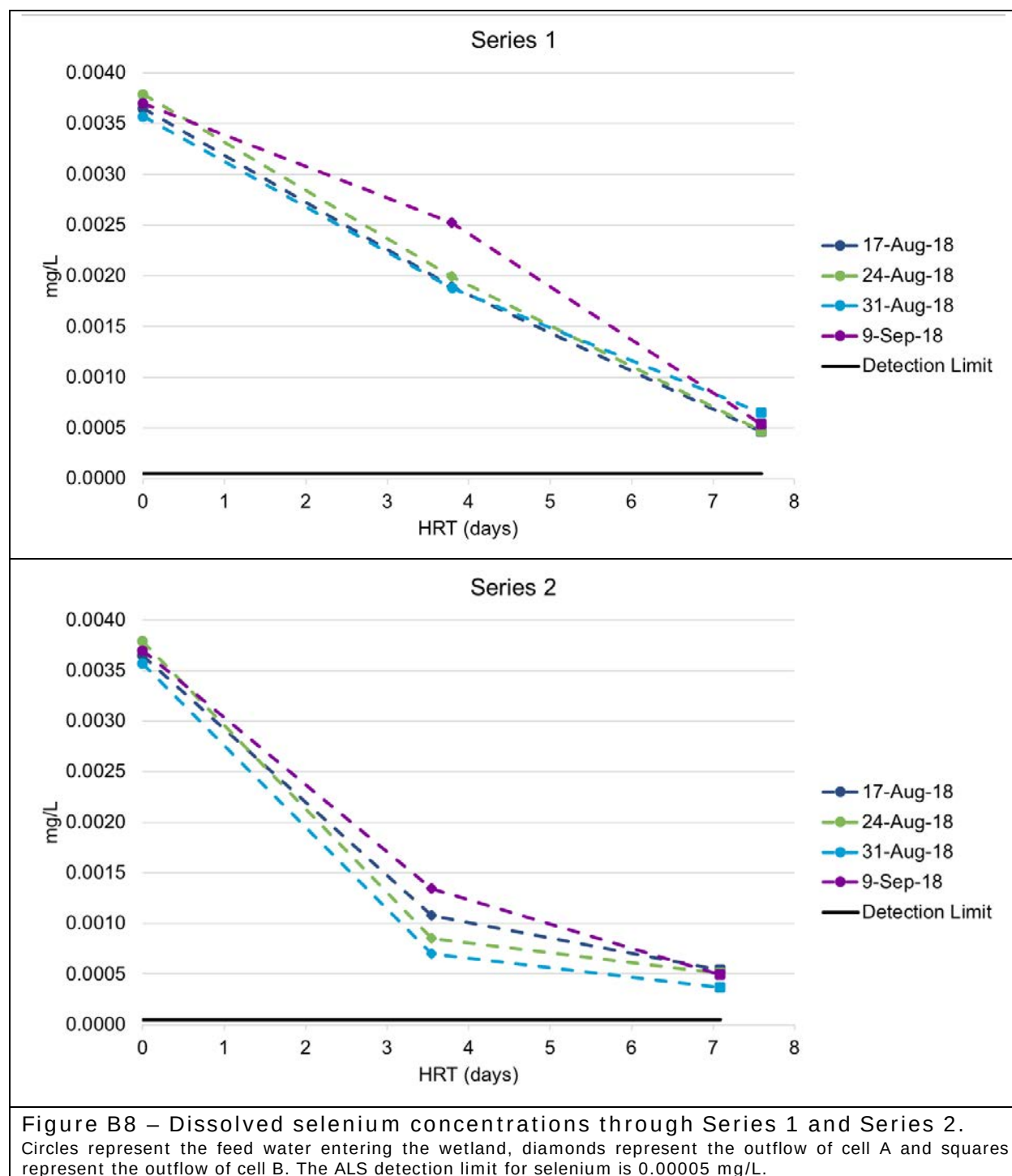
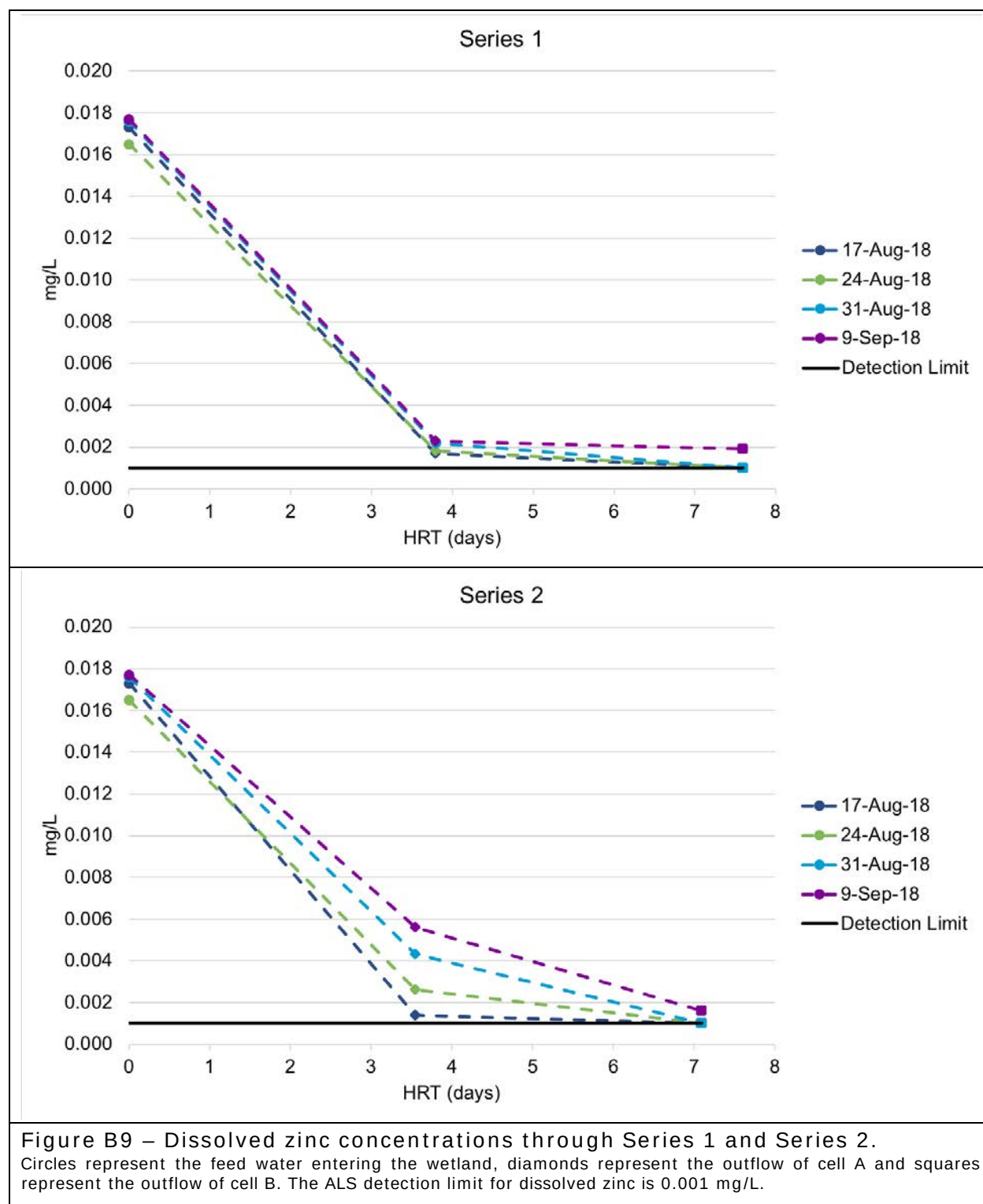


Figure B8 – Dissolved selenium concentrations through Series 1 and Series 2. Circles represent the feed water entering the wetland, diamonds represent the outflow of cell A and squares represent the outflow of cell B. The ALS detection limit for selenium is 0.00005 mg/L.

Appendix B



B2. Soil Results

Table B1 – Total and leachable soil copper concentrations in Series 1 since first year of operations.

CWTS Cell	Sampling Date	Days in Operation	Sample Depth (cm)	Total Cu (mg/kg)	SPLP Cu (mg/L)	Leachable Cu (mg/kg)
1A	28-Aug-14	1	Initial Composite	-	0.298 (0.148-0.608)	-
	19-Jun-15	58	0-5	960	0.055 ¹	-
	16-Aug-15	116	10-20	950	0.187	-
	18-Sep-15	149	10-20	1300	0.049	-
	29-Sep-15	160	10-20	910	0.069	-
	15-Jun-16	194	0-10	1440	-	0.953
	15-Jun-16	194	10-20	1210	-	0.66
	8-Jul-16	217	0-10	1430	-	0.603
	8-Jul-16	217	10-20	1730	-	0.832
	7-Sep-16	247	0-10	1290	-	0.449
	20-Jun-17	336	0-10	1470	0.315	0.308
	25-Jul-17	371	0-10	1630	0.529	0.463
	12-Sep-17	420	0-10	1490	0.590	0.481
	27-May-18	452	0-10	1510	-	0.616
	8-Jul-18	494	0-10	1420	-	0.628
	9-Sep-18	557	0-10	1160	-	0.038
1B	28-Aug-14	1	Initial Composite	-	0.298 (0.148-0.608)	-
	19-Jun-15	58	0-5	1400	0.033 ¹	-
	16-Aug-15	116	10-20	1400	0.209	-
	18-Sep-15	149	10-20	830	0.065	-
	29-Sep-15	160	10-20	880	0.059	-
	15-Jun-16	194	0-10	1130	-	1.01
	15-Jun-16	194	10-20	1240	-	0.822
	8-Jul-16	217	0-10	1250	-	1.11
	8-Jul-16	217	10-20	1620	-	1.21
	7-Sep-16	247	0-10	1190	-	0.197
	20-Jun-17	336	0-10	1290	0.450	0.338
	25-Jul-17	371	0-10	1100	0.290	0.165
	12-Sep-17	420	0-10	1100	0.716	0.492
	27-May-18	452	0-10	1930	-	0.784
	8-Jul-18	494	0-10	1430	-	0.232
	9-Sep-18	557	0-10	1580	-	0.238

¹ Samples collected in June 2015 were at a shallow depth (0-5 cm) and copper content had therefore likely already been removed by washing from the faster flows of the CWTS system. The blue shading indicated samples that were taken from a shallower depth (0-5 cm and 0-10 cm).

Appendix B

Table B2 – Total and leachable soil copper concentrations in Series 2 since first year of operations.

CWTS Cell	Sampling Date	Days in Operation	Sample Depth (cm)	Total Cu (mg/kg)	SPLP Cu (mg/L)	Leachable Cu (mg/kg)
2A	28-Aug-14	1	Initial Composite	-	0.298 (0.148-0.608)	-
	19-Jun-15	58	0-5	1175	0.037 ¹	-
	16-Aug-15	116	10-20	660	0.139	-
	18-Sep-15	149	10-20	880	0.081	-
	29-Sep-15	160	10-20	1000	0.073	-
	15-Jun-16	194	0-10	1100	-	0.823
	15-Jun-16	194	10-20	1280	-	0.900
	8-Jul-16	217	0-10	1450	-	0.963
	8-Jul-16	217	10-20	1150	-	1.68
	7-Sep-16	247	0-10	1290	-	0.838
	20-Jun-17	336	0-10	1820	0.381	1.24
	25-Jul-17	371	0-10	1290	0.419	0.927
	12-Sep-17	420	0-10	1440	0.389	0.381
	27-May-18	452	0-10	1100	-	0.600
	8-Jul-18	494	0-10	1480	-	0.252
	9-Sep-18	557	0-10	1630	-	0.048
2B	28-Aug-14	1	Initial Composite	-	0.298 (0.148-0.608)	-
	19-Jun-15	58	0-5	1100	0.039 ¹	-
	16-Aug-15	116	10-20	1000	0.201	-
	18-Sep-15	149	10-20	830	0.078	-
	29-Sep-15	160	10-20	540	0.059	-
	15-Jun-16	194	0-10	1040	-	0.771
	15-Jun-16	194	10-20	1310	-	1.16
	8-Jul-16	217	0-10	1070	-	1.38
	8-Jul-16	217	10-20	1180	-	1.25
	7-Sep-16	247	0-10	1520	-	0.123
	20-Jun-17	336	0-10	1110	0.283	0.523
	25-Jul-17	371	0-10	1240	0.477	0.540
	12-Sep-17	420	0-10	1140	0.596	0.809
	27-May-18	452	0-10	1430	-	1.01
	8-Jul-18	494	0-10	1260	-	0.637
	9-Sep-18	557	0-10	1670	-	0.046

¹ Samples collected in June 2015 were at a shallow depth (0-5 cm) and copper content had therefore likely already been removed by washing from the faster flows of the CWTS system. The blue shading indicated samples that were taken from a shallower depth (0-5 cm and 0-10 cm).

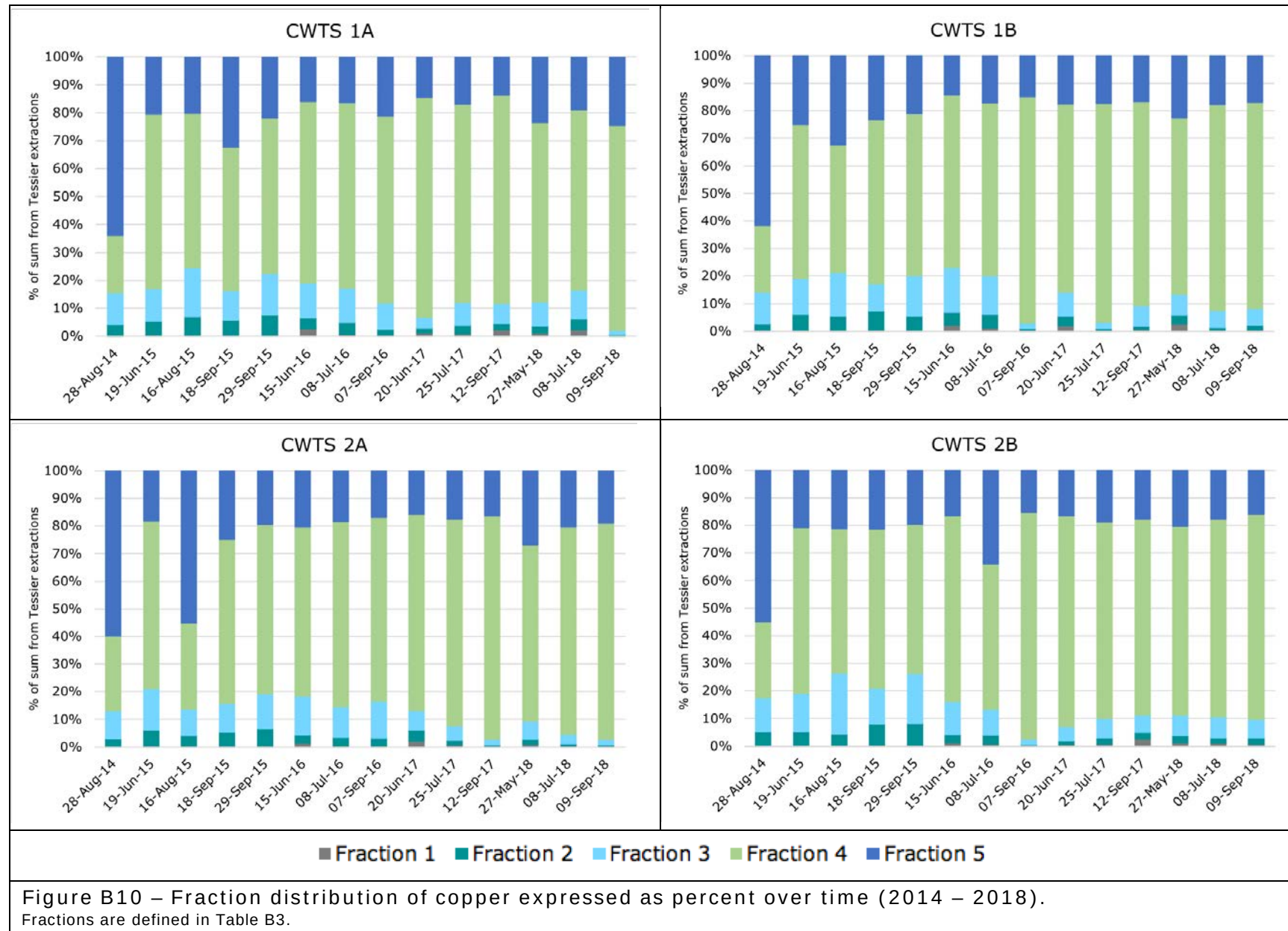
Appendix B

Table B3 – Summary of extractable fractions from sequential extraction procedure for the speciation of metals¹.

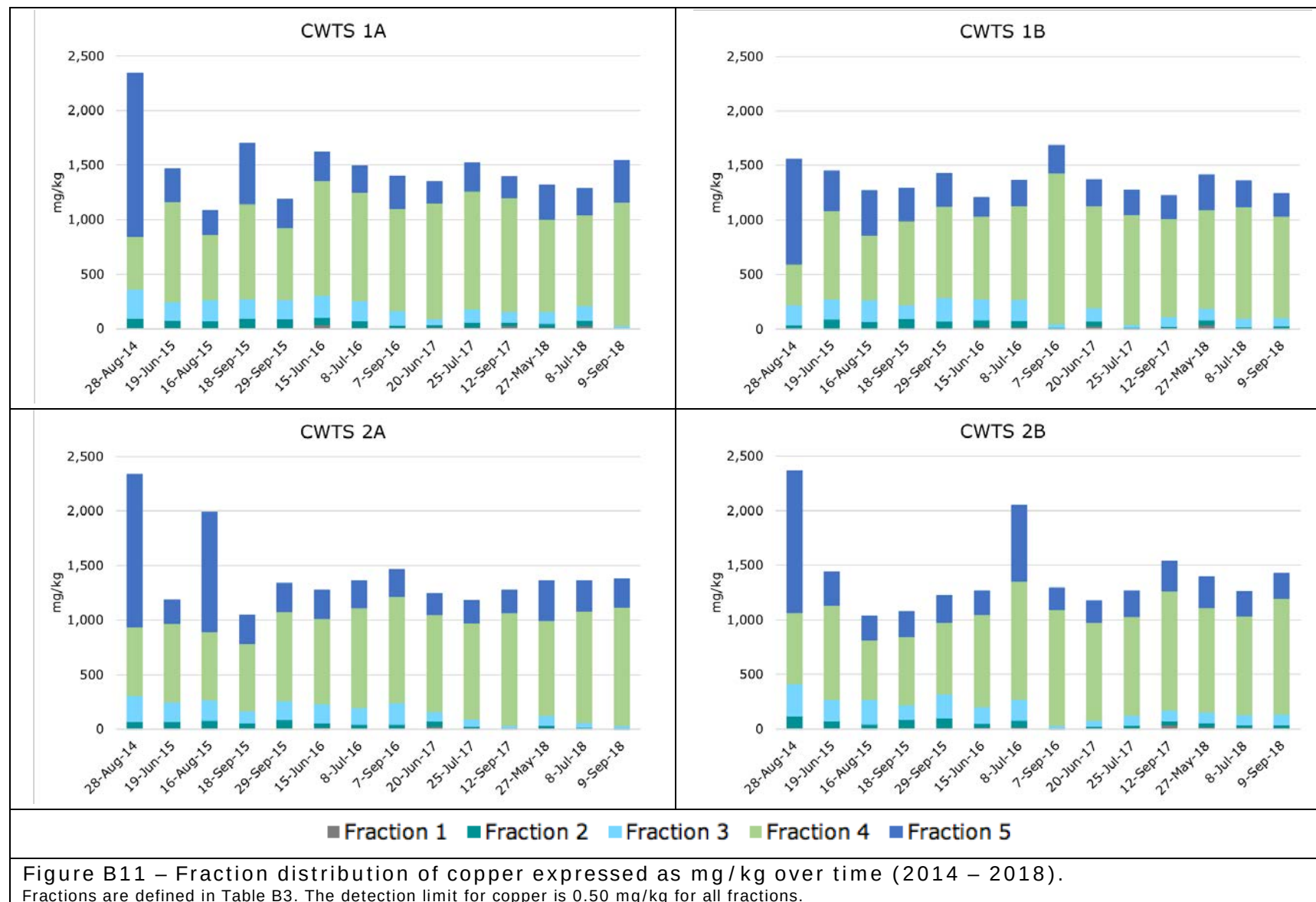
Fraction	Description	COCs unstable when
1	Exchangeable fraction for adsorbed minerals	Readily released (i.e., soluble and exchangeable)
2	Mineral fraction bound to carbonates or solubilized at pH 5	Decreased pH
3	Oxidized mineral fraction bound to Fe-Mn oxides	Reducing conditions
4	Reduced mineral fraction and sulphides	Oxidizing conditions
5	Residual mineral fraction (primary and secondary minerals)	Not expected to be released in solution over time under conditions normally encountered in nature

¹ Method based on Tessier et al., 1979.

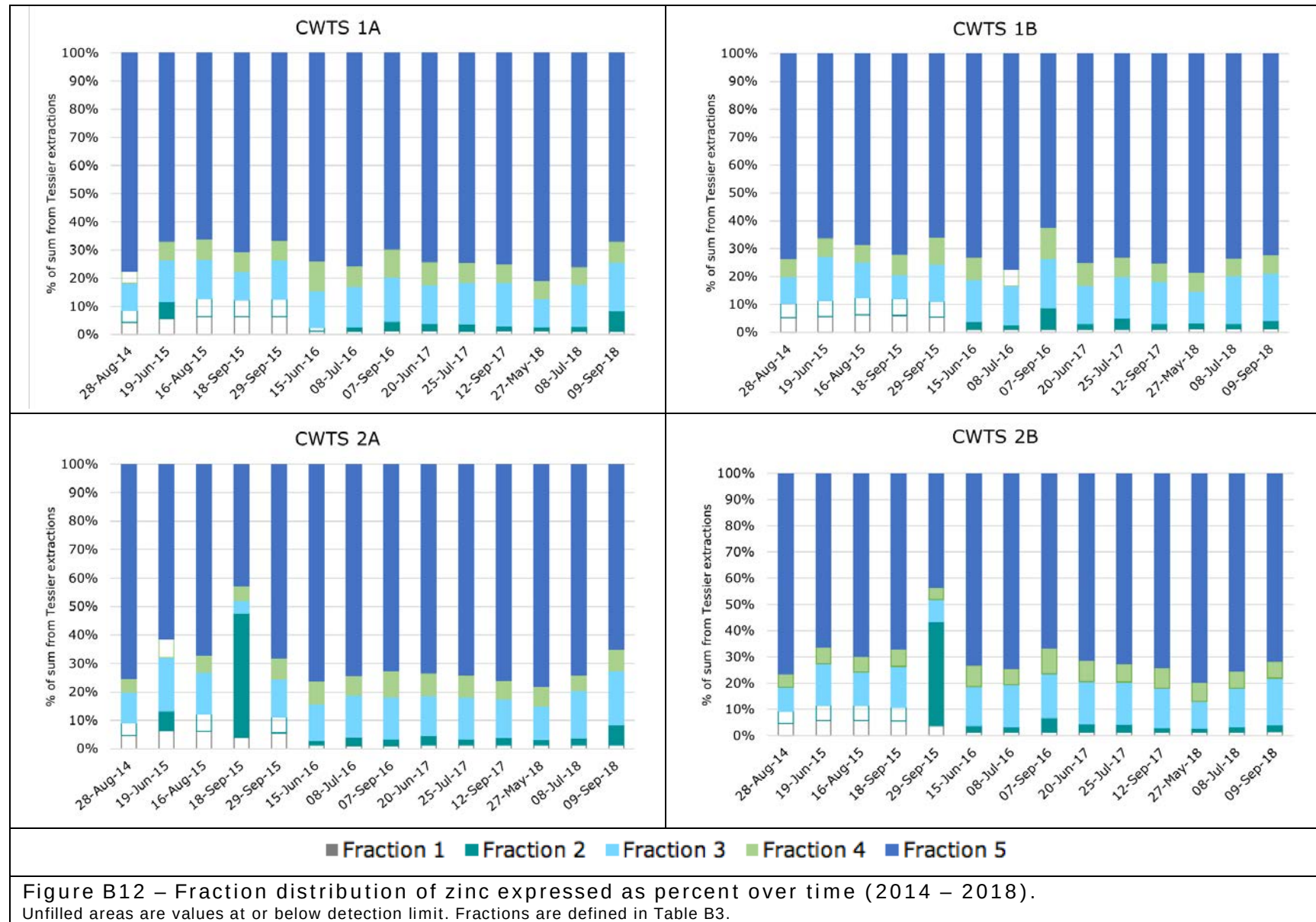
Appendix B



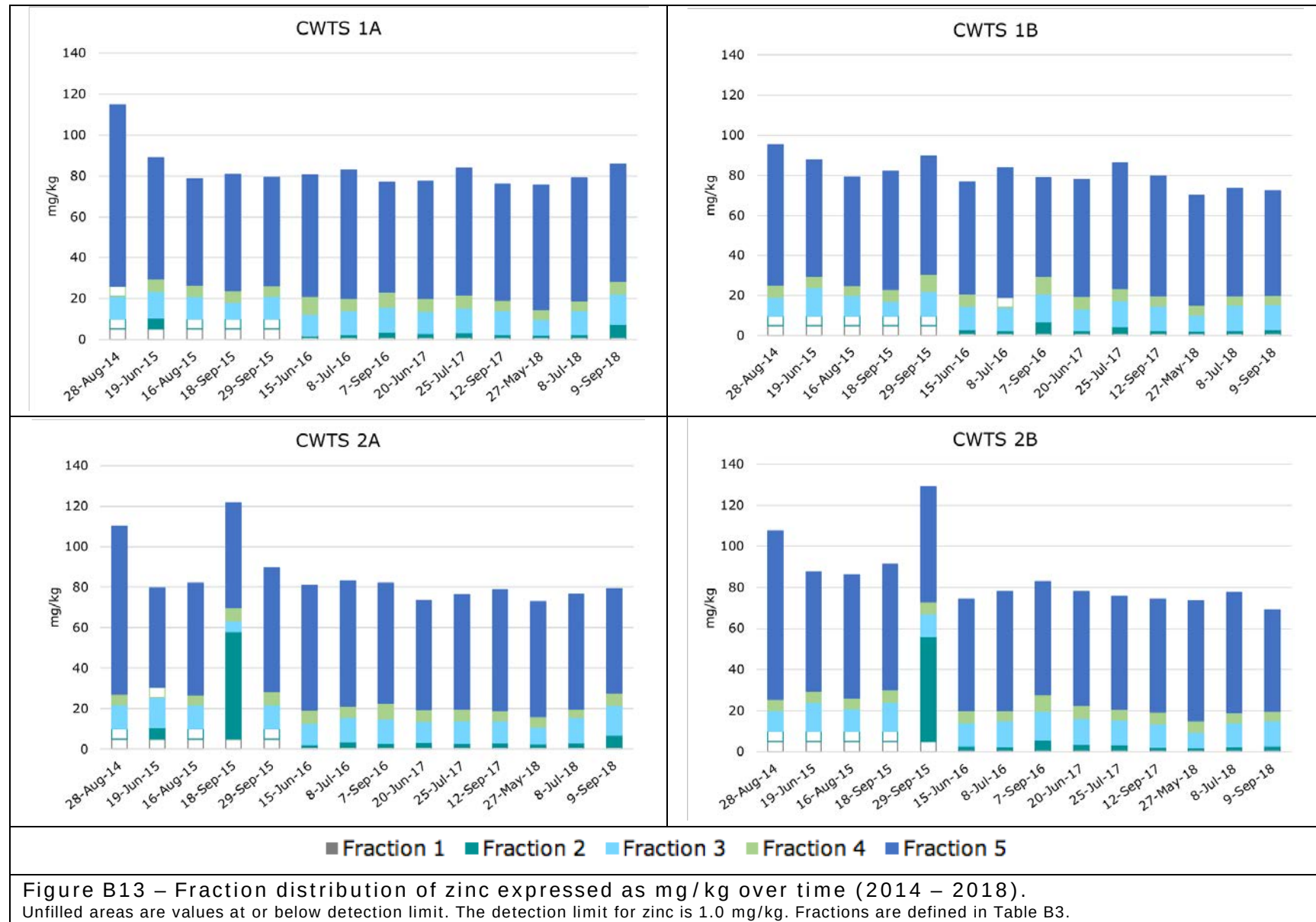
Appendix B



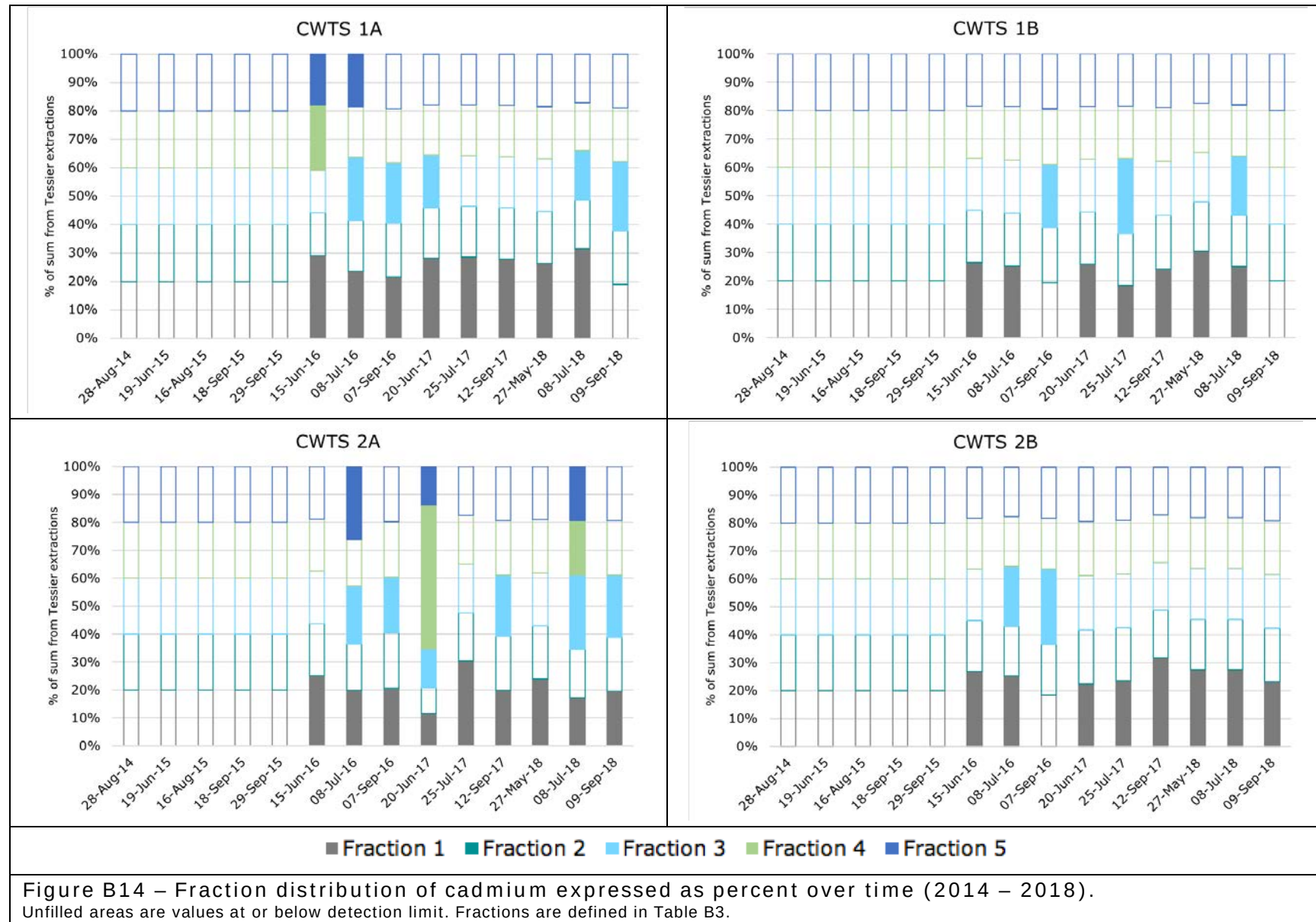
Appendix B



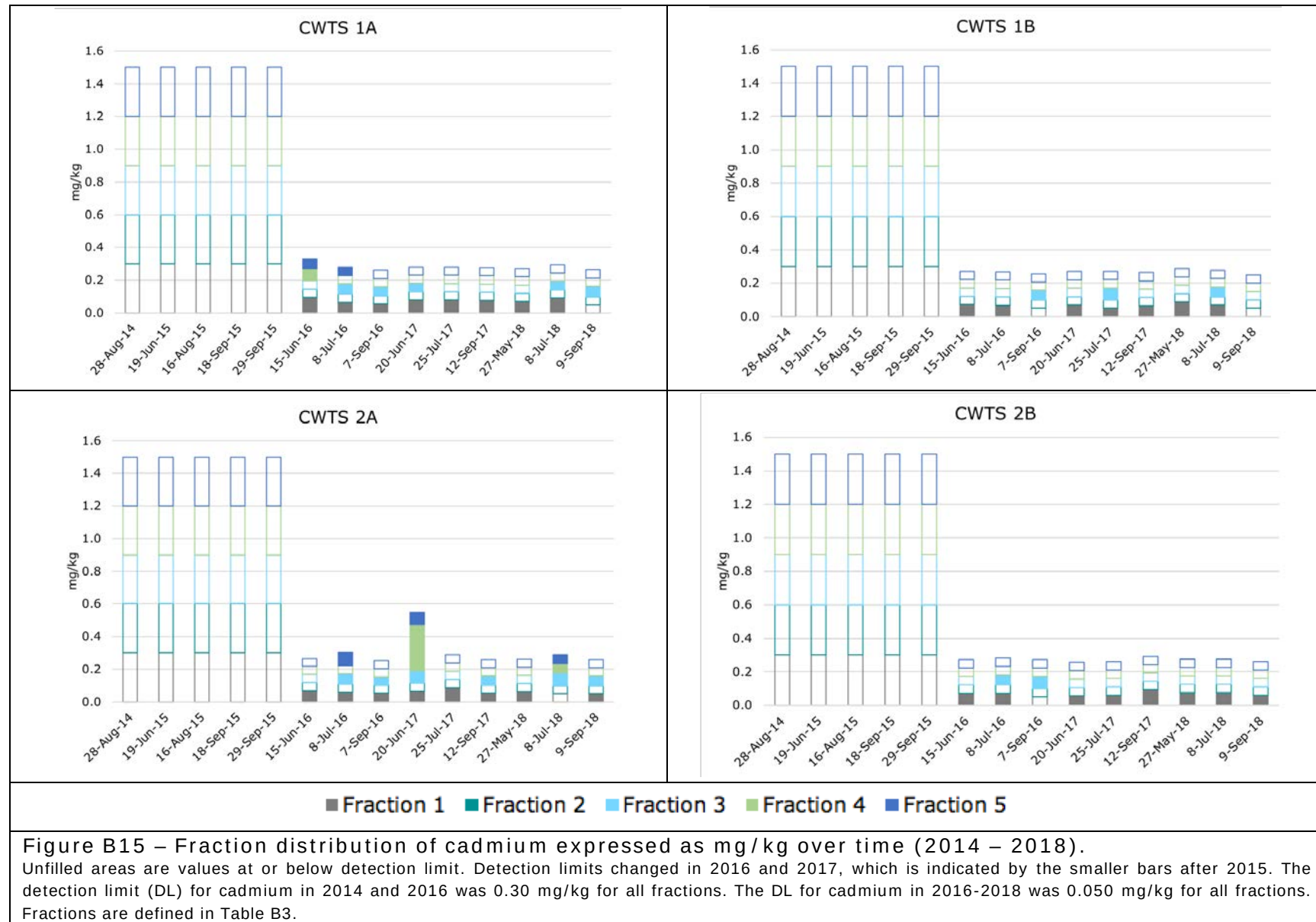
Appendix B



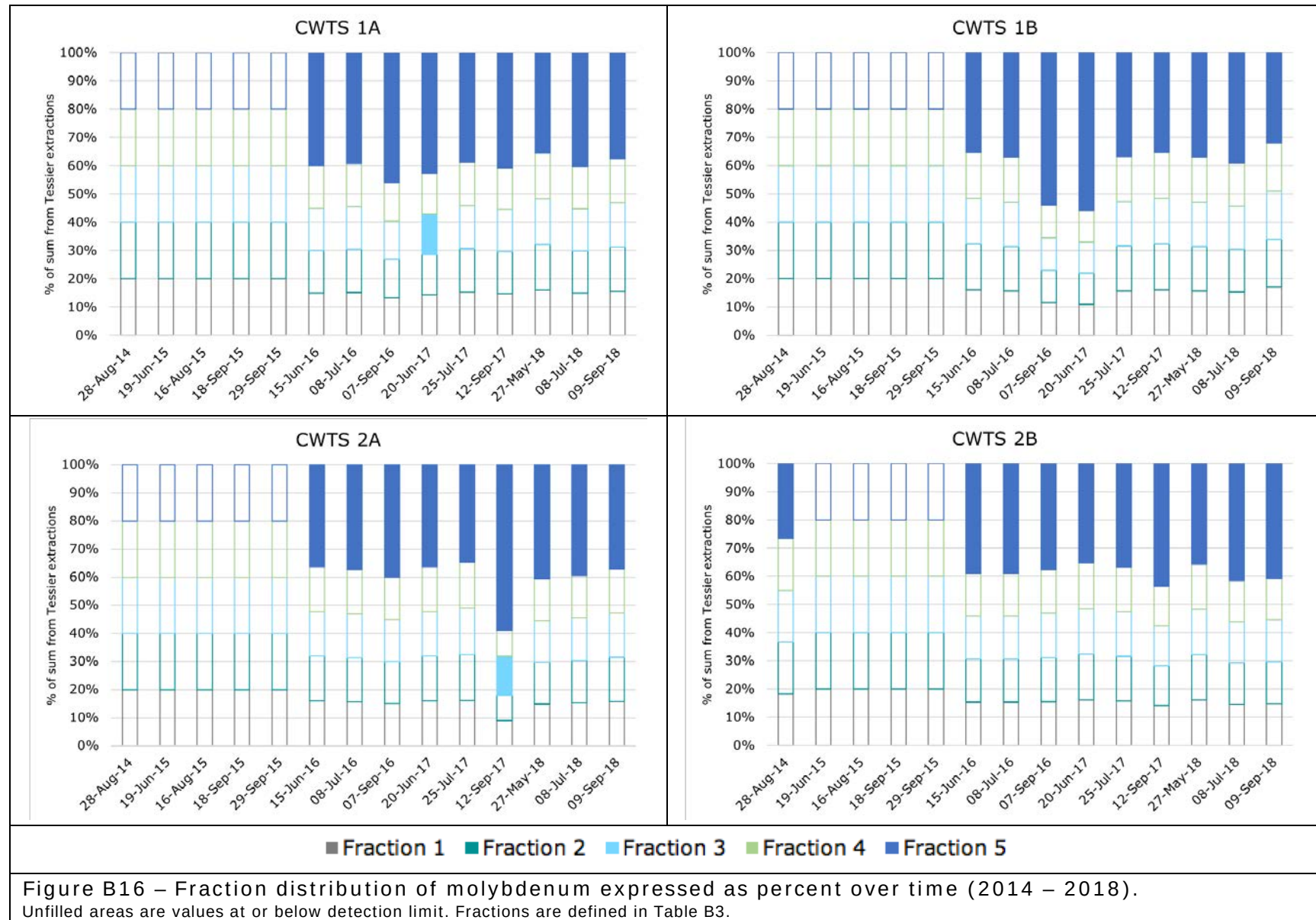
Appendix B



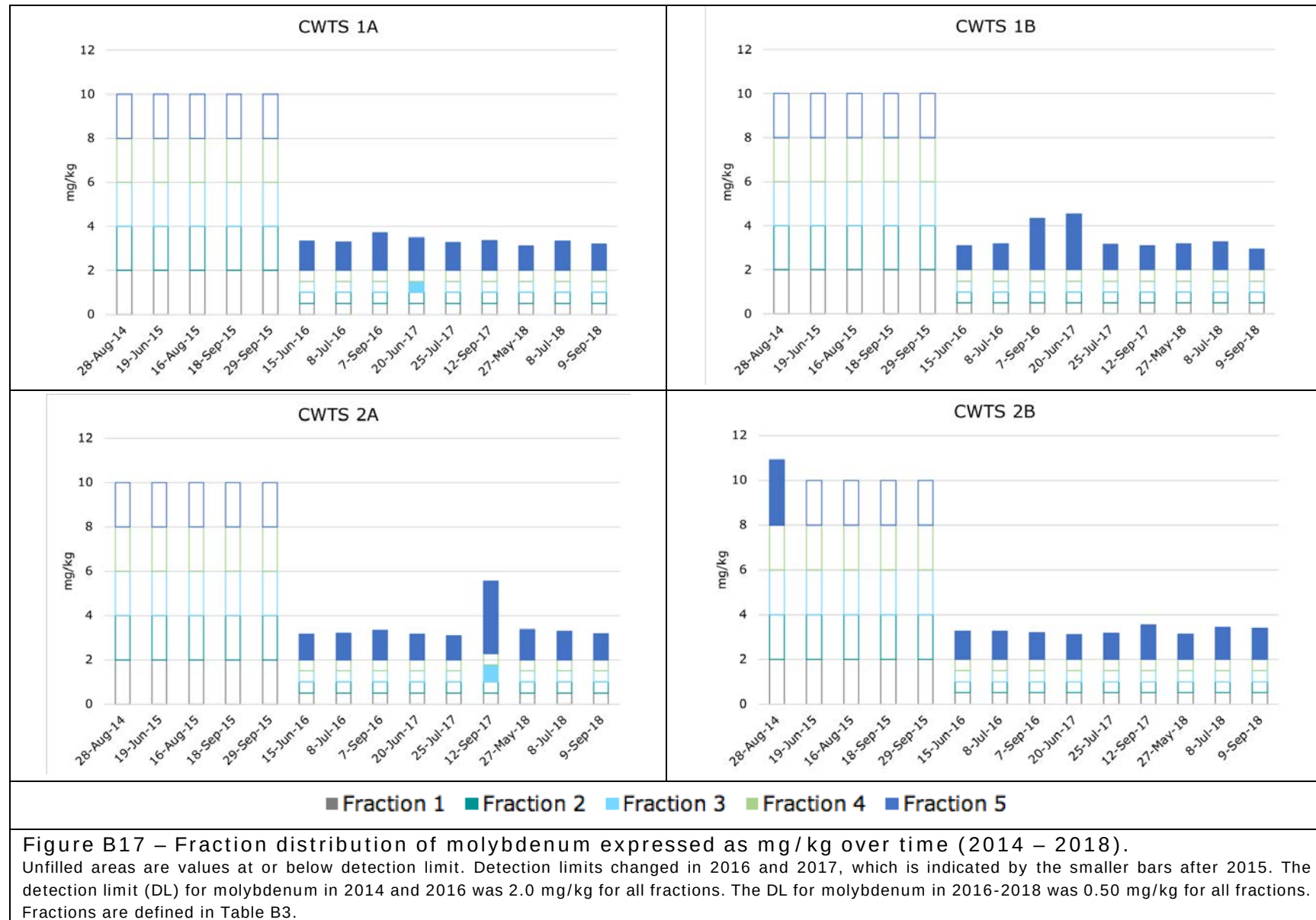
Appendix B



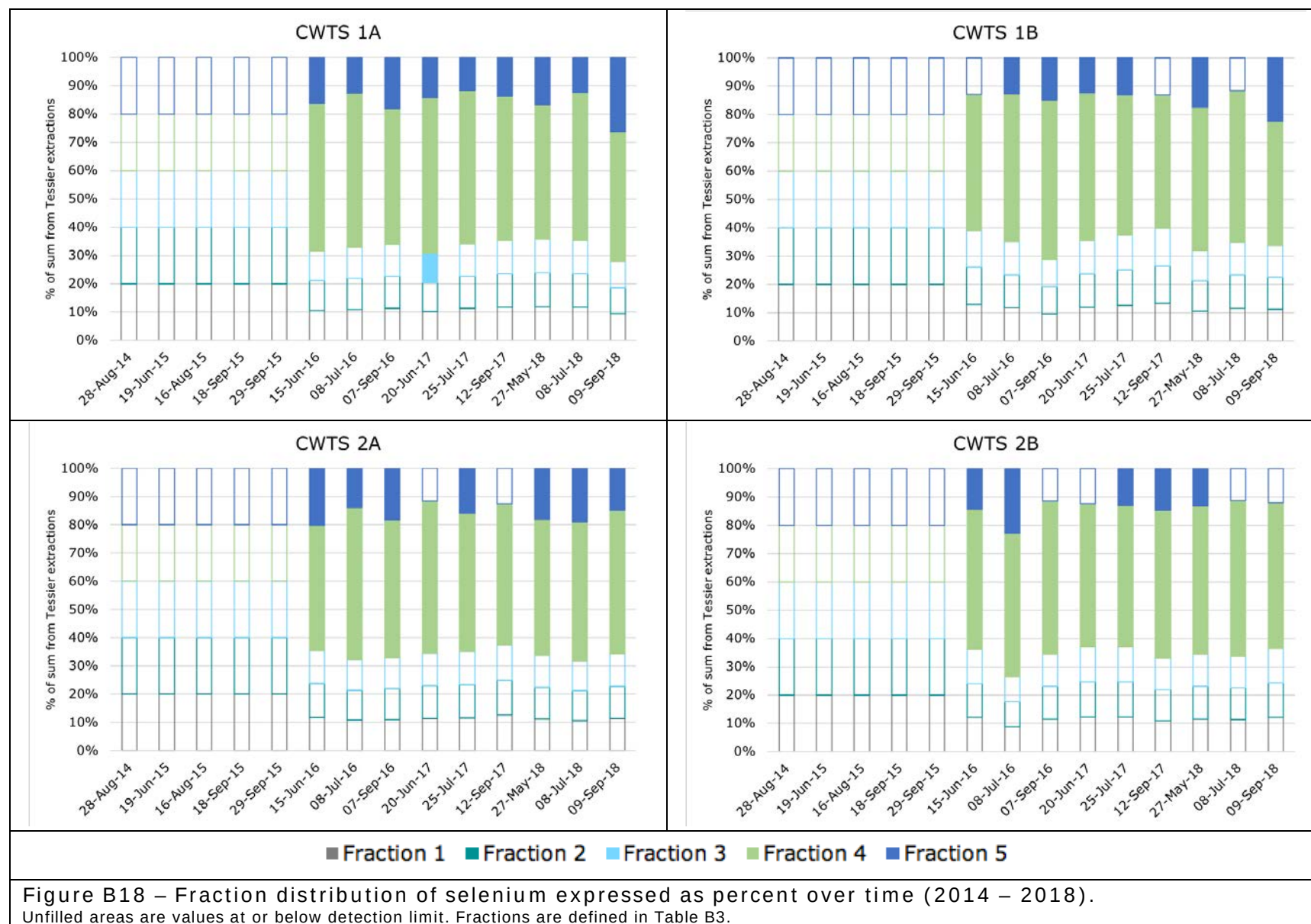
Appendix B



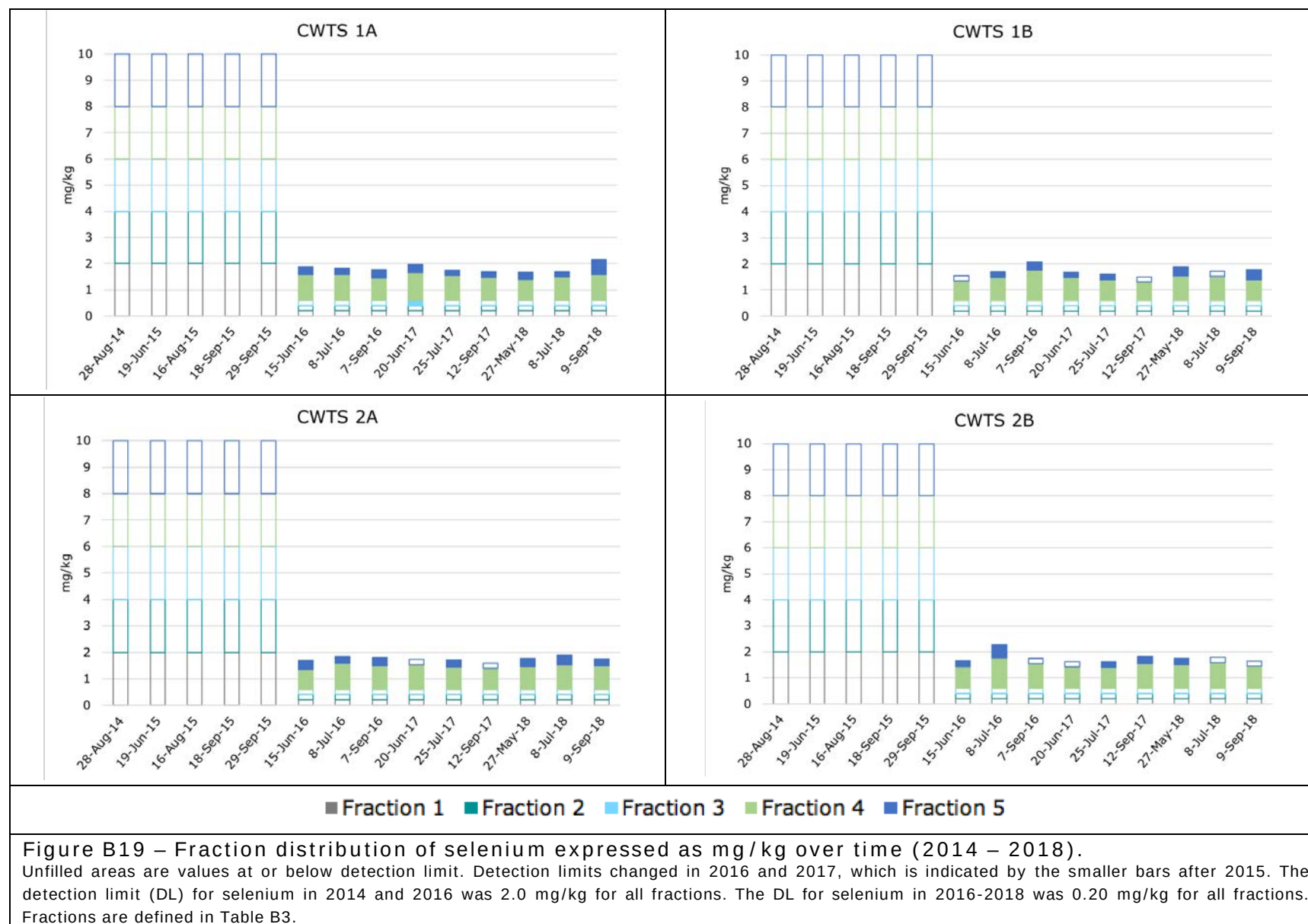
Appendix B



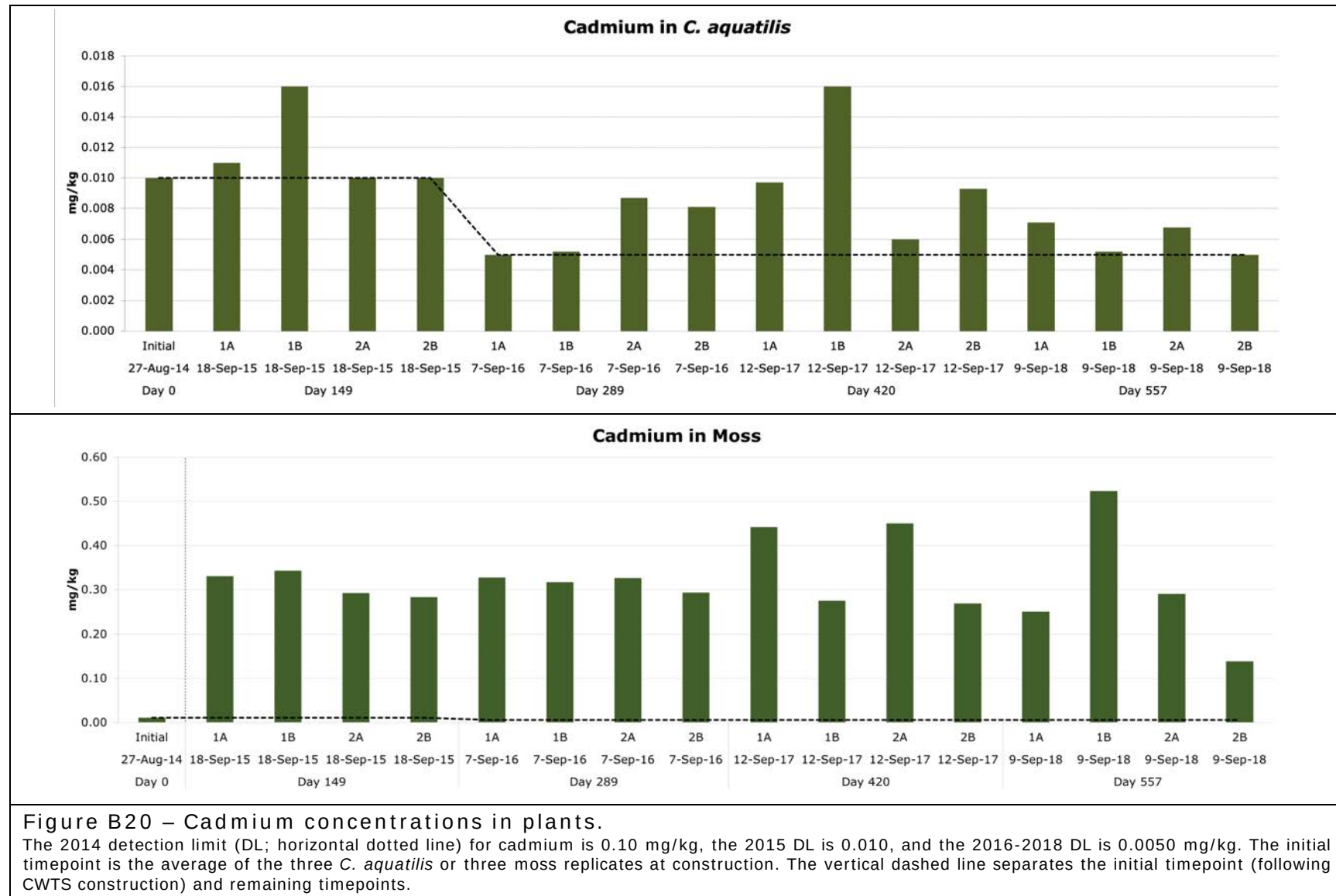
Appendix B



Appendix B



B3. Plant Results



Appendix B

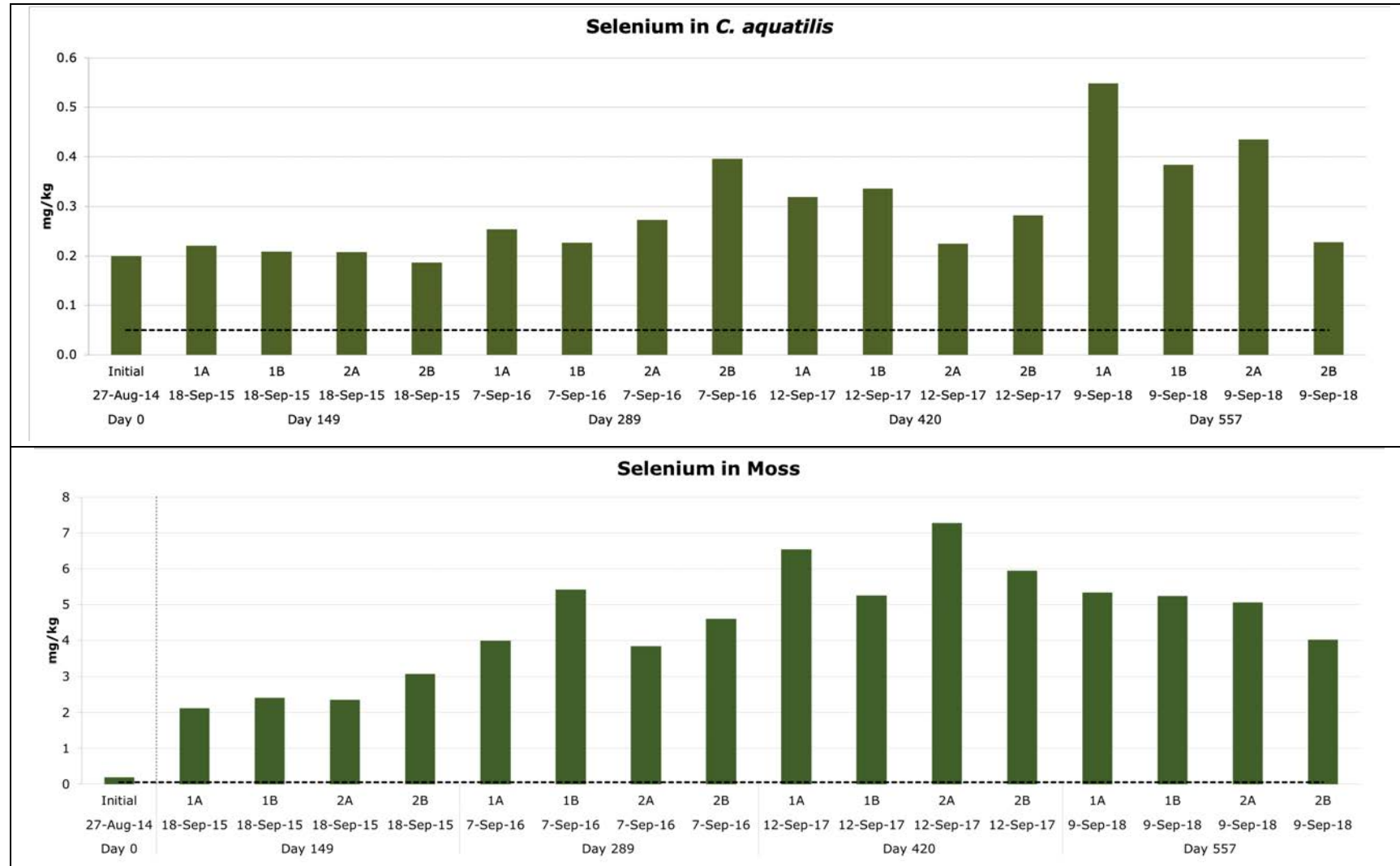
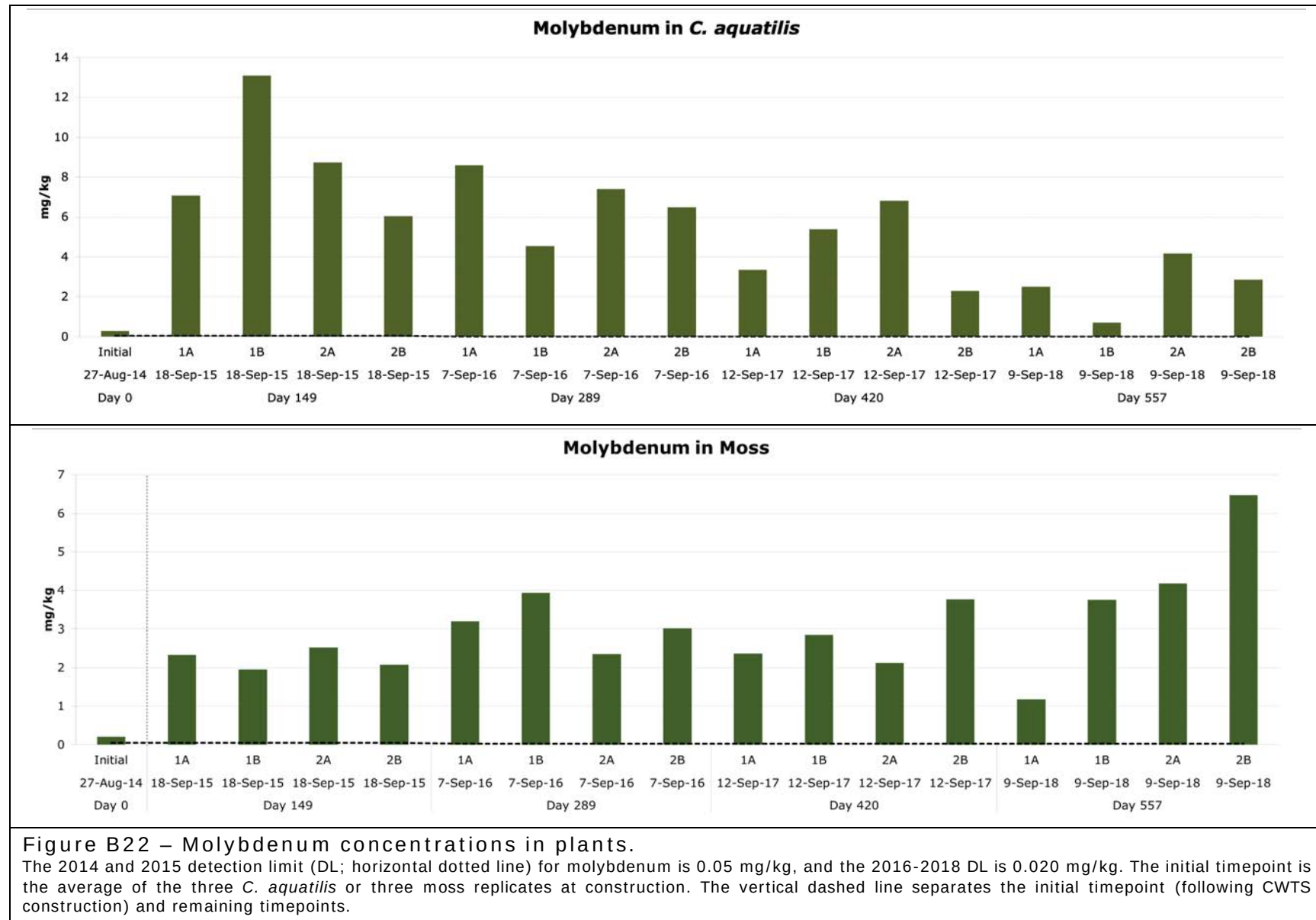


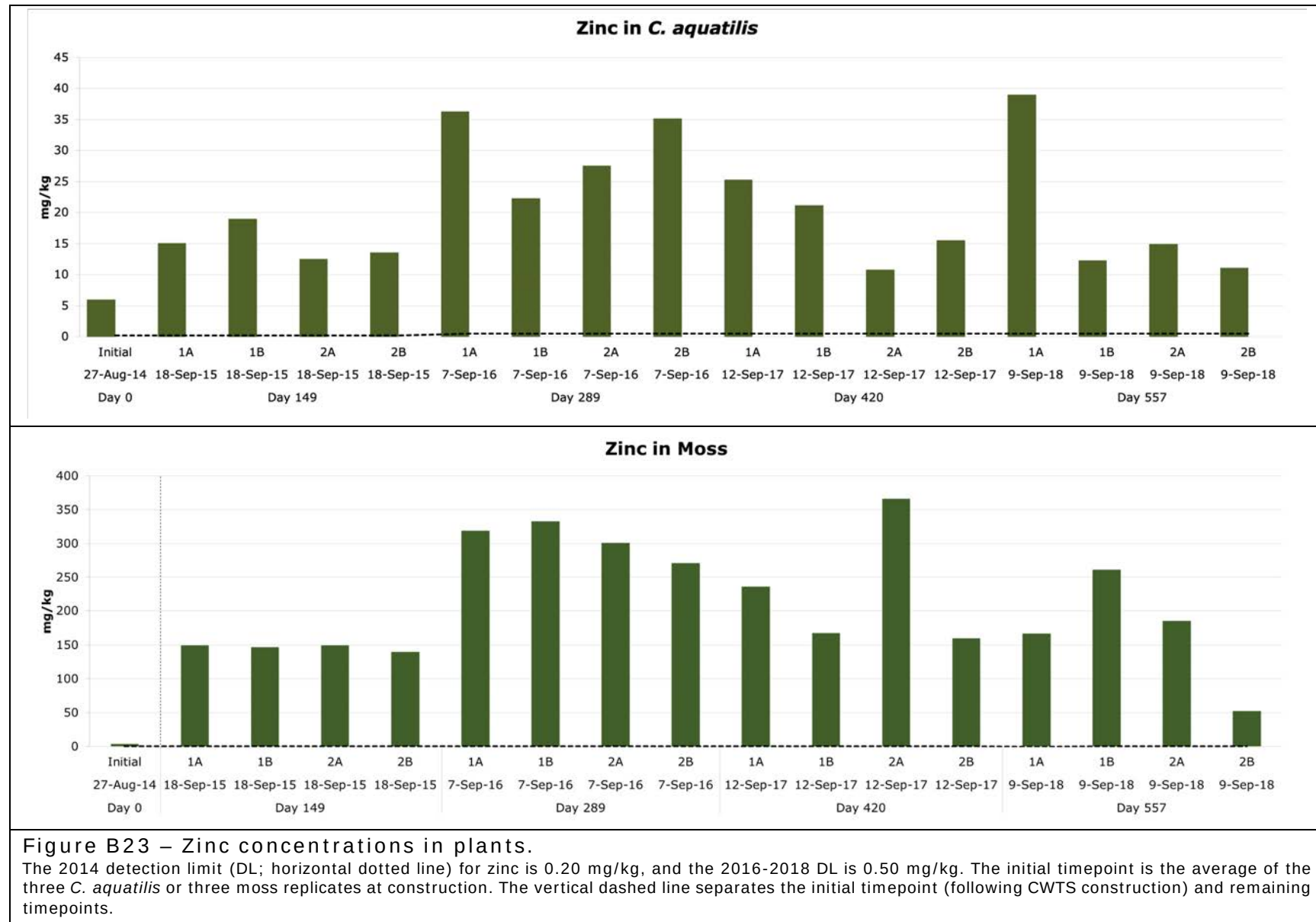
Figure B21 – Selenium concentrations in plants.

The detection limit (DL; horizontal dotted line) for all years for selenium is 0.050 mg/kg. The initial timepoint is the average of the three *C. aquatilis* or three moss replicates at construction. The vertical dashed line separates the initial timepoint (following CWTS construction) and remaining timepoints.

Appendix B



Appendix B



Appendix B

B4. Microbiology Results

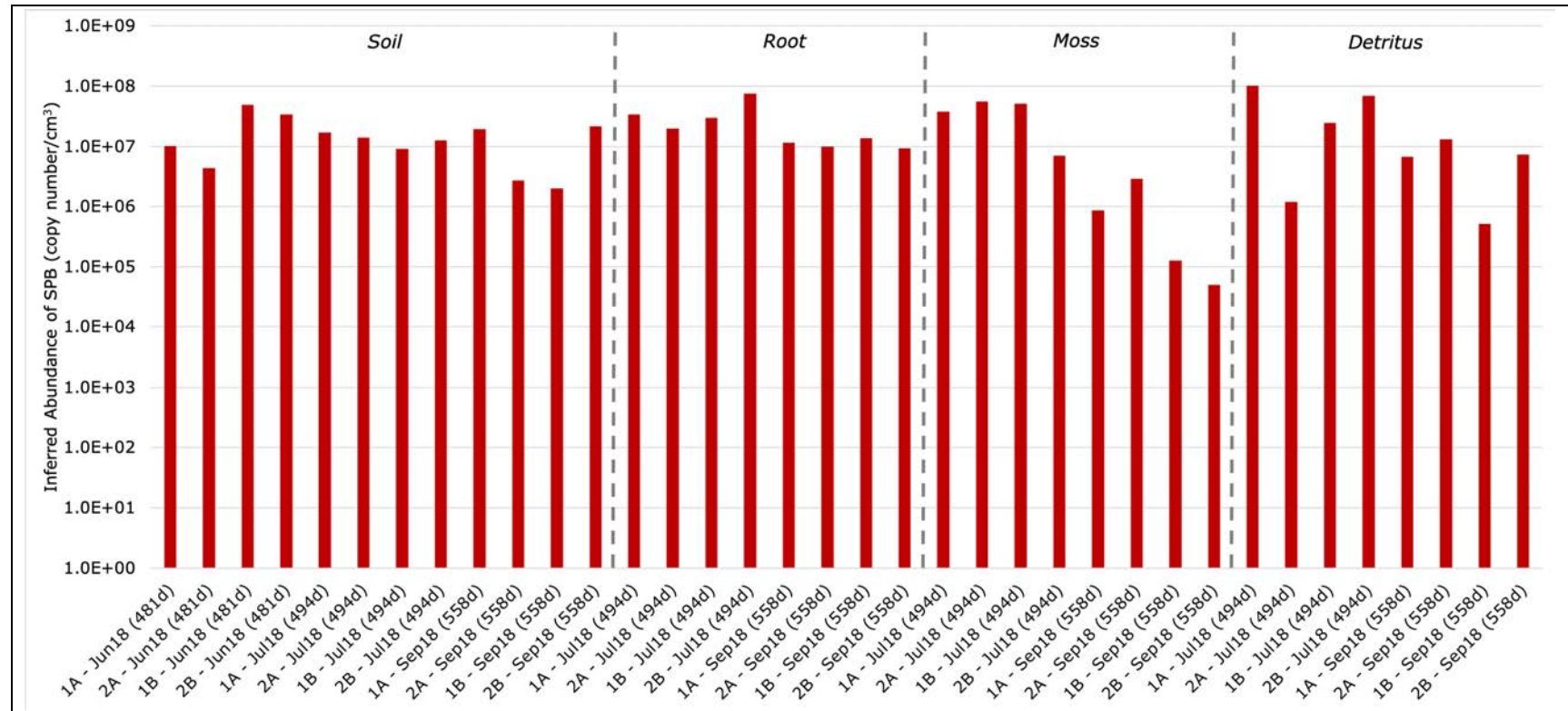


Figure B24 – Inferred abundance of sulphide-producing bacteria in soil, root, moss, and detritus in the demonstration-scale CWTS in 2018.

Inferred abundance is calculated based on a combination of genetic and quantification data. Methods for quantification changed from growth-based analyses (most probable number) from 2014 to 2017 to quantitative polymerase chain reaction (qPCR) analyses in 2018. As methods are not directly comparable (Appendix A, Section A6.5), only results from 2018 analyses are shown here and overall trends for all years are described in the main report.

Appendix B

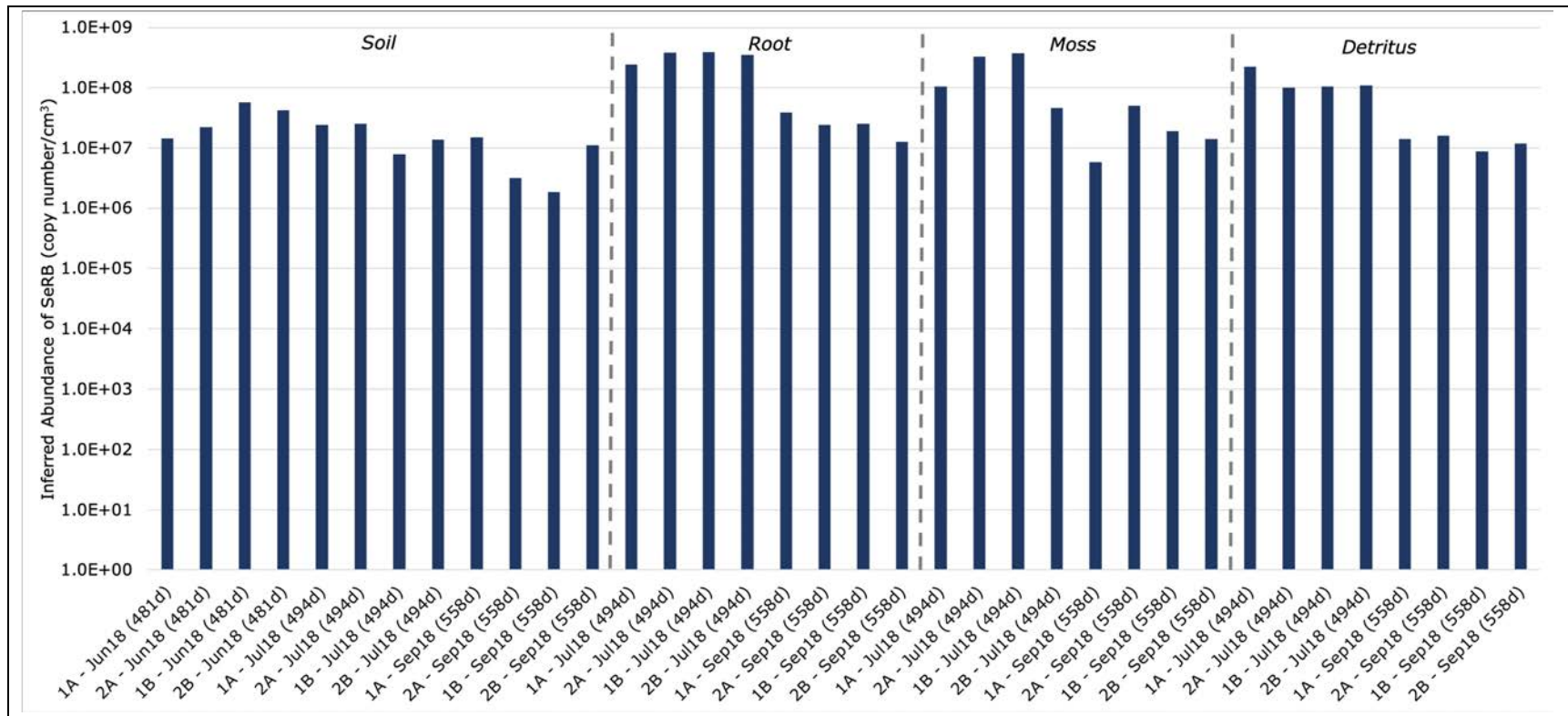


Figure B25 – Inferred abundance of selenium-reducing bacteria in soil, root, moss, and detritus in the demonstration-scale CWTS in 2018.

Inferred abundance is calculated based on a combination of genetic and quantification data. Methods for quantification changed from growth-based analyses (most probable number) from 2014 to 2017 to quantitative polymerase chain reaction (qPCR) analyses in 2018. As methods are not directly comparable (Appendix A, Section A6.5), only results from 2018 analyses are shown here and overall trends for all years are described in the main report.

Appendix B

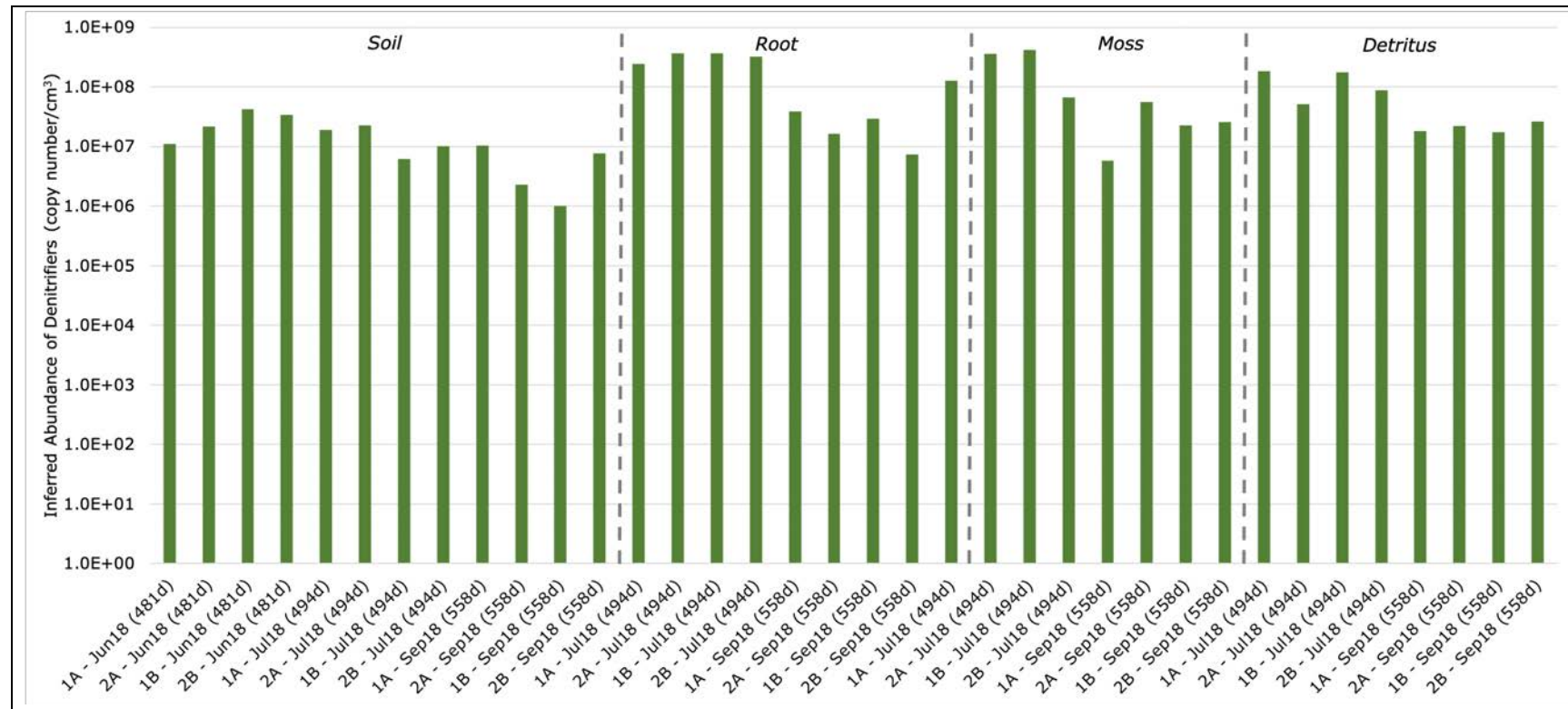


Figure B26 – Inferred abundance of denitrifying bacteria in soil, root, moss, and detritus in the demonstration-scale CWTS in 2018.

Inferred abundance is calculated based on a combination of genetic and quantification data. Methods for quantification changed from growth-based analyses (most probable number) from 2014 to 2017 to quantitative polymerase chain reaction (qPCR) analyses in 2018. As methods are not directly comparable (Appendix A, Section A6.5), only results from 2018 analyses are shown here and overall trends for all years are described in the main report.

Appendix C

Appendix C – Multi-year Workplan

Table C1 – Schedule of work and activities for demonstration-scale CWTS.

Item	Date	Activities	Actual
Construction	2014	Identify potential location for demonstration scale CWTS (Contango site visit – 1 scientist)	Completed June 2014
		Engineering and geotechnical (Minto)	Completed July 2014
		Construction (Minto)	Completed July 2014
		Planting and bringing system online (Contango site visit – 1 scientist, 1 technologist), coordinate for local students to assist	Completed August 2014 (no students available, brought 2 technologists)
Commissioning	2014	Acclimation and maturation at constant flow rate, ~20 hr HRT	Completed
		September - Contango site visit/checkup (1 technologist, 1 scientist)	Did not occur because construction was last week of August
	2015	Continued commissioning. Operation at constant flow rate, ~20 hr HRT	Completed (at shorter HRT)
		Spring – Contango site visit/checkup (1 technologist, 1 scientist), includes micro sampling	Completed
		Summer - Increase depth from 10 cm to 20 cm (1 technologist), includes micro sampling	Completed (scientist)
		Fall – Contango site visit/checkup (1 technologist), includes micro sampling	Completed (scientist)
	2016	Minto to add sandbags prior to first site visit and begin W15 creek monitoring	Completed May/June 2016
		Spring – Contango site visit (1 scientist, 1 technologist), includes microbial sampling and tasks outlined in Table 5 of report. HRT tracer study completed, outlined in section 7 of report.	Completed June 2016
		Summer - Contango site visit/checkup (1 scientist, 1 technologist), includes microbial sampling and tasks outlined in Table 5 of report. Evapotranspiration study completed as outlined in section 9 of report. Organics were added to the CWTS as outlined in section 5.1 of report.	Completed July 2016

Appendix C

Item	Date	Activities	Actual
	2017	Fall - Contango site visit/checkup (1 technologist), includes microbial sampling and tasks outlined in Table 5 of report	Completed September 2016
		Continued commissioning operations at constant flow rate.	Completed May 2017
		Two evapotranspiration studies were completed	Completed May/June 2017
		Spring – Contango site visit (1 scientist, 1 technologist), includes microbial sampling and tasks outlined in Appendix A of report. Completed HRT tracer study. Sample for AVS to assess if the added organics are having the desired effect.	Completed June 2017
		Summer - Contango site visit/checkup (1 scientist), includes microbial sampling and tasks outlined in Appendix A of report.	Completed July 2017. Seasonal water sampling was not completed due to flow interruptions. Seasonal water sampling was completed by Minto in August.
Commissioning		Minto added sandbags to outflows of CWTS cells to increase water depth	Completed August 2017
		Commissioning completed and beginning of operational period	Completed August 2017
Operations		Fall – Contango site visit/checkup (1 scientist), includes microbial sampling and tasks outlined in Table 5 of report.	Completed by Minto, after being taught microbial sampling by Contango. No site visit needed by Contango.
		Monitor soil redox. Determine when it consistently reaches targeted range.	Completed throughout 2017
Performance monitoring		Develop a sampling plan, and aphid control and monitoring plan for 2018	Completed March, 2018
Drought recovery	2018	Start water flow to CWTS; add sandbags to end and along perimeter of each CWTS cell to increase water depth by 1 to 5 cm; aphid control using more powerful insecticide on a routine schedule	Completed May 2018
		Assess recovery of CWTS from drought	Completed throughout 2018
		Summer – Contango site visit (1 scientist); conduct a vegetation plot harvest and assessment of biomass produced; collect one bag of <i>C. aquatilis</i> and one bag of polyester filter	Completed July 2018

Appendix C

Item	Date	Activities	Actual
		foam from each CWTS cell; replant <i>C. aquatilis</i> in areas with sparse vegetation	
		Iron added to Series 1	Completed July 2018
		Two evapotranspiration studies were attempted (were not informative due to precipitation during trials)	Completed July/August 2018
Performance monitoring	2019	Fluctuate flow rates, based on expected amount of water for full-scale wetland (scaled to size). Evaluate performance of CWTS at different key periods. Fertilize plants (if necessary).	Throughout 2019
Operations		Develop a flow rate schedule and sampling plan for 2019	April 2019
		Provision of updated standard operating procedures for new staff responsible for monitoring and sampling CWTS	
		Start water flow to CWTS; continue aphid control using insecticide on a routine schedule	April/May 2019
		Spring – Contango site visit; training of new staff responsible for monitoring and sampling CWTS, monitor for presence of aphids, add iron to Series 1, collect one bag of <i>C. aquatilis</i> and one bag of polyester filter foam from each CWTS cell	May/June 2019
		Summer – Contango site visit; conduct a vegetation plot harvest and assessment of biomass produced; conduct evapotranspiration trial for warmer months	July/August 2019
		Fall – Contango site visit (if necessary), replanting if needed, soil harvesting for additional off-site stress tests, final sampling event.	September, 2019
Reporting	2014-2020	Reporting will be performed annually, with verbal and/or emailed interim updates	On Schedule

Appendix Q - 2018 Annual Socio-Economic Monitoring Report



Minto Mine
2018 Annual Socio-Economic Monitoring Report

Prepared by:
Minto Explorations Ltd.
Minto Mine
March 2018

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1 Introduction

This report has been prepared by Minto Explorations Ltd., a subsidiary of Capstone Mining Corp., in regard to the Minto Mine property (Minto), located in central Yukon. The following report summarizes the results of the socio economic available data at Minto for 2018, as required by the Socio-Economic Monitoring Program framework.

The Minto Mine Socio-economic Monitoring Program (Minto Explorations, Yukon Government, Selkirk First Nation, 2014) is a program that has been developed in conjunction with Selkirk First Nation and the Yukon Government to monitor the socio-economic effects of Minto Mine on SFN. The primary components of the program include; the mine providing information relating to SFN (e.g. employment data, training information etc.), a community based survey (conducted by SFN and YG), and information from SFN and YG relating to Pelly Crossing or SFN. The information from all of those components is then used in the preparation of an annual report produced by a third-party consultant.

Not all of the data that has been requested from historical records is available. Going forward Minto will collect the required and necessary data in order to provide more accurate information for the bi-annual reports. Minto has given best efforts to collect and obtain historical data and going forward accuracy of information and data collection will continue to be further refined.

1.1 Factors at Minto that may have a socio-economic impact

The Minto Mine is an open pit and underground copper mine located 240 kilometres north of Whitehorse in central Yukon, Canada. Minto is located on Selkirk First Nation Category “A” land.

An initial cooperation agreement (CA) between Selkirk First Nation and Minto was agreed upon and signed in 1997, and was later amended in 2009. The agreement serves as a formal document that covers governance, business partnerships, training and employment, and royalties of the Minto Mine on Selkirk First Nations land.

The community of Pelly Crossing is located along the Klondike Highway on the banks of the Pelly River, 282 kilometers northwest of Whitehorse. Pelly Crossing is home to SFN people which includes 353 people (2016 Stats Can census), an increase of 5.1% from the 2011 census of 336 people, of which, 305 identify as being North American First Nations/Metis. The 2015 median total individual income of population aged 15 years and over in Pelly Crossing is \$24,576 with the average house price being \$265,909 (2016 Stats Can census). The average population age of Pelly Crossing is 37 years of age (2016 Stats Can census).

The city of Whitehorse is the capital of Yukon and is the largest community in the territory with a population of 28,225 (2016 Stats Can census) or 78.7% of the total Territorial population.

The remote location and access to Minto dictates a fly in fly out (FIFO) camp operation. In Yukon, there is a general shortage of available professional and skilled workers. The location is also impacted by low amounts of locally manufactured goods and materials.

The advanced and post-secondary education and training opportunities available in Yukon, is generally lower than opportunities further south. This impacts the local labour pool resulting in a shortage of

potential workers with mining career related experience, and educational backgrounds. Recruitment of local candidates is also impacted by lower overall literacy rates in the North, and a shortage of local candidates possessing a valid driver's license.

Other factors that may have impacted socio-economic indicators include:

- Implementation of socio-economic monitoring program
- Permitting and Regulatory delays
- Declining copper prices
- Mine life uncertainty
- News of potential sale of Minto Explorations Ltd. announced in February 2018. This sale inevitably did not occur due to unfavourable equity market conditions.

Furthermore, on March 20, 2018, Minto Explorations Ltd announced that a careful and calculated decision was made to not mine the Ridgetop open pit. After reviewing infill drilling results of the Ridgetop deposit, it was determined that the returns from the pit at the current copper prices were marginal. As a result, significant lay offs of Minto personnel occurred, as well, the Pelly Construction contract was not renewed and the milling time was reduced to 50%.

On October 11, 2018, the decision was made by Capstone to put Minto on temporary care and maintenance, while continuing to explore value maximizing alternatives. Mining operations ceased immediately, followed by milling; the property was then carefully mothballed and by the end of 2018, the majority of the workforce was laid off, with a small crew kept on to oversee the care and maintenance of the property and its assets.

2 Minto and Contractors Safety Statistics

The below table (Table 2-1) summarises the safety statistics for Minto Employees and site contractors for 2018. The total incidents include minor first aids treated at the site, any property damage, near-misses that could have resulted in an incident, medical aids (where treatment is required off site) and lost-time accidents where a worker would be unable to return to their duties and had to miss work. In 2018, there was 1 contractor employee lost time accident.

2018 Total incidents	Minto	Contractors
41	16	25

3 Employment

Minto utilizes a preferential hiring recruitment approach as outlined in our Cooperation Agreement, with Selkirk First Nation. Our preferential hiring involves the following: Positions are first advertised and offered in the following order of priority: SFN, NTC (Northern Tutchone) Pelly Crossing Resident, OFN, Yukon, and Western Canada.

3.1 Employment Income and Distribution

The following sections outline information and figures that demonstrate salaries are higher for those who are in major centres and/or employed outside of Yukon. Potential reasons for this for Minto include:

- During the course of 2018, 7 out of 8 Managerial staff (Department Heads) staff lived outside Yukon.
- The majority of professional, supervisory and designated staff are residents of the rest of Canada (Non-Yukon residents)

Other factors for this could potentially be linked to a lack of potential candidate pools in Yukon of professional and managerial experienced staff. Further, the post-secondary education requirements for these roles cannot be obtained in Yukon.

The Company operates a fly in fly out (FIFO) camp model which is attractive to employees who can stay in their current hometowns and not have to move North. This approach has become somewhat standard practice for the mining industry in Western Canada, our peer group, and Minto operates in a fashion to be competitive in this market. Employees expect a FIFO in a remote mining location.

Major centres of Whitehorse and Rest of Canada have the highest income. One of the possible reasons for this is that those areas have a larger qualified candidate pool. Outlying areas including Pelly Crossing and Rest of Yukon have less availability of qualified candidates for skilled, professional and managerial positions.

3.1.1 Minto - Average employment income by Residency

	Pelly Crossing	Whitehorse	Yukon	Rest of Canada
Minto (as of Dec 31, 2018)	\$0	\$34.74/hr	\$35.66/hr	\$50.21/hr
Minto (Separated in 2018)	\$28.75/hr	\$35.27/hr	\$34.55/hr	\$43.00/hr

3.1.2 Contractors - Average employment income by Residency (not including OT or UG Bonus)

	Pelly Crossing	Whitehorse	Yukon	Rest of Canada
Pelly Construction	\$27.63/hr	\$30.16/hr	\$28.89/hr	\$31.93/hr
Dumas	\$18.50/hr	\$20.75/hr	\$20.75/hr	\$23.29/hr
Sodexo	\$16.29/hr	\$16.14/hr	\$16.74/hr	\$18.19/hr
				\$55,000 (salaried)

Potential contributing factors include:

- Dumas Contracting is located in eastern Canada indicating hiring from a preferred talent pool in this location.
- Most Sodexo employees are entry-level non-skilled workers. Sodexo, like many Remote Site Service providers, has a high turnover rate. Sodexo's voluntary turnover at Minto for 2018 was 28.3%, down from 39% in 2017. In total there were 24 new hires in 2018 and 33 exits (including voluntary and involuntary).

- Pelly Construction, located out of Whitehorse, averaged an 89% Yukon employee base for 2018 (January – August). By September 2018, there were no more Pelly Construction personnel on site. Total voluntary turnover was 124%, with the bulk of the turnover happening after the announcement of no more open pit mining. In total, there were only 6 new hires in 2018 and the full workforce of 78 exits (including voluntary and involuntary)

3.1.3 Minto and Contractors – Annual and cumulative total employee income by Group

	Pelly Crossing	Whitehorse	Yukon	Rest of Canada
Minto (as of Dec 31, 2018)	\$0	\$591,253.34	\$694,355.39	\$1,368,926.44
Minto (Separated in 2018)	\$418,093.36	\$2,507,545.08	\$3,677,302.60	\$6,469,001.11
TOTAL Minto for 2018	\$418,093.36	\$3,098,798.42	\$4,371,657.99	\$7,837,927.55
Pelly	\$184,361.01	\$948,592.38	\$1,307,672.28	\$470,507.98
Dumas	\$97,769.02	\$615,017.00	0	\$6,748,337.74
Sodexo	\$73,041.05	\$381,663.77	\$7,282.33	\$201,999.88

3.1.4 Minto – Northern Employment by Group

	SFN	Yukon FN	OFN	Other Yukon	Other Canadians	Total
Minto (as of Dec 31, 2018)	2	2	0	6	11	21
Minto (Separated in 2018)	21	18	2	40	80	161
TOTAL Minto for 2018	23	20	2	46	91	182

3.1.5 Minto - Employment by Residency

	Pelly Crossing	Whitehorse	Other Yukon	Canada	Total
Minto (as of Dec 31, 2018)	0	9	1	11	21
Minto (Separated in 2018)	12	52	15	82	161
TOTAL Minto for 2018	12	61	16	93	182

3.1.6 Contractor - Employment by Residency

	Pelly Crossing	Yukon	Canada	Total
Pelly Construction	6	60	18	78
Dumas	2	8	76	86
Sodexo	4	18	9	31

3.1.7 Minto – 2018 New Hires by Group

	SFN	Yukon FN	OFN	Other Yukon	Other Canadians	Total
Minto	6	4	1	12	16	39

3.1.8 Minto - Employment by Job Categories and Group (including employees separated in 2018)

	SFN	Yukon FN	Other Yukon	OFN	Other Canadians	Total
Management			2		11	13
Professional		3	14		38	55
Skilled	4	10	18	2	38	72
Semi-skilled	16	7	10		4	37
Entry Level	3		2			5
TOTAL	23	20	46	2	91	182

3.1.9 Minto and Contractors – Annual and cumulative total employees by group

	Aboriginal	Yukon (Non-FN)	Total Yukon	Other Canadian	Total
Minto (as of Dec 31, 2018)	4	6	10	11	21
Minto (Separated in 2018)	41	40	79	82	161
TOTAL Minto for 2018	45	46	89	93	182
Pelly	28	36	60	18	78
Dumas	8	3	11	76	86
Sodexo	21	6	22	9	31

3.2 Voluntary Exits

In 2018, due to the announcement that the Minto Mine was up for sale, that Ridgetop would not be mined and later that the mine was going into care and maintenance, Minto had an increase in our voluntary turnover rate from the 2017 rate of 27.6%. A total of 39 employees voluntarily left Minto, which represents a voluntary turnover rate of 36.6%.

The results of voluntary exit surveys indicate the following main reasons for resignations:

- Most of the voluntary turnover was due to a combination of factors, such as:
 - the Company announcing in February that Minto was in the process of being sold;
 - that open pit mining was ceasing in April; and
 - that the mine was going in to temporary care and maintenance at the end of the year.
- Enhanced opportunity at other Mines coming on line, as other commodity prices picked up.

4 Business

As part of Minto and SFN's cooperation agreement there is a requirement for the company to provide preferred opportunity notification to SFN to negotiate and potentially be awarded a contract to supply the requirement. SFN has developed partnerships with a number of Minto's vendors for which the details of financial benefit Minto is not privy to. As such, this section summarizes expenditures by the company that is the primary vendor and does not account for any SFN proportional expenditures as a result of those partnerships.

In 2015, Minto and SFN worked jointly to establish new or maintained contracts to ensure involvement from SFN and support our First Nations partners. The contractual arrangements highlighted below represent the majority of the opportunities that SFN and Minto share with service providers. As well as financial gain, SFN also does benefit from employment opportunities on some contracts.

- Air North – Air Service
- Boreal Shuttle – Pelly Crossing Shuttle Service
- Capital Helicopters- Helicopter Support
- Cobalt Construction – Ore haul, equipment & reclamation
- DMC Mining Services – Raise Bore & Mining Services
- Driftwood Drilling- Exploration Diamond Drilling
- Dumas- UG Mining
- Dyno Nobel Canada- Blasting supplies and services
- Glacier Water Services- Water Hauling
- Manitoulin Transport- Freight Hauling
- Northwest Vacuum Services- Vacuum Truck Rental
- Nuway Crushing- Crushing Services
- Parkland Industries - Fuel Supply
- Pelly Construction- 988 loader rental
- Pelly Construction- Mining Services
- Quantum Machine Works – Custom machining services
- RC Crane – Cranes/equipment
- Sodexo- Catering and Janitorial Services
- Standard Bus- Transportation of Staff/Contractors
- Tintina Air- Secondary Air Support
- Underhill Geomatics – Survey & Engineering
- Yukon Inn - Employee lodging

The six rights of procurement must be met in selection of such vendor relationships.

- Right Materials (to fill need)
- Right Place (Yukon preference)
- Right Quantity and Quality (High quality and ability to supply)
- Right Supplier (Service, technical and aftermarket support, value added service)
- Right moment (product available when needed)
- Right price (competitive commercial price)

In total Minto spent \$36,942,913.67 on Yukon vendors in 2018. This represented 37% of total spend that stayed in the Yukon, supporting local business and developing partnerships for long term mutual benefit. Minto selects the appropriate local vendors based on vendors that meet selection criteria that support Minto's corporate social responsibility. Such partnerships are built on transparency, human rights and labor compliance, supplier status, financial, geographical, and environmental compliancy. The framework for successful local suppliers is based on common shared goals, continuous improvement, and vendors that support Minto's policies and procedures.

In addition to support of our First Nations partners, Minto also strives to support Yukon based companies and service providers based on ability to service our needs and meets commercial acceptance criteria. In analyzing a business for suitability Minto follows best practice guidelines and the six rights of procurement in selecting potential suppliers.

Minto will continue to maintain and increase its spend with local suppliers as they invest in supporting the mining industry and Minto is committed to sustainability in developing the relationships for long term mutual benefit.

4.1 Mine Capital and Operating Expenditures

Indicator #33: Minto Explorations operations & capital expenditures by group					
		Pelly Crossing	Other Yukon	Canada	Total
2018	Capital expenditures	\$136,342.20	\$1,726,767.71	\$8,406,943.55	\$10,270,053.46
2018	Operating expenditures	\$1,730,740.99	\$31,116,177.44	\$50,925,701.13	\$83,772,619.56

4.2 Yukon business names by group

See attached **Appendix "A"** noting all Yukon Business Names by group. Note that not all business have been captured due to some expenditure by employees and reimbursed through expenses and all contractor purchased items.

4.3 Minto Royalty Payments

Indicator #36: Minto royalty payments				
		SFN	Yukon	Total
Minto Royalties Paid 2018		\$	\$	\$
Net Smelter Royalties		\$1,612,892.43		\$1,612,892.43
Quartz Mining Act Royalties			\$3,531,955.48	\$3,531,955.48
Total		\$1,612,892.43	\$3,531,955.48	\$5,144,847.91

4.4 Minto Property Tax Payments and Other Fees

Indicator #37: Minto property tax payments and other fees					
	SFN	Yukon	Other Canada	Other	Total
Minto Fees & taxes Paid 2018	\$	\$	\$	\$	\$
Property Taxes		\$289,397.61			\$289,397.61
Landing Fees	\$25,000.00				\$25,000.00
Skagway Municipal Taxes				\$51,380.71	\$51,380.71
Total	\$25,000.00	\$289,397.61	\$0.00	\$51,380.71	\$365,778.32

5 Capacity, Training and Education

Minto, working with our major contractor partners, supported different capacity building, training and educational initiatives in 2018. Through a combination of “on-the- job” training and mentoring, combined with sponsoring apprenticeships, pre-apprenticeships and other educational initiatives, we continued to build upon work done starting in past years - to create a workplace that enhances our current employees skills and also supports the ongoing development towards a more advanced local labour force.

5.1.1 Selkirk First Nation and Other First Nation specific training in 2018

Mill Competency Program

- Minto continued with the Mill Operator Competency Program in 2018, specifically targeting, local entry-level workers.

Apprenticeship training

- Minto continued sponsoring one SFN student in apprenticeship training (Warehouse Parts person) however this employee failed the exam levels and is in the process of rewriting his level 1 training within that program of study.

- Additionally, Minto is sponsoring another Northern Tutchone citizen within the Warehouse Parts Person Apprenticeship program, and this employee has now successfully completed his program, and is a Certified Red Seal Warehouse Parts person.

SFN Summer Student

- Unfortunately, with the number of layoffs occurring in the Spring due to the announcement that Minto would cease open pit mining, we were not able to bring on additional SFN Summer students this year.

Environmental Monitor-in-Training

- Minto offered an Environmental Monitor-in-Training program to local a SFN citizen from July to October. The Trainee learned specific skills, such as how to: inspect and coordinate site waste management; monitor wildlife activity and deterrent on site; participate in small scale reclamation activities; proper chain-of-command for water and soil samples leaving site for testing; assist and conduct routine environmental monitoring activities according to Environmental Monitoring Plan and established protocols, including:
 - Surface water, groundwater and soil sampling;
 - Flow measurements;
 - Fisheries and other biological monitoring

6 Cultural Well-being

Minto's approach to community investment is based upon opportunities to further build and maintain our social license, maintain good relationships with our partners and maintain a local presence and good reputation in the communities where we operate and where our employees live and work. The goal of this is to strengthen accountability and working partnerships with stakeholders while providing a foundation to understand and consider the needs, opinions and interests of the community.

In the past years, Minto employed several methods of community engagement with different levels of involvement from the community and other stakeholders. These methods included formal and informal ways that were best suited for the various stakeholders. Minto employed many different engagement methods, they were, however, largely utilized in an ad hoc way. In the absence of signed, guiding document the general strategy was that management reviewed ways of engagement and used management best efforts and discretion for methods of engagement.

A community engagement plan was prepared and signed off by Minto management in 2015. A method of engagement and frequency table was prepared and presented to Selkirk First Nation Chief and Council.

Examples of community and cultural engagement initiatives included the following over the years:

- Fort Selkirk educational tours with Selkirk citizens and Minto employees and contractors
 - In August 2018, Minto organized a tour with our SFN/Minto Liaison and brought 8 Minto Employees, 2 SFN Elders and our SFN/Minto Liaison to Fort Selkirk for a day trip, including a stop at an elder fish harvesting camp. It was an informative trip, full of colourful stories narrated by the Elders on the tour, and provided us a historic and cultural glimpse of what life at Ft. Selkirk would've been like many years ago.

- Sports Sponsorship
- Christmas Turkey Distribution
- High school Bursaries, and attendance by Senior Minto Management at Graduation ceremonies.
- Selkirk First Nation Elder's workshops held at the Mine site, whereby Minto employees and Contractors get to participate in traditional cultural activities, such as beading workshops, birch bark crafts and traditional sewing.

In 2018 Capstone spending included the following designed to enhance and protect SFN cultural and community wellbeing;

- \$670 for lunch, boat trip to Fort Selkirk and honorarium for 2 elders to participate in the trip
- \$200 provided to each of the 3 SFN citizens who helped deliver the Christmas turkeys door to door in Pelly Crossing
- \$9,800 worth of turkeys, delivered to each home in Pelly Crossing for Christmas
- \$2,500 to support Yukon sports
- \$1,000 to support the SFN General Assembly that took place at Minto Landing
- \$1,500 in contributions to SFN events, including the Selkirk Bears Hockey team.

Minto also continued to support the primary industry event in the territory - the 2018 Geoscience Forum and Trade Show which is the territory's largest conference and industry event. We also continued to support the Yukon Chamber of Commerce, the Yukon Branch of the Special Olympics and the Yukon Hospital Foundation.

Appendix A – Yukon Businesses used by Minto in 2018

Acklands Grainger
Alberta Fuel Distributors Inc.
Air North
Ajax Steel Limited (Steel Only)
Ajax Steel Limited
Alkan Air Ltd.
All-West Glass Whitehorse Limited
All Yukon Refrigeration
ALX Exploration Services
Arcrite Northern Ltd.
Arctic Star Printing
Art Dell, P.Eng.
Boreal Express Shuttle Service
Boring Guy Equipment Repairs
Better Hearing Audiology Clinic Ltd.
The Brick
Bud's Industrial Installations (Yukon) Ltd.
Capital Helicopters (1995) Inc.
Carmacks Hotel
Cathway Water Resources
Chieftain Energy LP
Challenger Geomatics Ltd.
City Of Whitehorse
Cobalt Construction Ltd
Dimok Timber Ltd
Duncan's Limited
Dynamic Systems
The Edgewater Hotel (2009) Ltd.
Eecol Electric Corp.
Elite Hotel
Eriks Audio Video Unlimited
Finning (Canada) A Div Of Finning International
Fiber Optic Sales and Construction
Fountain Tire
Freda Alfred
General Waste Management

Government Of Yukon
GP Distributing
Griffiths Heating & Sheet Metal
Hi Tech Fluid Power
Home Hardware
Hurlburt Enterprises Inc.
Industrial Electric Services Ltd.
Inkspirationz Graphix
Inland Kenworth
Integraphics Ltd.
Jacobs Industries Limited
DSI Underground Canada Ltd.
Kathleen Burke Cleaning Service
KBL Environmental Ltd.
Kilrich Industries Ltd
Klondike Motors
Klondike Welding Ltd.
Kluane Freight Lines Ltd
Lamarche & Lang
Locksmith Services Ltd.
MacPherson Rentals
Maximilian's Corporation
Marj Eschak
Mercer Contracting
Mic Mac Toyota (Yukon) Ltd.
Napa Whitehorse (0331) Div Of Uap Inc
North 60 Petro Ltd
Northern Safety Network Yukon
Nuway Crushing Ltd.
Northwestel Inc.
Office Supply Centre
Pacific Northwest Freight Systems
Pelly Construction
Triniti Technology - A Subsidiary Of Triniti Investment Ltd.
Quality Bearing Supply Ltd
Quantum Machine Works

R.C. Crane And Construction
Real Canadian Superstore
Selkirk Development Corporation
39539 Yukon Inc.
Selkirk First Nation
Small's Expediting Services
Larry Smith O/A Red Dawg Kennels
Special Olympics Yukon
Staples #251 Whitehorse
Territorial Auto Parts
Territorial Contracting Ltd.
Tintina Air Inc.
Total North Communications Ltd.
Totaltrac Yukon Inc.
Transnorth Helicopters
Whitehorse Chamber Of Commerce
Whitehorse Beverages
Whitehorse Motors Ltd.
Yukon Energy Corporation
Yukon Hospital Foundation
Yukon Chamber Of Commerce
Government Of Yukon
Yukon Chamber Of Mines

Yukon Government
Yukon Honda
Yukon Inn
Yukon Pump Limited
Yukon Radiator Shop
Yukon College
Yukon Producer's Group
Yukon Yamaha
Yukon Workers' Comp Health & Safety Bd